Examining the Role of Academic Intrinsic Motivation, Need for Cognition and Curiosity in University Students' Experience of Flow in their Studies

Daniéla Perényi

S3937070

Department of Psychology, University of Groningen

Group 19

PSB3E-BT15: Bachelor thesis

Supervisor: Dr Miguel Garcia Pimenta

Second evaluator: Dr Burkhard Wortler

In collaboration with: Maria Duarte Galésio, Yvette Paul, Gabija Ruseckaite, Antonia Schlesinger, Cedric Williams

January 8, 2023

Abstract

The present study investigated if and how cognitive motivation factors predict the frequency of university students' flow experience during their studies. The data was gathered from a final sample of 370 first-year Psychology students of University of Groningen via an online survey. A correlational design was utilized. Drawing on past findings on the cognitive components of flow (Barthelmäs & Keller, 2021; Csikszentmihalyi, 1975), we theorized, that three cognitive motivation traits, namely Academic Intrinsic Motivation, Need for Cognition and Curiosity, positively predict flow state in studies (first hypothesis). Moreover, drawing on identified shared features (Coelho et al., 2020; Kashdan, 2018; Vallerand et al., 1992), we assumed positive correlations between the three independent variables (second hypothesis). The standard multiple regression analysis revealed a positive predictive relationship between flow and cognitive motivation traits as a whole, thus support for our primary hypothesis was acquired. The individual effects, however, were significant only for Academic Intrinsic Motivation to Know, toward Accomplishment, Need for Cognition and the Stress Tolerance aspect of Curiosity. We tested our secondary hypothesis by calculating Pearson's correlation coefficient. Significant results were found for each combination of the predictors, except for the correlation between one subscale of Academic Intrinsic Motivation (toward Accomplishment) and one subscale of Curiosity (Stress Tolerance). Implication of the findings, their connection to past literature and recommendations for future research have been elaborated on.

Keywords: flow state, academic intrinsic motivation, need for cognition, curiosity, university students

Examining the Role of Academic Intrinsic Motivation, Need for Cognition and Curiosity in University Students' Experience of Flow in their Studies

Flow has been a well-known phenomenon since Csikszentmihalyi (1975) established the concept approximately fifty years ago. He introduced flow to name the optimal psychological state many individuals experience during engagement in an activity. Phrases such as "being entirely caught up in", "completely absorbed in", or "highly engaged in" a task are often used to describe flow and its component of loss of self-consciousness and centering of attention (Csikszentmihalyi, 1975; Barthelmäs & Keller, 2021, p. 2). Motivation, happiness and cognitive efficiency are the key experiences reported to be present during flow state. Additionally, flow is not only pleasurable to experience, but has also been linked to positive outcomes in terms of well-being and performance (Barthelmäs & Keller, 2021; Chapman & Lurie, 2013; Nakamura & Csikszentmihalyi, 2002). Current research on flow vastly deals with how the construct is related to achievement and performance in diverse aspects of life, including sports, work settings and academic learning (Barthelmäs & Keller, 2021). The paper at hand focuses on flow state experienced among university students. Studying the predictive antecedents of flow in academic contexts is a relatively novel topic of research, the relevance of which roots in university students' frequent experience of difficulties related to their studies. These difficulties often take the form of academic stress, negatively impacting students' well-being, academic achievement and other areas of life (Koudela-Hamila et al., 2022). Hence, how to make students' life easier is an essential question. Considering the aforementioned positive consequences of flow state (Chapman & Lurie, 2013; Nakamura & Csikszentmihalyi, 2002), our research can offer valuable insight on how to improve psychological health and performance among students by providing a deeper understanding of what factors might predict an increased frequency of flow experience in studies.

Flow has previously been conceptualized as being fostered by activities in which there is a balance between perceived skills and task challenges, when the two variables are at a high level. During learning new skills or improving existing ones both task complexity and psychological growth increases. Thus, knowledge and skill acquisition - processes highly relevant in academic contexts - has the propensity to attain the challenge-skill balance (Lambert et al., 2013). Considering the number of factors that have been identified as components of flow in the past (such as the mentioned high challenge-skill balance), flow has been proposed to be a multifaceted construct (Barthelmäs and Keller, 2021; Nakamura & Csikszentmihalyi, 2002). However, some researchers (Beard & Hoy, 2010; Jackson & Marsh, 1996) argued, that the elements of flow can be merged into one, creating an unitary construct. In this study, we are aiming to find the predictive components of flow. Therefore, the decision of treating flow as a holistic, unidimensional construct was made.

Literature Review

We were drawing on previous literature on the components and antecedents of flow to determine which factors to study as predictors of flow state in studies (Barthelmäs & Keller, 2021; Csikszentmihalyi, 1975). According to the study by Csikszentmihalyi (1975), individuals with certain personality characteristics are predisposed to experience flow more often, than those lacking the same traits. He referred to these people as having an autotelic personality; a general proneness to enjoy and have curiosity in life and engage in activities for their own sake – the latter component also known as intrinsic motivation (Barthelmäs & Keller, 2021). Thus, these qualities serve as building blocks of flow; affecting both the frequency and intensity of the experience (Csikszentmihalyi, 1975). Curiosity and intrinsic motivation have also been associated with talent and success, undeniably important aspects of academic life as well (Barthelmäs & Keller, 2021; Csikszentmihalyi et al., 1993). Drawing on the paper by Beswick (2017), we refer to the aforementioned constructs by applying the

umbrella term cognitive motivation traits. An additional variable of interest in our research is need for cognition (NFC), which - akin to curiosity and intrinsic motivation - belongs under the term cognitive motivation factors Beswick (2017).

Intrinsic Motivation to Engage in Academic Activities

The present paper focuses on a specific form of motivation; that is, intrinsic motivation toward education. The general concept of intrinsic motivation is often described as individuals engaging in activities for their own sake and enjoyment, rather than for possible optimal outcomes. Intrinsic motivation, moreover, has repeatedly been identified to have a theoretical overlap between the basic components of flow (Barthelmäs & Keller, 2021; Marty-Dugas & Smilek, 2019; Rheinberg, 2020). Intrinsic motivation to engage in academic activities, therefore, might be an especially strong indicator of flow state experienced throughout one's studies. Amotivation – the lack of feeling of competence or controllability (Vallerand et al., 1992) – on the other hand, may be negatively predictive of flow state in studies. In accordance with the focus of our research and existing literature (Vallerand et al., 1992), four dimensions of academic motivation are explored in detail in this research; academic intrinsic motivation to know (INTtoKnow), toward accomplishment (INTtoAcc) and to experience stimulation (INTtoExp), and amotivation. Academic intrinsic motivation to experience stimulation is described as being driven by the desire to experience stimulating sensations - like sensory pleasure and excitement - and has been associated with the experience of flow (Vallerand et al., 1992). Academic intrinsic motivation to know, on the other hand, is defined by an intrinsic intellectuality, the need to understand and search for meaning besides its exploration and curiosity aspects (Vallerand et al., 1992).

The Need for Cognition

The need for cognition is often described as the tendency to seek out and enjoy effortful cognitive processes, and is regarded as a personality trait (Cacioppo & Petty, 1982).

Furthermore, it is associated with our ability to bring structure into the flood of incoming information in our own unique way (Coelho et al., 2020; Colling et al., 2022). A parallel can be drawn between the need for cognition and academic intrinsic motivation to know and toward accomplishment subdimensions, drawing on the definitions by Vallerand and colleagues (1992). Moreover, "the need" component of the construct suggests a drive; a striving for completion (Beswick, 2017). Similarity can be observed between the previously mentioned elements of the need for cognition and the premise of our third variable of interest; curiosity. In fact, Olson and colleagues (1984) have found significant, positive correlations between the two constructs – curiosity and the need for cognition - in the past, although different scales were implemented in their study. The research at hand investigates the need for cognition as a unidimensional variable and utilizes the scale adapted from Coelho and colleagues (2020).

Curiosity's Relation with Study Variables

Curiosity has been defined as a search for information in order to fill in a gap in knowledge (Loewenstein, 1994). Curiosity often takes the form of inquiry actions, such as asking questions and exploration (Tang et al., 2022). The sense of curiosity, moreover, has been associated with frustration and confusion besides other, more neutral feelings, such as eagerness to know more (Tang et al., 2022), parallel to the academic intrinsic motivation to know dimension and the need for cognition (Coelho et al., 2020; Vallerand et al., 1992). The concept has also been defined as a desire to explore for its own sake; terms often used in relation to the general concept of intrinsic motivation too (Schutte & Malouff, 2020; Tang et al. 2022). Some researchers even chose to study curiosity as a form of intrinsic motivation (Beswick, 2017; Tang et al. 2022). Here, curiosity is treated as a multidimensional construct based on the scale established by Kashdan and colleagues (2018). Regarding its relationship with flow, significant positive correlations have been found in the past between flow and

three dimensions of curiosity - Joyous Exploration, Deprivation Sensitivity and Stress Tolerance, among which Joyous Exploration stood out the most in terms of strength of relationship ($r = 0.71$, $p < .01$), followed by Stress Tolerance ($r = 0.47$, $p < .01$) and Deprivation Sensitivity ($r = 0.45$, $p < .01$) (Schutte & Malouff, 2020). Hence, we are focusing on the same three facets of curiosity in our research. Out of the three dimensions, deprivation sensitivity is associated with a negative valence the most - such as feeling of anxiety. These negative feelings are acting as the drive for the "need to know", and the "tendency to focus on achievements" elements of the concept (Kashdan, 2018), which are comparable to the intrinsic motivation to know and toward accomplishment subdimensions of academic motivation.

Present Research

The aim of the present research is to explore two research questions; how cognitive motivation traits are related to the frequency of flow experience in studies (first research question), and how cognitive motivation traits and their sub-dimensions relate to one another (second research question). The primary hypothesis states a positive predictive relationship between the three independent variables - Academic Intrinsic Motivation, Need for Cognition and Curiosity - and the dependent variable Flow (Hypothesis 1). The positive predictive effect of Academic Intrinsic Motivation to Experience Stimulation on Flow is expected to be especially strong, based on the similarities in the representation of the two concepts (Vallerand et al., 1992). Amotivation, on the other hand, is assumed to negatively predict Flow state in studies. Moreover, we are aiming to expand the findings by Schutte and Malouff (2020) on the relation between Curiosity and Flow. In contrast to their study (Schutte & Malouff, 2020), however, authors of this paper expect a positive predictive effect of Curiosity on flow, and look at the relationship specifically throughout university students' studies. Here, the strength of relationship between flow and the three facets of curiosity is predicted to

follow the same order, as in Schutte and Malouff's study (2020); joyous exploration to be followed by stress tolerance, and lastly by deprivation sensitivity in a descending order.

The second research question - how the predictors interrelate with each other – is based on identified similarities between the definitions of the cognitive motivation aspects (Kashdan, 2018; Vallerand et al., 1992). According to the secondary hypothesis, the Curiosity variable is positively related to all dimensions of Academic Intrinsic Motivation's subdimensions; the Need for Cognition is positively correlated with the subdimensions of Academic Intrinsic Motivation; and the Need for Cognition is positively related to all dimensions of Curiosity as well (Hypothesis 2). Further, Academic Intrinsic Motivation to Know is expected to have the average strongest correlations with all other variables based on identified similarities between definitions (Coelho et al., 2020, Kashdan, 2018; Vallerand et al., 1992). Moreover, especially strong correlation is assumed to be displayed between Academic Intrinsic Motivation toward Accomplishment and the Deprivation Sensitivity dimension of Curiosity (Kashdan, 2018; Vallerand et al., 1992).

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, age in years, and nationality. 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 see Table A1 for reliability statistics of measures).

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's was calculated at $\alpha = 0.726$.

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 accomplishment, 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 Accomplishment (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 Intrinsic 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

Descriptive statistics of measures and the values attained for the assumption checks and hypotheses checks are displayed in the result section.

Descriptive Statistics and Assumption Checks

To run the analyses of our data, we used the IBM SPSS Statistics (Version 28) predictive analytics software. The descriptive statistics acquired for our dependent variable Flow (M = 3.435, SD = 0.510) indicate an occasional to frequent experience of flow during studies in our sample, with a relative consistency of values in the dataset (see Table 3).

We inspected the descriptive statistics obtained for the independent variables too. The corresponding values are found in Table 3. First, participants scored the average highest on the Intrinsic Motivation to Know dimension of Academic Motivation, with a mean value slightly above the middle score ("corresponds enough"). Compared to this, participant identified with Intrinsic Motivation toward Accomplishment and to Experience Stimulation slightly less. Out of the studied three dimensions of curiosity, participants' mean scores were highest on Joyous Exploration, suggesting that participants could generally identify with the statements of the scale. The mean scores slightly above the middle score on the Stress Tolerance and Deprivation Sensitivity dimensions are implying an approximately average neutral attitude toward the corresponding statements among participants. Lastly, the mean value for the variable Need for Cognition's lies slightly below the fourth score ("somewhat characteristic of me") of the response scale.

We drew on six assumption checks to be able to build solid inferences from the following main analysis. We tested for linearity between the dependent and all the independent variables; normality and homoscedasticity. The scatterplot of residuals summarizes the results (Figure A1). A linear relationship was displayed. After the visual inspection of the scatterplot, we concluded that the homoscedasticity assumption was supported as well. The scatterplot and additional histograms summarize the normality of the data acquired for the DV (Figure A2) and the yielded normal distributions of residuals related to each predictor (Figure A3, A4, A5, A6, A7, A8 and A9). The histogram for the variable Amotivation displayed a deviation of normality of residuals. For this reason, Fisher z-transformation was applied to standardize the values obtained for Amotivation. However, the histogram still showed a violation to normal distribution, thus, the decision to remove the variable Amotivation from the main analysis was made. The assumption of multivariate normality of residuals was met, as indicated by the normal curve displayed on the related

histogram (Figure A10). The values acquired for the Variance Inflation Factor (VIF) of the individual contribution of each predictor deemed to show no evidence for multicollinearity (VIF < 4) (see Table 2). Therefore, the conclusion of support for independent observations was made.

Main Analysis

After data cleaning and finding no more violation of assumptions, we proceeded to conduct the main analysis. We performed a standard multiple linear regression analysis to test the first hypothesis; namely, if Academic Intrinsic Motivation (to Know, toward Accomplishment, to Experience Stimulation), Need for Cognition, and Curiosity (Joyous Exploration, Stress Tolerance, Deprivation Sensitivity) positively predict the frequency of Flow experience in studies. The result of the ANOVA (analysis of variance) indicated, that the model is indeed significant ($F(7, 362) = 22.631$, $p < .001$) and explains 29,1% of the variance, which is considered a moderate level of explained variance in flow ($\text{adj}R^2 = .291$; Table 1). Moreover, we found, that Stress Tolerance, Intrinsic Motivation toward Accomplishment and Intrinsic Motivation to Know have positive predictive effects on the frequency of Flow, with strength of effect size in the respective order (see Table 2 for individual predictive effects of IVs indicated by the standardized beta coefficients). The Need for Cognition variable was also found to significantly and positively predict the dependent variable in academic settings. The standardized beta coefficients corresponding to Intrinsic Motivation to Experience Stimulation, Joyous Exploration and Deprivation Sensitivity, on the other hand, were negative and non-significant (Table 2).

The unique contribution of each predictor to the total variance in flow was calculated by squaring the corresponding semipartial correlations. The acquired values are presented in Table 2. Stress Tolerance was found to have the largest effect size indicated by the 6.3 % of the unique explained variance, followed by the 4 % unique explained variance corresponding

to Intrinsic Motivation toward Accomplishment and 2.2 % corresponding to Intrinsic Motivation to Know. The Need for Cognition uniquely explained 1.7 % of the total variance in Flow.

The multiple correlation matrix summarizes the zero-order correlations between Flow in studies and the IVs (Table 3). We found the highest correlation between Flow and Intrinsic Motivation to Know albeit considered moderate in general terms. The correlations between Flow and Intrinsic Motivation toward Accomplishment, Joyous Exploration, Stress Tolerance and Need for Cognition yielded to be higher than 0.3. The correlations between Flow and the two remaining variables; Academic Intrinsic Motivation to Experience Stimulation and Deprivation Sensitivity were weak, although still significant (see Table 3).

To explore our second hypothesis, we inspected the interrelation between cognitive motivation traits and subdimensions by calculating Pearson's correlation coefficient (r). Table 3 displays the acquired values, where $r > .5$ corresponds a strong, $.3 < r < .5$ indicates a moderate, and $r < .3$ showcases a weak association between predictors, and significance level is determined at $\alpha = .05$. Most independent variables were correlated with each other strongly or moderately and the correlations between the seven predictors were each significant, except for the correlation between Academic Intrinsic Motivation toward Accomplishment and Stress Tolerance. Variables under the term Academic Intrinsic Motivation were strongly correlated with each other, as expected. Moreover, Academic Intrinsic Motivation to Know was highly correlated with Joyous Exploration and Deprivation Sensitivity. Joyous exploration was, besides, strongly correlated with Need for Cognition and had a moderate correlation with all other variables. On average, Stress Tolerance had the weakest correlations with all the other predictors, and was negatively related to Deprivation Sensitivity.

Table 1

Model Summary

Model	*R Square*	Adj. *R square*	Std. Error of the Estimate	Change Statistics			
				F Change	*df1*	*df2*	*Sig. F Change*
1	.304	.291	.430	22.631**	7	362	< .001

Note. Significant at the * .05 level; ** .01 level. Values obtained for Adj R square (adjusted R square), Std. (standard) Error of the Estimate, df (degrees of freedom) and Sig F Change (Significant F Change) are given.

Table 2

Multiple Linear Regression Analysis: Estimating the Relationship between Flow and IVs

Variable	Beta	*SE*	β	95 % CI		*t*	*p*	sr^2	*VIF*
				LB	*UB*				
INTtoKnow	0.171	0.050	0.259	0.072	0.270	3.387**	<.001	0.022	3.054
INTtoAcc	0.136	0.030	0.271	0.077	0.195	4.542**	<.001	0.040	1.857
INTtoExp	-0.047	0.024	-0.113	-0.094	0.000	-1.960	.051	0.007	1.730
NFC	0.140	0.048	0.171	0.046	0.234	2.934**	.004	0.017	1.776
JoyExpo	-0.042	0.037	-0.072	-0.115	0.032	-1.116	.265	0.002	2.168
StressTolerance	0.114	0.020	0.281	0.075	0.154	5.695**	<.001	0.063	1.270
DeprSens	-0.017	0.024	-0.043	-0.065	0.030	-0.720	.472	0.001	1.821

Note. Significant at the * .05 level; ** .01 level. Values for Beta (beta coefficient), Standard Error (SE), β (standardized beta coefficient), CI (confidence interval) and corresponding LB (lower bound) and UB (upper bound) are given. Moreover, t (result of t-test), p (p-value), sr2 (squared semiparial correlation) and VIF (variance inflation factor) are given. Values are calculated for the independent variable INTtoKnow (intrinsic motivation to know), INTtoAcc (intrinsic motivation toward accomplishment), INTtoExp (intrinsic motivation to experience stimulation), NFC (need for cognition), JoyExpo (joyous exploration), StressTolerance and DeprSens (deprivation sensitivity)

Table 3

Descriptive Statistics and Pearson's Correlations between Study Variables

	Variable	n	M	SD	1	2	3	4	5	6	7	8
1	Flow	370	3.435	0.510	-							
2	INTtoKnow	370	5.376	0.774	.406**	-						
3	INTtoAcc	370	4.757	1.016	.387**	.634**	-		.		.	
4	INTtoExp	370	4.113	1.233	.242**	.570**	.551**	-				
5	NFC	370	3.576	0.623	.355**	.478**	.316**	.389**	-			
6	JoyExpo	370	5.108	0.883	.325**	.599**	.420**	.467**	.618**	-		
7	StressTol	370	4.361	1.256	.326**	.094**	.015	.128**	.280**	.320**	-	
8	DeprSens	370	4.354	1.245	.182**	.612**	.349**	.259**	.378**	.372**	-.135**	-

Note. Significant at the * .05 level; ** .01 level. n (sample size). Values are calculated for flow and independent variables: INTtoKnow (intrinsic motivation to know), INTtoAcc (intrinsic motivation toward accomplishment), INTtoExp (intrinsic motivation to experience stimulation), NFC (need for cognition), JoyExpo (joyous exploration), stressTol (Stress tolerance) and DeprSens (deprivation sensitivity)

Discussion

The present research was conducted to explore, if cognitive motivation traits positively predict frequency of flow in studies (Hypothesis 1). Moreover, cognitive motivational aspects and subdimensions were anticipated to be positively associated with each other (Hypothesis 2). Significant result was obtained for the regression analysis corresponding to the primary

hypothesis ($F(7, 362) = 22.631$, $p < .001$). This indicates, that cognitive motivation aspects as a whole indeed predict the frequency of university students' flow experience during their studies. However, the model explained only approximately one-third of the variance in flow, which demonstrates a moderate level of model fit. Regarding individual predictive effects, academic intrinsic motivation to experience stimulation was expected to be especially strongly related of flow drawing on Vallerand and colleagues' definition (1992). Based on the acquired standardized beta coefficients, however, stress tolerance was found to be the best individual predictor of flow ($\beta = .281$, $sr^{2} = .063$) with a positive direction, followed by academic intrinsic motivation toward accomplishment ($\beta = .271$, $sr^{2} = .040$) and to know ($\beta = .259$, $sr^{2} = .022$). Need for cognition had a relative moderate positive predictive effect ($\beta = .171$, $sr^{2} = .017$). Contradicting our expectations, intrinsic motivation to experience stimulation did not show significant individual predictive effect at all, neither did joyous exploration and deprivation sensitivity. The findings were supported by the calculated squared semipartial correlations, which indicated the effect size of each IV. The negative predictive effect of amotivation could not be tested due to violation of the normality assumption.

Furthermore, we were aiming to expand Schutte and Malouff's findings on the relation between flow and the three dimensions of curiosity studied (2020). The zero-order correlations between flow and the three facets of curiosity – joyous exploration, stress tolerance and deprivation sensitivity - were found to be significant in the current research, albeit weaker and following a different order compared to the findings in the original study (Schutte & Malouff, 2020). Thus, the replication attempt of their research on the relationship between the two constructs was only partially successful. Moreover, Schutte and Malouff's findings could not be expanded by providing a predictive direction of relationship between the flow and curiosity constructs, as joyous exploration and deprivation sensitivity were non-significant predictors of flow in studies. Interestingly, only the stress tolerance aspect of

curiosity was significantly predictive of flow with a positive direction, as mentioned previously.

The zero-order correlations between flow and IVs followed a different order of strength compared to the predictive effect sizes of IVs. For instance, stress tolerance predicted flow state in academic settings to the largest extend in the model, however - in terms of strength of zero-order correlations with flow – stress tolerance came fourth. This highlights and supports the fact, that the significant correlations between variables is a result of interactive processes, and does not provide information on the direction of relationships - unlike the standardized beta coefficients.

Our second hypothesis about the interrelation of predictors was partially supported – as displayed by the significant associations between predictors, with the exception of one zero-order correlation. The subdimensions of curiosity were significantly and positively related to the need for cognition and the need for cognition was significantly and positively associated with the three facets of curiosity. The subdimensions of academic intrinsic motivation were significantly and positively correlated with facets of curiosity too, except for the correlation between intrinsic motivation toward accomplishment and stress tolerance. This finding is unexpected, as curiosity was theorized to be strongly related to all facets of academic intrinsic motivation.

Academic intrinsic motivation to know was expected to have the average strongest positive correlations with all other variables, and support for that was indeed gathered ($r_{average}$= .450). Moreover, especially strong positive correlation was assumed to be displayed between academic intrinsic motivation toward accomplishment and the deprivation sensitivity dimension of curiosity based on prior literature (Kashdan, 2018; Vallerand et al., 1992). However, only a moderate strength of correlation was observable between the two IVs (r = .349).

Limitations and Direction for Future Research

This paper aimed to provide a clearer view on the relationships between cognitive motivational traits with each other and with flow. One limitation of our research, however, might stem from the specific sample gathered. From the one hand, participants whose data we used were all Psychology students and all from the same year. These two factors could pose the risk for effecting our data to an extent, that it becomes nongeneralizable. The decision to exclude participants from second and third years of their studies, however, was inevitable due to adverse potential of the low sample size to introduce a systematic source of variability. As a suggestion for future research, a longer period of data collection, moreover the broadening of the sample to university students majoring in other subjects could all bring about positive outcomes in terms of generalizability of our findings

Moreover, most facets of curiosity were found to not predict our dependent variable flow in studies. Our choice of measure was justified by the findings by Schutte and Malouff (2020), however, studying a specific form of curiosity, named academic curiosity might be a topic of investigation in future research expanding the findings of the present paper. Academic Curiosity can be measured based on the Scale of Academic Curiosity introduced by Vidler and Rawan (1974), and its relevance roots in the potential to relate more to the academic contexts. Academic curiosity, nevertheless, been found to be strongly correlated with need for cognition (r = .68) as well (Olson et al., 1984).

Another limitation could stem from biases in participants' response styles. Social desirability could potentially impact the degree to which participants rated their general attitudes towards education. Moreover, the scales adapted included a neutral midpoint in the answer options of the Likert scale, which could strengthen the possibility of neutral responding. To avoid this, modifications to the answer options could be implemented in future research.

Another suggestion for future research concerns the design of the study. During exploration of the frequency of flow experience, participants were required to recall the nature of past flow experiences during their studies. Thus, their reports could be affected by many additional factors – such as current mood and attitude towards their studies and memory processes. To avoid these biases and be able to reach solid inferences, an experimental design to prompt flow could be implemented.

Conclusion

Stress and mental health difficulties are familiar concepts to most university students related to their studies. The context of our research was based on the assumption, that a more frequent experience of flow state during university students' studies might facilitate an improved quality of academic life. Thus, we were interested to find what factors can predict the frequency of flow state in studies. Determining which factors to examine as predictors of flow was a nuanced process, that was based on previously identified relations between the constructs of interest (Barthelmäs & Keller, 2021; Csikszentmihalyi, 1975) and the comparison of their definitions in the current paper.

To summarize the results of the main analyses of the research, it can be stated that the primary hypothesis was supported and partial support for the secondary hypothesis was found. Flow experience in studies was found to be predicted by cognitive motivation traits as whole. Two out of three facets of curiosity were non-significant predictors, contradicting our expectations based on Schutte and Malouff (2020) findings. This might be explained by the possible bias in participants response styles. In future research, the use of measures that does not include a neutral midpoint is suggested, to avoid neutral responding. Most motivational traits and subdimensions were also positively correlated with each other. These results might also indicate, that the three studied cognitive motivation aspects do have an underlying process, which could stem from the striving for integration and completeness as described by

Beswick in 2017. This would also be in line with the suggestion, that although flow has several components (Barthelmäs and Keller, 2021; Nakamura & Csikszentmihalyi, 2002), these elements can be treated as one.

References

Barthelmäs, M., & Keller, J. (2021). Antecedents, Boundary Conditions and Consequences of Flow. Advances in Flow Research. https://doi.org/10.1007/978-3-030-53468-4_3

Beard, K. S., & Hoy, W. K. (2010). The nature, meaning, and measure of teacher flow in elementary schools: A test of rival hypotheses. Educational Administration Quarterly, 46(3), 426–458. https://doi-org.proxy-ub.rug.nl/10.1177/0013161X10375294

Beswick, D. (2017). Towards a General Theory of Cognitive Motivation. In Cognitive Motivation (pp. 9–27). Cambridge University Press. https://doi.org/10.1017/9781316822920.003

Cacioppo J. T., Petty R. E. (1982). The need for cognition. *Journal of Personality and Social Psychology*, 42, 116-131.

Coelho, G. L. H., Hanel, P. H. P., & Wolf, L. J. (2020). The Very Efficient Assessment of Need for Cognition: Developing a Six-Item Version. Assessment, 27(8), 1870–1885. https://doi.org/10.1177/1073191118793208)

Colling, J., Wollschläger, R., Keller, U., Preckel, F., & Fischbach, A. (2022). Need for Cognition and its relation to academic achievement in different learning environments. Learning and Individual Differences, 93, 1–14. https://doi-org.proxy-ub.rug.nl/10.1016/j.lindif.2021.102110

Csikszentmihalyi, M. (1975). Beyond boredom and anxiety: Experiencing flow in work and play. San Francisco: Jossey-Bass.

IBM Corp. Released 2021. IBM SPSS Statistics for Windows, Version 28.0. Armonk, NY: IBM Corp

Jackson, S. A., & Marsh, H. W. (1996). Development and validation of a scale to measure optimal experience: The flow state scale. Journal of Sport & Experience Psychology, 18, 17–35.

Jackson, S. A., Martin, A. J., & Eklund, R. C. (2008). Flow State Scale 2--short form. *PsycTESTS Dataset*. https://doi.org/10.1037/t69534-000

Kashdan, T. B., Stiksma, M. C., Disabato, D. J., McKnight, P. E., Bekier, J., Kaji, J., & Lazarus, R. (2018). The five-dimensional curiosity scale: Capturing the bandwidth of curiosity and identifying four unique subgroups of curious people. *Journal of Research in Personality*, *73*, 130–149. https://doi.org/10.1016/j.jrp.2017.11.011

Koudela-Hamila, S., Santangelo, P. S., Ebner-Priemer, U. W., & Schlotz, W. (2022). Under which circumstances does academic workload lead to stress? Explaining intraindividual differences by using the cortisol-awakening response as a moderator. Journal of Psychophysiology, 36(3), 188-197. https://doi.org/10.1027/0269-8803/a000293

Lambert, J., Chapman, J., & Lurie, D. (2013). Challenges to the four-channel model of flow: Primary assumption of flow support the moderate challenging control channel. The Journal of Positive Psychology, 8(5), 395–403. https://doi-org.proxyub.rug.nl/10.1080/17439760.2013.809138

Loewenstein, G. (1994). The psychology of curiosity: A review and reinterpretation. Psychological Bulletin, 116(1), 75–98. https://doi.org/10.1037/0033-2909.116.1.75

Marty-Dugas, J., & Smilek, D. (2019). Deep, effortless concentration: re-examining the flow concept and exploring relations with inattention, absorption, and personality. Psychological Research, 83(8), 1760–1777. https://doi.org/10.1007/s00426-018-1031-6

Nakamura, J., & Csikszentmihalyi, M. (2002). The Concept of Flow. In C. Snyder, & S. Lopez (Eds.), Handbook of Positive Psychology (pp. 89-105). New York: University Press.

Olson, K. R., Camp, C. J., & Fuller, D. (1984). Curiosity and need for cognition. Psychological Reports, 54, 71-74.

Rheinberg, F. (2020). Intrinsic motivation and flow. *Motivation Science*, *6*(3), 199–200. https://doi- org.proxy-ub.rug.nl/10.1037/mot0000165

Schutte, N. S., & Malouff, J. M. (2020). Connections between curiosity, flow and creativity. Personality and Individual Differences, 152(July 2019), 109555. https://doi.org/10.1016/j.paid.2019.109555

Tang, X., Renninger, K. A., Hidi, S. E., Murayama, K., Lavonen, J., & Salmela-Aro, K. (2022). The differences and similarities between curiosity and interest: Meta-analysis and network analyses. Learning and Instruction, 80(May 2021), 101628. https://doi.org/10.1016/j.learninstruc.2022.101628

Vallerand, R. J., Pelletier, L. G., Blais, M. R., Briere, N. M., Senecal, C., Valleries, E. F. (1992). Academic motivation scale: A measure of intrinsic, extrinsic and amotivation in education. *Educational and Psychological Measurement 52*(4): 1003-1003. https://doi.org/10.1177/0013164492052004025

Vidler, D. C., & Rawan, H. R. (1974). Construct Validation of a Scale of Academic Curiosity. *Psychological Reports, 35*(1), 263–266. https://doi.org/10.2466/pr0.1974.35.1.263

Appendix A

Table 1

Reliability of Study Variables' Measures

Scale	Cronbach's Alpha	N of Items
Flow	.737	9
Joyous Exploration	.769	5
Stress Tolerance	.810	5
Deprivation Sensitivity	.832	5
Need for Cognition	.794	5
Intrinsic Mot. to Know	.825	4
Intrinsic Mot. to Acc.	.779	4
Intrinsic Mot. to Exp. S.	.820	4

Note. N (number)

Figure 1

Assumption Checks for Linearity, Normality and Homoscedasticity of Data

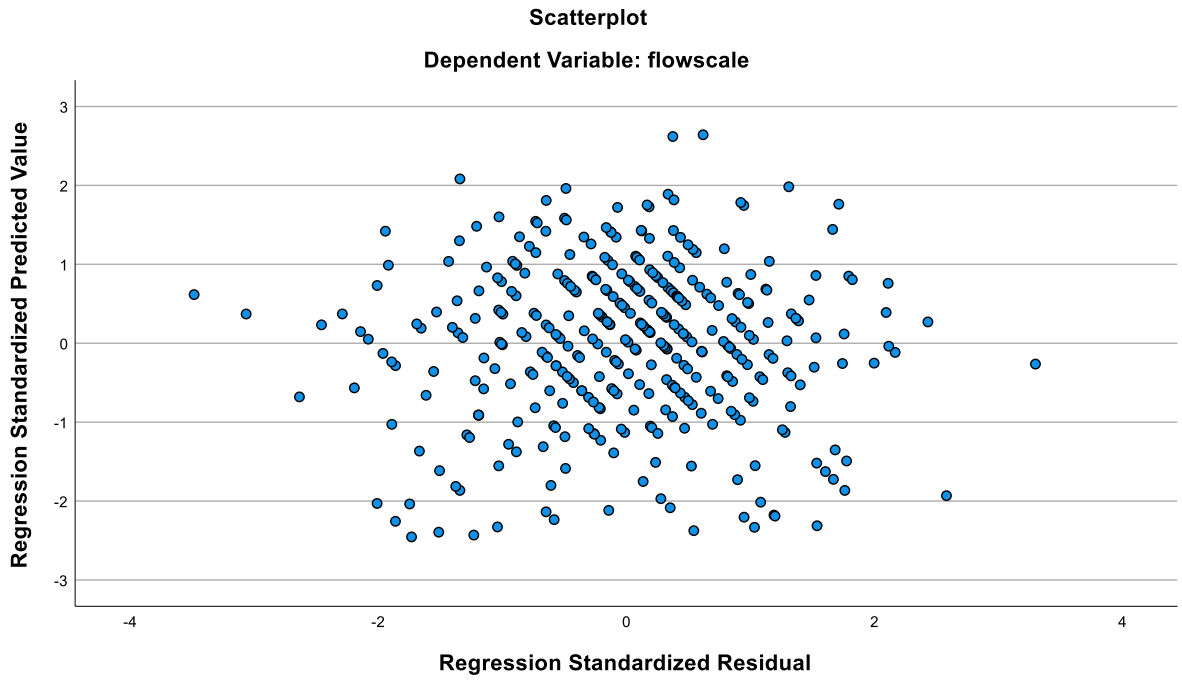

Figure 2

Normality of Dependent Variable

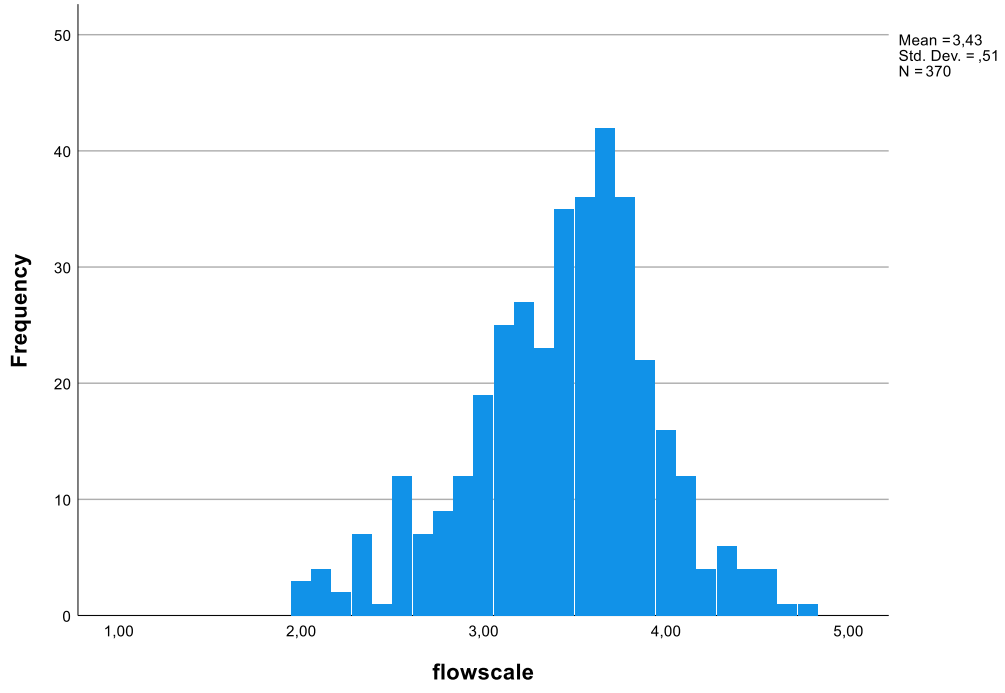

Figure 3

Academic Intrinsic Motivation to Know: Normality of Residuals

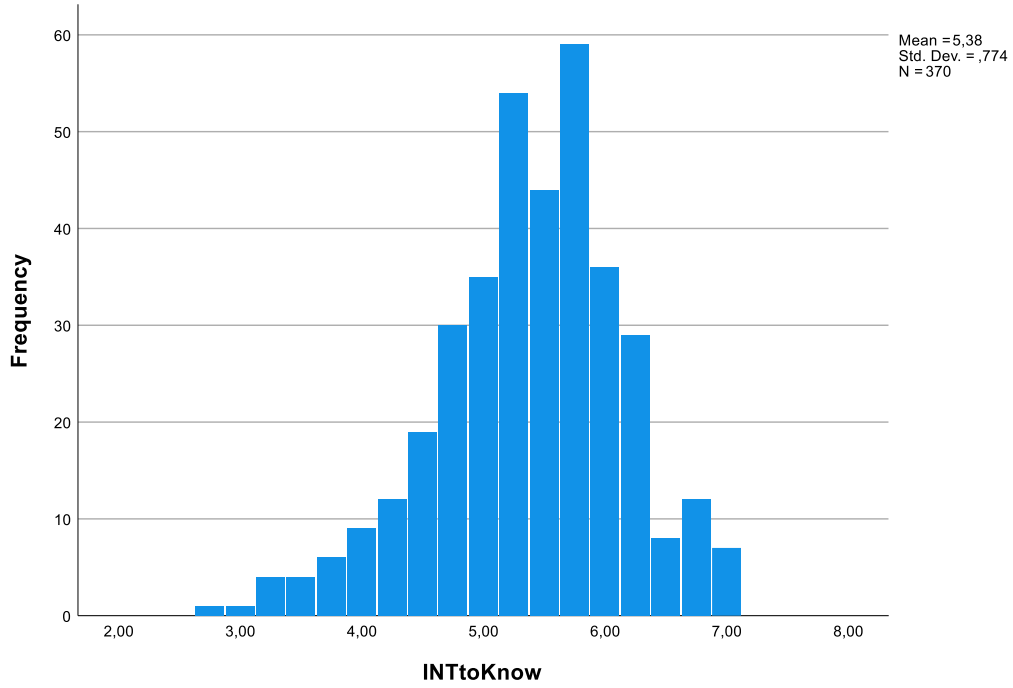

Figure 4

Academic Intrinsic Motivation towards Accomplishment: Normality of Residuals

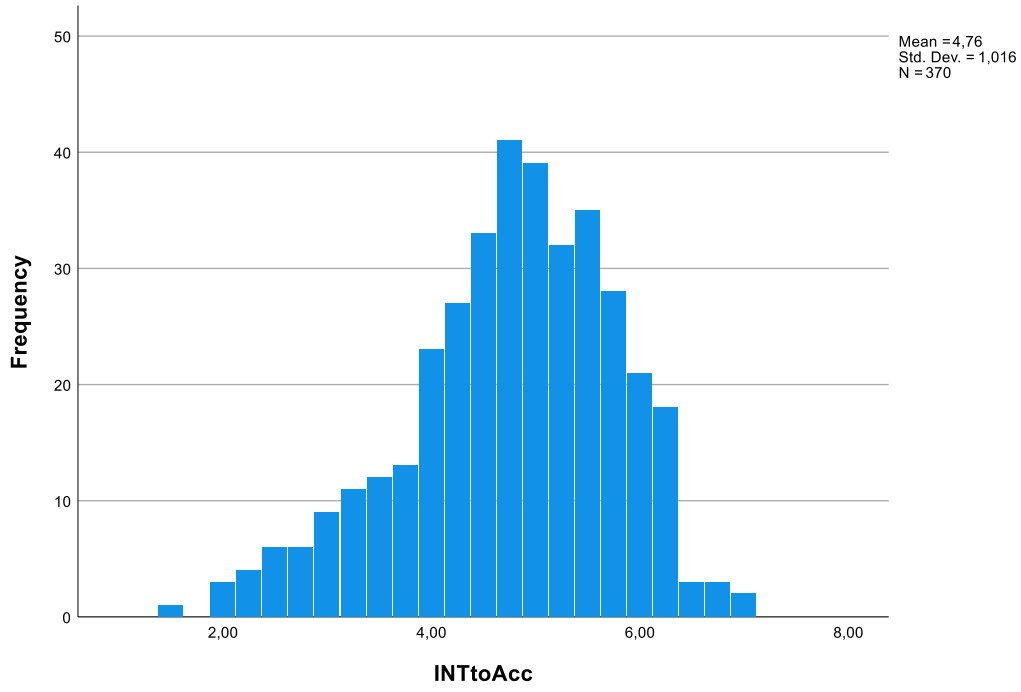

Figure 5

Academic Intrinsic Motivation to Experience Stimulation: Normality of Residuals

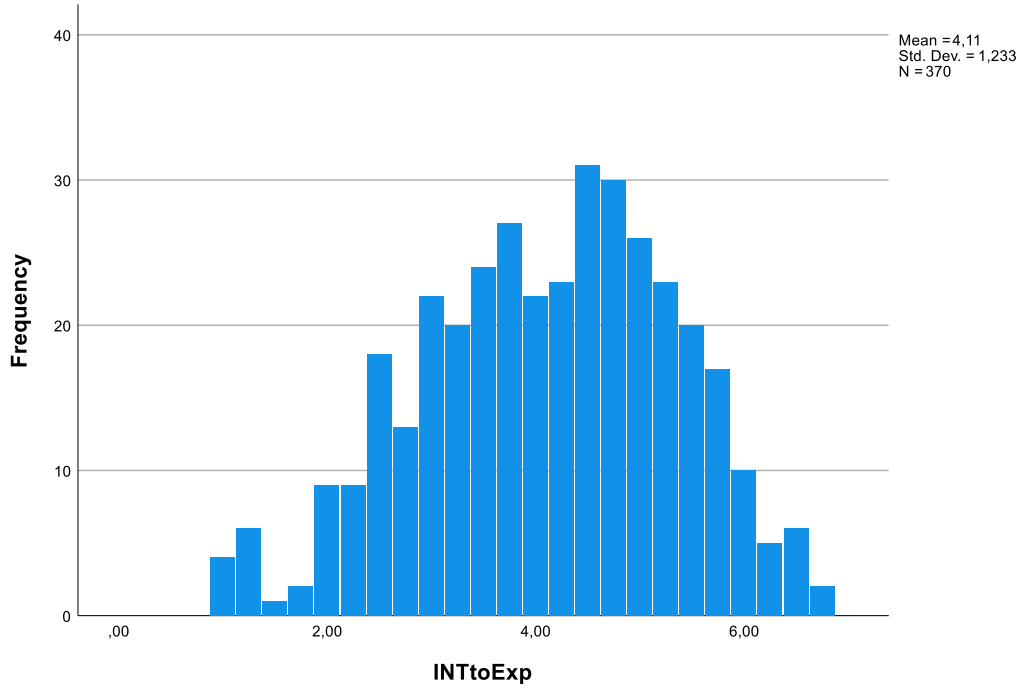

Figure 6

Need for Cognition: Normality of Residuals

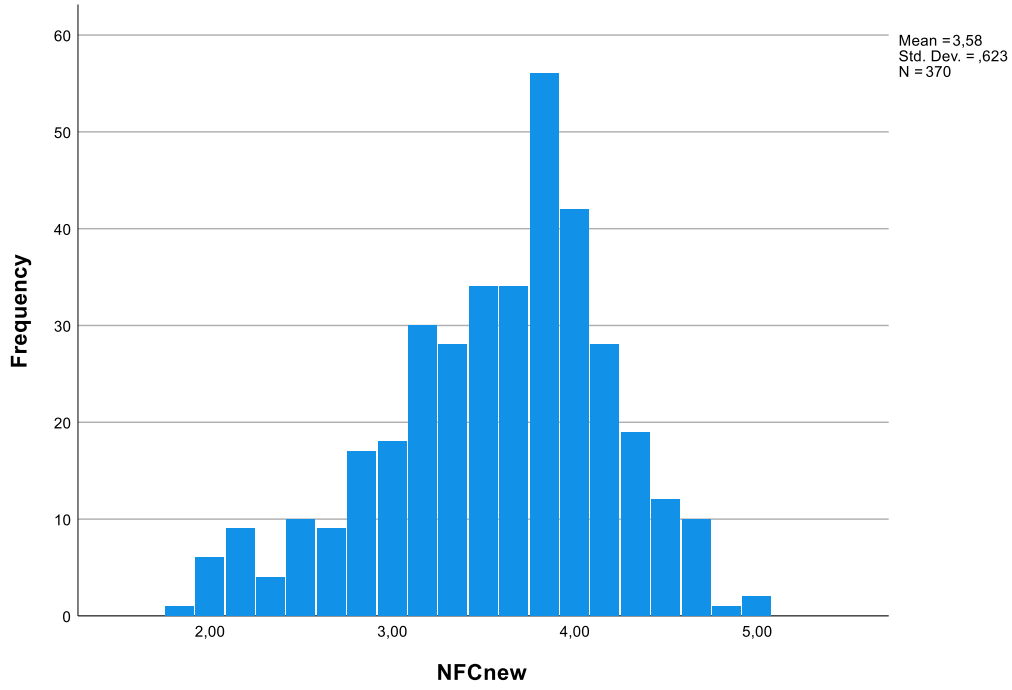

Figure 7

Joyous Exploration: Normality of Residuals

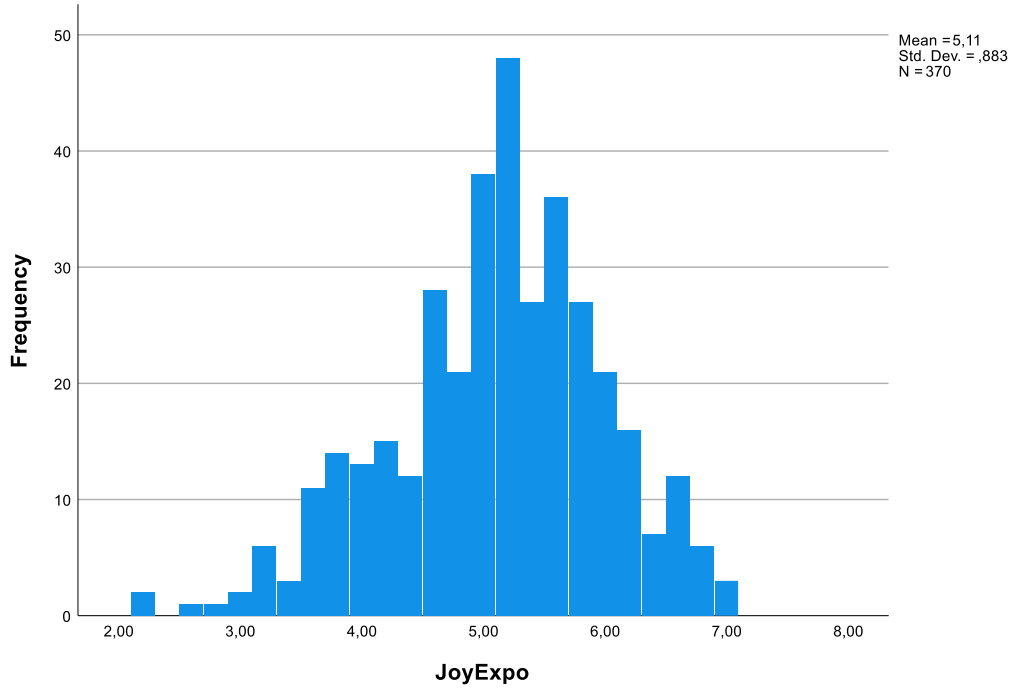

Figure 8

Stress Tolerance: Normality of Residuals

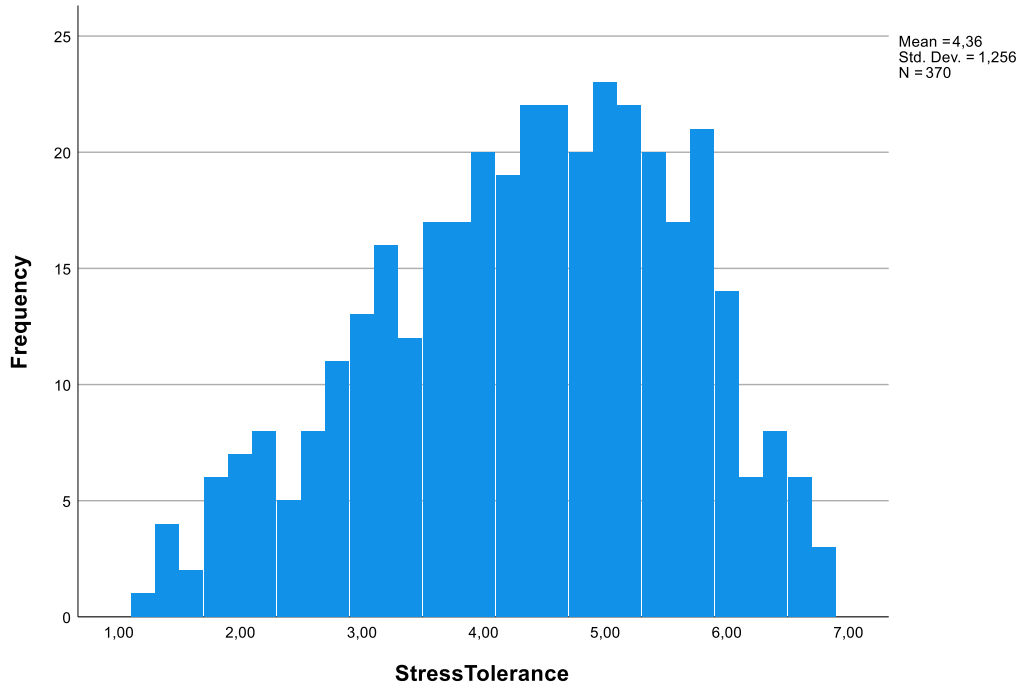

Figure 9

Deprivation Sensitivity: Normality of Residuals

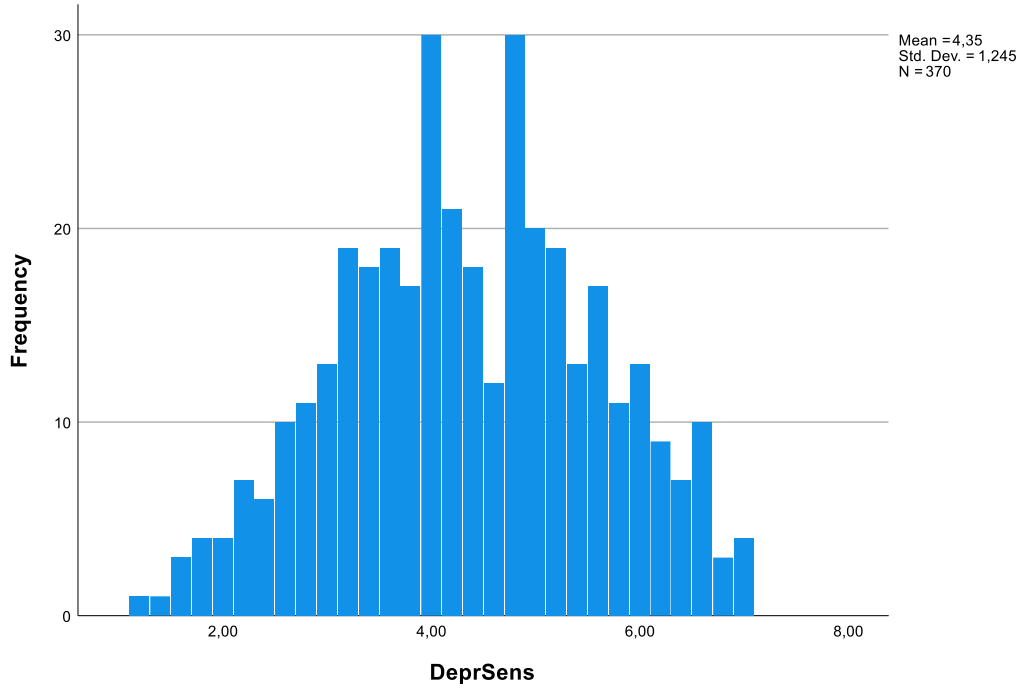

Figure 10

Multivariate Normality of Residuals