Association between Cognitive Motivation Aspects and State of Flow in Academic Studies

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PSB3E-BT15: Bachelor Thesis

Group number 19

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Date: January 22, 2023

Abstract

Flow is a mental state experienced when one is fully concentrated on the present activity. A deep focus is necessary while studying at the university. Important variables facilitating the studying process are cognitive motivation aspects such as curiosity, need for cognition, and academic intrinsic motivation. In this study, we researched how cognitive motivation aspects relate to the state of flow. Firstly, we hypothesized that curiosity, need for cognition, and academic intrinsic motivation altogether predict flow in studies. As for the secondary research question, we assume that all the cognitive motivation aspects are interrelated between each other. The sample was made of 370 first-year Psychology programme students, 75.7% females and 23.8% males. The data of the participants were collected through an online questionnaire. To test the first hypothesis, we used standard multiple regression. The first hypothesis was supported, cognitive motivation variables altogether predict the flow. However, on the individual level, not all the predictors significantly contributed to flow. The most significant predictors were: stress tolerance, intrinsic motivation to know and toward accomplishments, and need for cognition. To test the second, third, and fourth hypotheses we used Pearson's correlation coefficient. Academic intrinsic motivation had low, moderate to strong positive correlations with curiosity and need for cognition. Stress tolerance had the weakest positive correlation with all of the predictors and a non-significant correlation with academic intrinsic motivation toward accomplishments. Future research is necessary to investigate cognitive motivation aspects in relation to flow in studies to improve the academic lives of the students.

Keywords: flow, need for cognition, curiosity, academic intrinsic motivation, studies

Association between Cognitive Motivation Aspects and State of Flow in Academic Studies

Most people could say that they experienced a flow state occasionally. It can be described as deep concentration, happiness, or "tunnel vision". It is mentioned in almost all spheres of human experience, from climbing, and crafting to playing chess. The pioneer of the flow concept was Csikszentmihalyi (1975), who described flow as an experiential state emerging from cognitive, affective, and physiological aspects. State of flow produces myriad positive effects on well-being (Csikszentmihalyi, 2008), and increases focus and optimal performance (Engeser & Rheinberg, 2008). In order for a flow state to be present it is necessary for an individual to have clear goals, direct feedback, and a balance of perceived skills and perceived task demands (Nakamura & Csikszentmihalyi, 2009). In the aforementioned study of Nakamura and Csikszentmihalyi (2009), the state of Flow is treated as a multidimensional construct. In the study of Barthelmäs and Keller (2021), the concept of flow is treated as a multidimensional construct as well. They state that flow intensity depends on the perceived fit of skills and task demands (low to high level) and to subjective value of the activity. Thus, the higher level of flow experienced under a condition of perceived fit of skills and task demands, the higher the subjective value of the activity is attached. In the current study, we will treat flow as a unidimensional construct based on the study of Jackson et al. (2008), since it is a more parsimonious and pragmatic approach.

Further, we wanted to find out which predictors could be positively associated with the flow and predict its intensity. In a study by Csikszentmihalyi (1975), it was proposed that some individuals have a particular set of personality traits, and experience flow more often than other people. These individuals can be described as having an autotelic personality which is associated with concepts such as curiosity, being intrinsically motivated, and entering a flow state more easily than others (Nakamura & Csikszentmihalyi, 2002).

According to the study of Furnham and Thorne (2013), the Need for Cognition was positively linked with openness to experience and intelligence, which is important in academic studying as well. Added to that, a study by Marty-Dugas and Smilek (2018), found a significant correlation between openness to experience and state of flow. It shows that the need for cognition could predict flow since they share similar traits. Based on this information we decided to use curiosity, intrinsic motivation, and the need for cognition as predictors of flow.

The Need for Cognition

In this study, we are going to investigate one of the cognitive motivation aspects possibly associated with flow, which is the need for cognition. The need for cognition is described as a personality trait and general tendency to enjoy activities that involve effortful cognition (Cacioppo & Petty, 1982). A study by Cacioppo et al. (1996) showed that individuals scoring higher in need for cognition have a more positive attitude towards complex problem-solving and reasoning. Moreover, a study by Cacioppo et al. (1996) has shown that the need for cognition is positively related to intrinsic motivation and predicts the achievement of a higher GPA. These findings show that the need for cognition could be interrelated with curiosity and intrinsic motivation and influence the state of Flow. In this study, we treated need for cognition as a unidimensional construct (NCS-6; Coelho, Hanel & Wolf, 2020).

Curiosity

Another predictor of interest in this study is curiosity. Loewenstein (1994) described curiosity as an information search aimed at closing a knowledge gap. This trait is seen as a psychological state that is characterized by increased attention, concentration, and affect, as well as the motivation to re-engage with the content (Hidi, 1990; Renninger et al., 1992; Renninger & Wozniak, 1985). It is a desire to be cognitively stimulated, similar to the need for cognition. In a study by Olson et al. (1984), a mean of positive moderate correlation

(r=.57) was found between general curiosity and the need for cognition scale. It shows that these constructs could be closely related. Thus, investigating the relationship between them in a current study can bring insightful results on the possible influence on the state of flow. Further, in a study by Schutte and Malouff (2020), curiosity was treated as a multidimensional construct using curiosity scales developed by Kashdan et al. (2018). More in detail, joyous exploration is one of the curiosity subscales and is described as a pleasurable experience of finding the world intriguing (Kashdan & Silvia, 2009). The other subscale is called deprivation sensitivity which is the discomfort one feels until they find out missing information (Litman, 2005; Noordewier & van Dijk, 2017). and stress tolerance is the tendency to handle the anxiety of something new (Kashdan et al., 2020). The researchers Schutte & Malouff (2020) found that these three subscales of curiosity: joyous exploration, deprivation sensitivity, and stress tolerance were significantly associated with flow and had moderate to strong correlations. Based on these findings we decided to use these three subscales.

Academic Intrinsic Motivation

The concept of intrinsic motivation is described as striving to achieve a goal because of the enjoyment and instrumental value it gives not because of the external rewards (Marty-Dugas & Smilek, 2018). Lepper et al. (1973) stated that if an activity is rewarded with external rewards this can lead to decreased intrinsic motivation. For example, quite often university students are motivated because of the external rewards (the grade that they will get) and not because of the enjoyment of the studying process itself. Changing the source of the motivation from extrinsic to intrinsic motivation could increase the state of flow and as a consequence increase efficiency of studying. Moreover, Intrinsic motivation is also related to the cognitive motivation variable need for cognition (Cacioppo et al., 1996). The individuals scoring higher on the need for cognition are more intrinsically motivated to use cognitive

effort (Amabile et al., 1994). In the current study, we are specifically interested in academic intrinsic motivation and we are going to use scales developed by Vallerand et al. (1992). Csikszentmihalyi, 1975 stated that intrinsic motivation is a form of flow and that to experience flow one has to engage in the activity without expecting an external reward (Engeser & Rheinberg, 2008). Thus, we think that academic intrinsic motivation will be associated with flow in the academic setting. We are specifically interested in four academic intrinsic motivation subscales. It is intrinsic motivation toward accomplishments – a focus on the process of the achievement rather than the outcome, intrinsic motivation to know – performing an activity due to pleasure experienced while learning, intrinsic motivation to experience stimulation – engaging in an activity to feel exciting sensations (Vallerand et al., 1992). More in detail, intrinsic motivation to know was mentioned to be conceptually related to flow in the study of Vallerand et al. (1992). Thus, we expect Intrinsic motivation to know to be the strong predictor of flow. Moreover, academic intrinsic motivation to know relates to a construct such as curiosity (Gottfried, 1985; Vallerand et al., 1992). Considering that curiosity is seen as a construct of academic intrinsic motivation to know, we assume that these scales will be related to each other.

Research Hypotheses

In this study, our general research question investigates cognitive motivation aspects, the need for cognition, curiosity, and academic intrinsic motivation to the state of flow in studies in the population of university students. From the first research question, we developed the first hypothesis.

Hypothesis 1. (H1) Need for Cognition, curiosity (joyous exploration, deprivation sensitivity, stress tolerance) academic intrinsic motivation (intrinsic motivation to know, toward accomplishments, to experience stimulation) altogether positively predict the state of flow in academic studies.

As for the secondary research question, we wanted to study to what extent cognitive motivation aspects are interrelated with each other. Since concepts defining cognitive motivation aspects are used interchangeably, we predict that these variables are related to each other. Based on that we developed further hypotheses.

Hypothesis 2. (H2) The Need for Cognition is positively correlated with academic intrinsic motivation in academic studies.

Hypothesis 3. (H3) academic intrinsic motivation is positively correlated with curiosity in academic studies.

Hypothesis 4. (H4) Curiosity is positively correlated with need for cognition in academic studies.

It is important to study the relationship between the state of flow and cognitive motivation aspects in university students' due to multiple reasons. One of them is that the research about the state of flow and its relation with cognitive motivation aspects is relatively new, not extensively researched, and lacks information. By doing the current study, we tried to fill in a knowledge gap about cognitive motivation aspects and flow. Secondly, academic studying can become a mundane task. Thus, a better understanding of flow and cognitive motivation aspects might help to increase the intensity and frequency of the flow state, and make academic studying more effective and enjoyable.

Methods

Participants

The population of interest in this study are first-, second- and third- year psychology students at the University of Groningen. Thus, our sample was gathered from the mentioned population. The second- and third year student participants of this study were recruited via flyers placed around the faculty of Behavioural and Social Sciences buildings or a WhatsApp link shared in psychology group chats. First year students could only join via SONA, a

research platform the University of Groningen uses where first year psychology students earn credits by participating in research studies. The first-year psychology students were rewarded with SONA points, the second- and third-year students were rewarded with a financial compensation of 1.5 Euro. We will not include the data of the second- and third-year student participants of this study in the data analysis, in order not to introduce a systematic source of variability due to the insufficient data collected.

There were in total 394 participants in the initial dataset. Seventeen of them had incomplete responses or failed either of the two attention checks, which makes their responses unreliable. Their data thus have not been included in the analysis. Seven additional participants were excluded based on detecting the corresponding values as multivariate outliers with Mahalanobis distance. The final sample consisted of 370 participants between the ages 17 and 35 (M = 19.765, SD = 2.106). Men composed 23.8% of the participants, 75.7% were female and 0.5% preferred not to say which gender they identify with. From the different nationalities that participated, 50% were Dutch, 22.2% were German, and 27,8% had other nationalities.

Materials

To gather demographic information, respondents were then asked to indicate their biological sex (required to choose from options Male, Female and Prefer not to say), age in years, and nationality (Dutch, German or Other, in which case they could specify). Moreover, participants provided their professional status (Student, Working Student or Other) and chose from seven options to indicate level of education.

To measure flow experiences, the study utilizes the short version of the Dispositional Flow Scale (DFS-2; Jackson, Martin & Eklund, 2008). The DSF-2 includes nine items on which participants indicate the frequency of experienced flow states. Modifications to the instructions were implemented in order to align the scale to the aim of the current study.

Instructions were changed from asking about specific experiences of flow from a recently executed activity to general flow experiences in studies. Participants were requested to rate "thoughts and feelings [they] may experience during [their] studies" on the basis of frequency of these experiences. The scale included questions such as "When I am studying… I am competent enough to meet the demands of the situation", which participants then ranked on a five-point Likert scale ranging from 1 (never) to 5 (always / everyday). As to obtain a single value for the unidimensional flow construct, the mean average of the participants' scores on the nine items was calculated and used as the dependent variable. To check for reliability of the new calculated variable of Flow, Cronbach's Alpha was determined at α =.737. This value indicates the reliability of the variable as sufficient, allowing for the creation of a single variable and to test for potential relations to the independent variables.

The Five-Dimensional Curiosity Scale was applied to investigate the degree to which participants described themselves as curious (5DC; Kashdan et al., 2018). The questionnaire consists of 25 items, each of them with an answer option of a seven-point Likert scale. An example of items is the statement "I find it hard to explore new places when I lack confidence in my abilities" which participants had to rank from 1 (does not describe me at all), to 7 (completely describes me). The questions are categorized into five distinct subscales - Joyous Exploration, Deprivation Sensitivity, Stress Tolerance, Social Curiosity and Thrill Seeking - each of them consisting of 5 items. All questions falling under the Stress Tolerance dimension were reversed-scored. In the present research, curiosity was treated as a multidimensional variable based on three dimensions; Joyous Exploration, Deprivation Sensitivity and Stress Tolerance. In accordance with the lack of theoretical relevance, the Social Curiosity and Thrill Seeking subscales have been excluded from our analysis. Participants' scores on the four items of Joyous Exploration were combined to a mean

average justified by the high internal reliability (α = .769). We proceeded similarly in case of the subscales Stress Tolerance (α = .810) and Deprivation Sensitivity (α = .832).

We investigated the need for cognition by utilizing the Need for Cognition Scale (NCS-6; Coelho, Hanel & Wolf, 2020) which includes six items on individual characteristics. The participants were asked to indicate to what extent a statement is congruent with a personal characteristic on a five-point Likert scale ranging from 1 (extremely uncharacteristic of me), to 5 (extremely characteristic of me). One example of a statement of a characteristic is “I would prefer complex to simple problems”, to which participants answered to what extent this describes them, or what they believe about themselves. Two out of the six questions are negatively phrased (“Thinking is not my idea of fun”), so these items were reverse-coded for the initial statistical analyses. The mean average of six items was combined and need for cognition was treated as a unidimensional construct. The internal consistency of these six items to measure Need for Cognition was calculated at α = 0.726.

In order to explore participants’ motivation in educational settings, the Academic Motivation Scale (AMS; Vallerand et al., 1992) was administered consisting of 28 statements. The scale consists of seven subscales that assess the dimensions of motivation toward education, namely: intrinsic motivation toward knowledge, intrinsic motivation toward accomplishments, intrinsic motivation to experience stimulation, extrinsic motivation - identified, extrinsic motivation - introjected, extrinsic motivation - external regulation as well as amotivation. All subscales consist of four items and assess the participants motivation about attending university and pursuing a degree. In the questionnaire, respondents were required to indicate how much they could identify with the stated reasons to go to university or college on a seven-point Likert scale ranging from 1 (does not correspond at all) to 7 (corresponds exactly). One example of a statement is “Because I want to show myself that I can succeed in my studies.”, which assesses motivation, but also “I don’t know what I am

doing at University", which assesses Amotivation. We treated academic motivation as a multidimensional variable based on the seven subscales, however we excluded the three subscales related to extrinsic motivation due to lack of relevance and Amotivation based on its adverse effects on the homoscedasticity assumption. As to obtain a single value for each of the remaining three dimensions, the mean averages of the participants' scores on each subscale were calculated. To check for internal reliability, Cronbach's Alphas were computed for the three new variables; Intrinsic Motivation to Know (α = .825) Intrinsic Motivation toward Accomplishments (α = .779) and Intrinsic Motivation to Experience Stimulation (α = .820).

In the scales included in the current research, two attention checks were implemented to see if participants' responses were reliable. The first attention check was included after the 13th item of the Five-Dimensional Curiosity Scale, the second one came after the 19th item of the Academic Motivation scale. In both cases, participants were asked to choose a specific answer from the Likert scale (e.g., "barely describes me") to confirm that they have been paying attention.

Procedure

The online survey was developed using Qualtrics. Ethical approval by the research committee was obtained prior to distribution. After providing information regarding their study year, the participants are informed about the premise and goals of the study. Following this, the participants are asked to give their informed consent to continue the study. Demographic background, including sex, age, nationality, and current occupation is then established. The participants are then asked to provide their educational background. The blocks following this consist of scales to assess the constructs of interest, namely Curiosity, Need for Cognition, Academic Motivation, Work Engagement, Hyperfocus, Dispositional Flow, and ADHD. Each construct is being measured on a single Scale. In order to prevent

order biases, two randomization processes took place throughout the survey. The scales of Curiosity, Need for Cognition, and Academic Motivation were randomized together, while Work Engagement, Hyperfocus and Dispositional Flow were the second randomization. The independent and dependent variables' blocks followed a predetermined order, thus, it was in fact a pseudo-randomization. The following block puts forth questions assessing the mental health of the participants on a general level and asks whether the person was diagnosed with a mental disorder within the last six months. The block after assesses the potential intake of prescription drugs and potential misuse of it in the past 6 months. The questionnaire is completed after approximately twenty minutes after which the participants are debriefed and finish the survey by providing indications towards the quality of their answers. After finishing the survey, the participants received their rewards.

Design

The study is designed as quantitative research using correlational design, each participant taking part one time in the research. In this study, we are examining the predictive relationship between cognitive motivational aspects and experienced flow frequency in the student population of the Psychology programme, and therefore run a multiple regression analysis. The independent variables (IVs) are three motivational aspects: the Need for Cognition, Curiosity, and Academic Motivation. The dependent variable (DV) is the experienced frequency of flow in academic studies. Further, we examine the interrelation between cognitive motivation aspects by calculating Pearson's r for each combination of the predictors.

Results

Firstly, it proceeded to make assumption checks for multiple regression analysis to see if we can draw correct conclusions. The first assumption of normality was checked using a scatterplot of residuals. The normality assumption was met with visible homoscedasticity in

the scatterplot. The linearity assumption was checked using a scatterplot of residuals. After the scatterplot was visually inspected, we concluded that the linearity assumption was met. Multicollinearity was checked using the Variance Inflation Factor method. It showed that the predictors had no multicollinearity with one another (VIF < 4). The assumption of multivariate normality of residuals was checked using a histogram with a normal curve overlay. Lastly, the assumption of independence of observations was met as well.

After the assumption check was tested and no more violations were present, the main analysis was conducted. In this correlational study, the standard multiple regression analysis was used to inspect the relationship between predictors need for cognition, curiosity, academic intrinsic motivation, and outcome variable flow. The first hypothesis was tested: if need for cognition, curiosity (joyous exploration, deprivation sensitivity, stress tolerance), and academic motivation (intrinsic motivation to know, toward accomplishments, to experience stimulation) are positively associated with a state of flow. After conducting multiple regression analysis and looking up the table of ANOVA (analysis of variance), the R^2adjusted was 29.1% ($F(7,362) = 22.631$, $p < .001$, $R^2 = .304$). Thus, it means that curiosity, need for cognition, and academic intrinsic motivation explains a small amount of the variance in the frequency of flow in studies. However, the correlation was significant ($p < .001$), thus we can conclude that our first hypothesis was supported.

In more detail, by looking at the standardized beta coefficients it was found that variables intrinsic motivation to know, intrinsic motivation toward accomplishments, stress tolerance, and need for cognition are the most significant positive predictors of flow (see Table 1). The non-significant predictors of flow were curiosity subscales: joyous exploration, deprivation sensitivity, and academic intrinsic motivation subscale: intrinsic motivation to experience stimulation. The squared semi-partial correlation coefficient showed that independent variables intrinsic motivation toward accomplishments, intrinsic motivation to

know, and especially stress tolerance contributes the largest percentage (6.2%) of variance in the dependent variable flow (see Table 1).

Table 1

Regression Coefficients of Curiosity, Need for Cognition, Academic Motivation in predicting Flow in Academic Studies

			95 % CI				
Variable	Beta	*SE*	*LL*	*UL*	β	*p*	sr^2
JoyExpo	-0.042	0.037	-0.115	0.032	-0.072	.265	0.002
DeprSens	-0.017	0.024	-0.065	0.030	-0.043	.472	0.001
INTtoKnow	0.171**	0.050	0.072	0.270	0.259	.001	0.022
INTtoAcc	0.136**	0.030	0.077	0.195	0.271	.001	0.040
INTtoExp	-0.047	0.024	-0.094	0.000	-0.113	.051	0.007
NFC	0.140**	0.048	0.046	0.234	0.171	.004	0.017
StressTolerance	0.114	0.020	0.075	0.154	0.281	.001	0.062

Note: N = 370,* indicates $p < .05$, ** indicates $p < .01$

To test the second, third, and fourth hypotheses the table of correlation matrix was inspected. The Pearson's r correlations and descriptive statistics of the dependent, and independent variables are illustrated in Table 2. Here Pearson's correlation coefficient was considered strong when $.5 < r < 1.0$, moderate when $.3 < r < .5$, and weak if $.1 < r < .3$. All the predictors had statistically significant correlation with each other at the set significance level of $p < .01$. Only stress tolerance did not have significant correlations with intrinsic motivation toward accomplishments. Further, the strongest positive correlation was found between intrinsic motivation and deprivation sensitivity, need for cognition, and joyous exploration. Also, joyous exploration and need for cognition had moderate strength positive correlations with all the academic intrinsic motivation scales. Deprivation sensitivity had

weak strength positive correlations with variable Intrinsic motivation to experience stimulation. Subscale stress tolerance had the weakest correlations with all of the predictors and was negatively correlated with variable deprivation sensitivity.

Table 2

Descriptives and Correlations of Independent variables (Need for Cognition, Curiosity, Academic Intrinsic Motivation) and Dependent variable Flow

	M	*SD*	1	2	3	4	5	6	7	8
1. Flow	3.43	0.51								
2. JoyExpo	5.11	0.88	.33**							
3. DeprSens	4.35	1.25	.18**	.37**						
4. INTtoKnow	5.38	0.77	.41**	.60**	.61**					
5. INTtoAcc	4.76	1.02	.39**	.42**	.35**	.63**				
6. INTtoExp	4.11	1.23	.24**	.47**	.26**	.57**	.55**			
7. NFC	3.58	0.62	.36**	.62**	.38**	.48**	.32**	.39**		
8. StressTolerance	4.36	1.26	.33**	.32**	-.14**	.09**	.02	.13**	.28**	

Note: N = 370, JoyExpo = joyous exploration, DeprSens = deprivation sensitivity, INTtoKnow = intrinsic motivation to know, INTtoAcc = intrinsic motivation toward accomplishment, INTtoExp = intrinsic motivation to experience stimulation, NFC = need for cognition, * indicates $p < .05$, ** indicates $p < .01$

Discussion

The first hypothesis suggested that cognitive motivation aspects, the need for cognition, curiosity (joyous exploration, deprivation sensitivity, and stress tolerance), and academic intrinsic motivation (intrinsic motivation - to know, intrinsic motivation – toward accomplishments, and intrinsic motivation to experience stimulation) positively predict the state of flow. The development of the hypothesis was based on Csikszentmihalyi's (1975),

research where he described that some individuals experience flow more often than others. It is a so-called autotelic personality that is associated with curiosity and intrinsic motivation. The need for cognition was chosen due to being linked to openness to experience as well as Flow, based on a study by Marty-Dugas and Smilek (2018). After conducting multiple regression analysis, results showed that curiosity, need for cognition, and academic motivation were significant predictors of flow in studies, thus the first hypothesis was supported. Although, not all the cognitive motivation aspects had a significant association with flow on the individual level.

The most significant predictors to flow were intrinsic motivation to know, intrinsic motivation toward accomplishments, and need for cognition and especially stress tolerance. Based on standardized beta coefficients stress tolerance had the largest predictive value of flow. The largest predictive value of stress tolerance could be explained by the quadrant model of flow (Csikszentmihalyi & LeFevre, 1989). Stress Tolerance by description is a tendency of handling the anxiety of something new (Kashdan et al., 2020). A person scoring high on stress tolerance might handle anxiety better when skills are low and the challenge is high, as a consequence enter the flow state more easily. A large predictive effect of Intrinsic motivation to know to Flow was as expected based on the work of Vallerand et al. (1992). A moderate predictive value of the need for cognition to flow is as expected, based on the constructs sharing the same conceptual trait, openness to experience (Furnham & Thorne, 2013; Marty-Dugas & Smilek, 2018)

The non-significant predictors of flow were joyous exploration, deprivation sensitivity, and intrinsic motivation – to experience stimulation. This finding was unexpected because according to the study of Schutte and Malouff (2020), we predicted joyous exploration and deprivation sensitivity to be related to the state of flow. The difference in results might be due to the inclusion of more predictors in our study. A larger number of

predictors in our study could have influenced the individual predictive effects due to their different characteristics and traits.

As for the second research question, we hypothesized that cognitive motivation traits are interrelated with each other. From this research question three hypotheses followed: The need for cognition will positively correlate with academic motivation (H2), academic motivation will positively correlate to curiosity (h3) and lastly, curiosity will positively correlate with need for cognition (H4). The second, third, and fourth hypotheses were supported as well. All the correlations were significant, except between stress tolerance and intrinsic motivation toward accomplishments. A low to moderate, positive correlation was found between academic intrinsic motivation subscales and need for cognition (H2), curiosity subscales positively correlated with academic intrinsic motivation, ranging from moderate to strong correlations (H3), and need for cognition had positive moderate to strong correlation between curiosity subscales (H4). Stress tolerance had the weakest positive correlation among all the predictors, a negative correlation with deprivation sensitivity, as well a non-significant correlation between intrinsic motivation toward accomplishments.

In our study, one subscale of curiosity – joyous exploration, was positively associated with the variable need for cognition. A similar result was found in a study by Olson et al. (1984). Here mean correlation of r=.57 was found between general curiosity scales and the need for cognition. In more detail, in the study of Olson et al. (1984), the strongest correlation was found between the need for cognition and thinking response subscale (r=.59) and the lowest with diverse curiosity (r=.01), which means the need to seek new experiences, or can be described as diverse exploration. The term diverse exploration resembles the curiosity subscales variable – joyous exploration, where we found a strong positive correlation between the need for cognition *(r*=.62). These differences in findings between Olson et al. (1984) study and ours might be due to different measurement scales that we used.

The need for cognition was significantly correlated with academic intrinsic motivation as we expected based on the study of Amabile et al. (1994). Also, the academic intrinsic motivation to know subscale significantly correlated with most of the curiosity subscales as it was predicted before (Gottfried, 1985; Vallerand et al., 1992). In a study by Vallerand et al. (1992), academic intrinsic motivation to know was linked to general curiosity. Our findings included specific curiosity subscales, thus it was possible to differentiate how strongly these subscales are correlated with academic intrinsic motivation, which was not done before in aforementioned studies.

Limitations and Future Implications

Further, one of the limitations of this study was an unproportioned number of females and males. The larger part of the study consisted of the female population (75.7%), with a smaller proportion of males (23.8%), which could make our study data less generalizable to the general population. Finding more male participants would make a study diverse and widely applicable. Also, our study had not considered female and male possible differences in their experience of flow or cognitive motivation aspects. For example, in a study by Vallerand et al. (1989), females experienced higher levels of intrinsic motivation to know. Including gender differences for future research into account could bring a context and understanding of how they affect the flow and cognitive motivation aspects. Further, in this study, we lacked second and third-year students which could impact the representability of our study. The first-year student responses could vary from senior-year students due to their experience in studying and age. A larger collection of second and third-year could increase the statistical power of our study and show more generable results. Also, our study was constructed as quantitative correlational. It would be insightful to also construct this study as longitudinal and see if the frequency of flow differs from the first year of studies at the university to the last year. Besides limitations, the strong side of the study was controlled

spurious association by including several motivation predictors and subscales. Another strength is that the results of the current study gave more context on understanding cognitive motivation aspects to flow and their interrelation in academic studies. Since cognitive motivation aspects to flow in an academic setting are not extensively researched this study came one step closer to reducing this knowledge gap.

Conclusion

All in all, results showed that the first hypothesis was supported and some of the cognitive motivation aspects are stronger predictors of flow than others: stress tolerance, intrinsic motivation to know and toward accomplishments, and need for cognition. The second, third, and fourth hypotheses were supported as well, cognitive motivation aspects are interrelated with each other. For future research, it would be interesting to investigate what remains to be known considering our research's limitations. It would be insightful to study how cognitive motivation aspects affect flow in a longitudinal study setting, include a more homogeneous sample, and study stress tolerance in depth. The literature on flow and cognitive motivation aspects is still scarce, thus it is important to keep studying this field since it could help to improve the academic lives of the students.

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