Cognitive Motivation Aspects and Flow: Using Curiosity, Need for Cognitions, and Intrinsic Academic Motivation to Predict Flow in Studies in Psychology Students

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Abstract

Flow in studies describes subjective experiences during the performance of academic activities of students in their studies. Flow in general describes states of deep concentration and full contentment in the present moment. The flow state involves multiple antecedent and boundary conditions that could be influenced by individual differences on cognitive motivational aspects, such as curiosity, need for cognition or intrinsic academic motivation. In the current research, first-year psychology students (N = 370) filled out self-report measures on academic motivation aspects, curiosity, need for cognition and intrinsic academic motivation, as well as on flow experiences in studies. We hypothesized the motivational aspects, curiosity, need for cognition and intrinsic motivation to be predict flow in studies. Further, we hypothesized positive relations between the predictors. The multiple regression analysis gives partial support for the hypothesis of relations of motivational factors to flow in studies. Noteworthy, not all dimensions of the motivational aspects had a significant individual predictive effect on flow in studies. The hypotheses of relations among the predictors were supported. Pearson correlations showed small to moderate correlations between the dimensions of curiosity, need for cognition and intrinsic academic motivation. Limitations to the study are the homogeneity of the sample, giving issue to conclusions based on findings. Further, the sample consisted of significantly more female participants, giving reason to believe in a bias of findings due to gender.

Keywords: Flow in studies, motivational aspects, cognitive motivation, curiosity, need for cognition, intrinsic academic motivation

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Academic performance can be looked at in the context of positive experiences, such as fulfillment, involvement, and task enjoyment. In our present research we are interested in the relation between motivational factors, curiosity, need for cognition and intrinsic motivation to engage in academic activities, and flow experiences during studies in university students. One central aspect of these experiences is the absorption in a task as well as the enjoyment of the task, which is often referred to as flow. The flow state has been described in prior research, for example by Mihaly Csikszentmihalyi, who was a formative figure on the research subject and who described flow as an optimal state of deep concentration (Csikszentmihalyi, 1975). Our current research is interested in the construct of flow in the context of study experiences in university students. We will look at the relationship between motivational factors of curiosity, need for cognition and academic intrinsic motivation and flow experiences of students in their studies.

Flow

Csikszentmihalyi's research investigates what makes an activity inherently motivating and enjoyable, which is part of the progression towards "positive psychology" (Seligman, 1998). In this movement the focus shifts from a problem-oriented approach towards one that is more concerned with well-being. Flow is defined by a state of deep, effortless concentration in which an activity, such as studying, becomes the source of enjoyment. Flow emerges out of a set of conditions that set the basis of the experience of flow, which include three antecedents: clear goals, immediate and unambiguous feedback and balance of perceived skills and task demands. Clear goals are characterized by a clear understanding of the task at hand, whereas feedback relates to information about the progress made on the task. Task balance is the key concept of the former model of flow (Csikszentmihalyi, 1975) and describes skill fit as an optimal balance of kill and task demand when performing an action.

The revised flow-model describes the intensity of flow experiences as a result of two factors: subjective value given to the current activity in addition to the perceived fit of skill and task demands. When subjective value and fit of skill is high, the intensity of flow experiences is expected to be high (Keller & Landhäuser, 2012). The subjective value given to an activity or task is characterized by individual differences in personality, such as motivational aspects.

We will investigate the relation of the motivational factors curiosity, need for cognition and intrinsic academic motivation on flow experiences, as well as the extent to which these motivational factors are related to each other. By looking into this relationship, we hope to contribute to the research on flow and provide possible directions on how to foster and sustain flow states in students. One potential positive aspect for the population at hand, undergraduate university students, is that flow experiences while studying can become a source of enjoyment and thereby contribute to overall well-being.

Curiosity and Flow Experiences

Curiosity is a construct that has long been the focus in studies of individual differences in motivation and learning outcomes. In the context of learning experiences, curiosity can motivate the exploration for stimulation and can lead to the reduction of negative states such as uncertainty or anxiety, as gaps in knowledge are filled (Gagne, 2015). The curiosity construct includes multiple dimensions, with some being expected to be more positively related to flow than others. For the current study, the three dimensions joyous exploration (JE), deprivation sensitivity (DS) and stress tolerance (ST) will be explored used to predict flow experiences in studies. JE describes the personal enjoyment of experiencing ones surrounding and finding pleasure in its uncertainty. DS describes a persons need to gather information about the world to minimize feelings of uncertainty. A person that measures high on levels of DS might experience discomfort and anxiety when gaps in knowledge are present. ST defines the tendency to endure anxiety for example when

encountering novel situations (Kashdan et al., 2020). In a study by Schutte and Malouff (2020), the relation between curiosity and flow was assessed using a creativity task, in which participants were presented with an activity novel to them. The study hypothesized that three dimensions of curiosity (JE, DS, ST) are associated with experiences of flow in a creative task. Participants reported their experiences after completing the task on the Dimension Curiosity Measure (Kashdan et al., 2018) as well as the Flow Short Scale (Engeser & Rheinberg, 2008). Results show that all three dimensions of curiosity had significant correlations with flow. JE showed to be strongly associated to flow, while DS as well as ST showed to be moderately related to flow experiences. This study supports the assumption that curiosity is linked to the experience of flow, suggesting that higher curiosity in an individual is associated with experiences of flow states.

Need for Cognition and Flow Experiences

The need for cognition (NfC) defines individual differences on the likelihood to engage in effortful thinking. A person scoring higher on measures of NfC would be more likely to employ cognitively challenging reflections to make sense of their surrounding and to form opinions (Shackelford & Zeigler-Hill, 2020). Thus far, NfC has mostly been looked at in the light of academic performance rather than experiences of enjoyment and flow, leaving the relation of NfC and flow experiences largely understudied. For example, Stumm and Ackerman (2013) found that investment traits, like NfC, had an influence on the transition from process to knowledge. A person with higher levels of intellectual investment is more likely to seek out cognitively stimulating experiences, thus leading to more opportunities to learn and accumulate knowledge. In their paper, Stumm and Ackermann recognize substantial overlaps of constructs and scales of investment traits, like NfC and typical intellectual engagement. They propose that NfC and intellectual engagement could be thought of as dimensions of investment, due to high intercorrelations and lacking divergent validity of the

scales. Differing from the study by Stumm and Ackermann, our study is not interested in investment traits or overall intellect, nonetheless we assume NfC to be a meaningful predictor when measuring flow experiences in students. Our current sample is derived from a population of psychology students in their propaedeutic year of their research bachelor. In their studies these students are presented with complex and novel learning material. With respect to the balance of skill and task demand as a boundary condition of flow, we expect cognitively challenging tasks, as seen in university studies, to be an optimal challenge for individuals with high need for cognition and thereby foster flow experiences.

Intrinsic Academic Motivation and Flow Experiences

Intrinsic motivation describes an individual's drive to explore and learn without any obvious external rewards. The motivation derives from the actualization of personal potential and the enjoyment of a task and can foster feelings of autonomy, purpose, and mastery (Spawr, 2011). There are multiple types of intrinsic motivation, for the current research we are interested to what extent intrinsic academic motivation (IAM) can foster flow experiences in studies. IAM is the degree to which an individual is intrinsically motivated to engage in academic activities and consists of several components. We will look at the relation between flow experiences in studies and three dimensions of IAM: intrinsic motivation to know (IMK), intrinsic motivation to experience (IME), and intrinsic motivation to accomplish (IMA). IMK relates to how much pleasure is found in activities that involve learning or exploring and is closely related to concepts of curiosity and exploration. IME is the extent to which a person seeks out experiences that provoke stimulating sensations. IMA describes an individual's experience of enjoyment when working towards a desired goal (Vallerand et al., 1992). Dissimilar to the motivational constructs curiosity and NfC is, that IAM is not a personal trait. While curiosity and NfC describe individual differences that are consistent across situations, motivation describes the interaction between an individual and a specific

situation or activity. We thereby expect IAM to add meaningful explanatory value to our study. In his research on flow, Csikszentmihalyi (1975) observed that artists would work relentlessly on a project, whilst becoming fully emersed in the activity. However, once the project was finished it seemed like the interest in the finished product would rapidly decrease and the artists proceeded to get started on a new project. This example highlights how the incentives reside within the performance of the activity, rather than in an external goal. This illustration of motivation highlights how flow is associated to intrinsic motivation. In our current study, we expect IAM, more specifically IMK, IME and IMA, to be positive associated with flow experiences,. We expect that intrinsic motivation to engage in cognitive activities will foster flow in studies, as the incentive of the activity (studying) resides in the performance of the activity itself. Thereby, the activity is deemed to be intrinsically motivating.

Noteworthy is the multiplicity of definitions of motivation constructs, like for example IAM and NfC: there are inconsistencies in the literature regarding the term “intrinsic”. Sometimes intrinsic motivation is referred to as activity-related motivation (Rheinberg, 2008), other times it is characterized as the product of underlying needs (Deci & Ryan, 1980), which would suggest vast resemblances between IAM and NfC. The lack of distinct definitions and their dimensions have implications on how broader theoretical frameworks of motivation are operated and how findings in research are interpretated (Schunk, 1999).

Relations between Motivational Factors

We will examine correlations amongst measures of the motivational factors, curiosity, NfC and IAM. Definitions for constructs show varying degrees of overlap and strict terminology has not been established, especially in earlier publications. For instance, Ohlson, Camp and Fuller (1984) have found significant medium-large correlations of NfC with almost all measures of curiosity employed in the study. The study uses eight different tests for

curiosity, including measures like the Ontario Test of Intrinsic motivation (Day, 1968) and the Academic Curiosity Scale (Vidler and Rawan, 1974). The correlation between curiosity and NfC can be assumed to arise from the similarities between the two constructs, but also by the measures employed to assess curiosity. For example, the academic curiosity scale includes items such as "I like to try to solve problems that present a mental challenge", which largely overlaps with the definition for NfC, as it is describes the tendency to engage in effortful thinking. Moreover, the curiosity construct can foster academic engagement by a raised need for exploration in general. It is therefore interesting to investigate the magnitude of the relation between these two constructs.

Malone (1981) describes the dimensions of curiosity as an element of intrinsic motivation that increases engagement and exploration for cognitive stimulation, which broadly corresponds to the definition of IMK. Further, in a field study of motivation and gamification, curiosity was used as a measure for intrinsic motivation in students (Treiblmaier & Putz, 2020). Lastly, NfC can be described as an intrinsic motivation to engage in cognitive activities, as higher levels of NfC show a negative relation to intrinsic costs of cognitive effort (Sandra & Otto, 2018). We therefore also assume to find positive relations between the constructs curiosity, IAM and NfC.

Hypotheses

Our current research aims to explore the relation of motivational aspects to experiences of flow in studies. Measures of motivational aspects include three dimensions of curiosity (JE, DS, ST), the unidimensional construct of NfC and three dimensions of IAM (IMK, IME, IMA). Based on existing literature we hypothesize that:

H1: Higher levels of curiosity, more specifically JE, DS and ST, lead to more experiences of flow in studies.

H2: Higher levels of NfC lead to more experiences of flow in studies.

H3: Higher levels of IAM, more specifically IMK, IME and IMA, lead to more experiences of flow in studies.

Furthermore, we will investigate the extent of relations between the motivational aspects, curiosity, NfC and IAM. Based on construct definitions and findings of prior literature we hypothesize that:

H4: The construct curiosity, with the dimensions JE, DS, and ST, is positively correlated with the construct NfC.

H5: The construct curiosity, with the dimensions JE, DS, and ST, is positively correlated the construct of IAM, with the dimensions IMK, IMA, and IME.

H6: The construct of NfC is positively correlated to the construct of IAM, with the dimensions IMK, IMA, and IME.

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 Behavioral 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 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" based on 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's was calculated at α = 0.726.

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 program, 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

Assumptions

A residual analysis was used to verify that the conditions of heteroscedasticity and linearity were met. The residual plot (see Appendix, Figure 1) displays a random dispersion of data points, meaning that the assumptions are not violated. Checks of normality were conducted using a histogram (see Appendix, Figure 2), which shows a normal curve. While Cook's distance did not detect influential data points, Mahalanobis distance found seven observations to be multivariate outliers, which were removed from the sample. Lastly, to check assumptions for all Pearson's bivariate correlations among the predictors, multicollinearity was assessed. No value over r = .80 was found, meaning that the effects of the independent variables on the outcome variable can be separated.

Descriptive Statistics

Mean averages and standard deviations of the dependent variables, curiosity, NfC and IAM, as well as the independent variable flow, were calculated. They reflect the average responds of all participants ($N = 370$) on the different dimensions of interest (JE, DS, IMA, IMK, IME, NfC and ST). All independent variables as well as the outcome variable showed mean average scores of one or more standard deviations above the mid-score of the respective Likert-scale. All mean values as well as standard deviations can be seen in Table 1. Largest deviation was found for the predictor IMK ($M = 5.38$), with a mean of more than two standard deviations above the average of 2.50 of the five-point Likert scale for IAM. The highest amount of variation in the sample can be found in the predictors DS ($SD = 1.25$), ST ($SD = 1.26$), and IME ($SD = 1.23$).

Table 1

Mean Average, Standard Deviation, and Number of Observations for all Variables

	Mean	Std. Deviation	N
Flow	3,4348	,51017	370
JE	5,1081	,88259	370
DS	4,3535	1,24513	370
IMK	5,3764	,77439	370
IMA	4,7574	1,01635	370
IME	4,1128	1,23340	370
NfC	3,5757	,62299	370
ST	4,3605	1,25608	370

Main Analysis

The first research question of this study is concerned with positive associations of motivational factors, curiosity, NfC, and IAM, on flow in studies. To test the hypotheses, a standard multiple regression was run. Fur the current study, acceptance level with a cut-off value of $p < .005$ is used to determine the significance of results. The independent variables significantly predicted flow in studies, ($F(7, 362) = 22, 631$ $p < .001$), using JE, DS, ST, IMK, IMA, IME, and NfC to make predictions about the depended variable flow. Together the predictors explained 29.1 % of the variability of the dependent variable, flow experience ($SE = .43$, $R^2 = .304$, $R^2adjusted = .291$).

Results of the regression analysis show that ST significantly predicted flow experiences. While holding all other variables constant, the estimate of the standardized coefficient predicting 0.281 increase in flow per unit increase in ST ($b = .114$, ß = .281). The predictor was found to be significant, with the t-test statistic $t(368) = 5.695$ ($p < .001$). The

estimated coefficient of NfC accounted for 0.171 increase in the dependent variable flow (b = 0.140, ß = 0.171). Based on the acceptance level used in our study, NfC meets significance by the test statistic t(368) = 2.934 (p = .004). Furthermore, IMK showed to be a significant predictor of flow in studies, with an estimated increase of 0.259 units of flow (b = .171, ß = 0.259). The test statistic meets significance with t(368) = 3.387 ($p < .001$), as does IMA with t(368) = 4.542 ($p < .001$). The standardized coefficient of IMA estimated 0.271 units of increase in flow (b = .136, ß = 0.271) while holding the other predictors constant.

The other predictors used in the model, JE, DS, and IME, did not met statistical significance, therefore meaningful conclusions about the effects of the predictors cannot be drawn. Regression coefficients, as well as confidence intervals and (semi-) partial correlations for all predictors can be seen in Table 2.

Table 2

Regression Results using Flow as the Criterion

		Unstd. Coefficients		Std. Coefficients			95% CI for B		Correlations	
Model		B	SE	Beta	t	Sig.	LB	UB	Partial	Part
1	(Constant)	1.349	,180	-	7.476	<,001	,994	11,704	-	-
	JE	-,042	.037	,072	-1,116	,265	-,115	,032	-,059	-,049
	DS	-,017	,024	,043	-,720	,472	-,065	,030	-,038	-,032
	IMK	,171	,050	,259	3,387	<,001	,072	,270	,175	,148
	IMA	,136	,030	,271	4,542	<,001	,077	,195	,232	,199
	IME	-,047	,024	,113	-1,960	0,51	-,094	,000	-,102	-,086
	NfC	,140	,048	,171	2,934	,004	,046	,234	,152	,129
	ST	,114	,020	,281	5,695	<,001	0,75	,154	,287	,250

[a] Dependent Variable: flow

In our analysis, the unique contributions of the predicting variables on flow in studies were calculated by means of semi-partial correlations. When removing the effects of the other independent variables, ST showed the largest positive effect of the predictors with 6.3 % ($sr^2 = .063$) of unique explained variance. Other measures of curiosity, JE, and DS explained only for very minor changes in the dependent variable when the effects of the other variables were removed, with JE explaining for only 0.02 % and DS for 0.01 % of total explained variance ($sr^2 = .002$, $sr^2 = .001$ respectively). Besides ST, IMK and IMA had some unique contributions with IMK explaining for 2.2 % and IMA for 3.4 % of changes in measures of flow experiences.

In the second part of our study, we examined correlations between the motivational factors, curiosity, NfC and IMA. We assumed to find positive correlations among the three constructs. Pearson correlations among predictors, JE, DS, ST, IMA, IME, IMK, and NfC were calculated to assess the strength of the linear relationships between the predictors. All correlations between the predictors, as well as the dependent variable can be seen in Table 3. A significance level of $\alpha = .05$ for the one-tailed test was used to determine whether a correlation is statistically significant. Most of the correlations among variables were significant with $p < .001$. Only for the predictor ST non-significant correlations were found, for example between ST and two of the dimensions of IAM. The predictors IMK, and IMA showed non-significant correlations with ST ($p = .035$, $p = .388$ in order). Curiosity was found to be correlated with both NfC and the dimensions of IAM. Correlations between curiosity and NfC were positive, both weak to strong, and ranged from $r = .28$ for ST, to $r = .618$ for JE. NfC and the dimensions of IAM were also positively correlated with weak to moderate correlations ranging from $r = .316$ for IMA, to $r = .478$ for IMK.

Table 3

Pearson Correlations between Flow, Curiosity, NfC, and IAM

Model			ST	IMA	DS	NfC	IME	JE	IMK	Flow
1	Pearson	ST	-							
	Correlations	IMA	.015***	-						
		DS	-.135**	.349*	-					
		NfC	.280*	.316*	.378*	-				
		IME	.128**	.551*	.259*	.389*	-			
		JE	.320*	.420*	.372*	.618*	.467*	-		
		IMK	.094***	.634*	.612*	.478*	.570*	.599*	-	
		Flow	.326*	.387*	.182*	.355*	.242*	.325*	.406*	-

Note. * $p < .001$, ** $p < .01$, *** $p > .03$

Discussion

The aim of the current study is to contribute to the research on the flow concept in the context of flow in studies. We hypothesized cognitive motivation aspects to be associated with more frequent experiences of flow in studies. Overall, our model accounted for 29.1 % of variability of the dependent variable, flow in studies, while not all independent variables included in the regression predicted increase in flow in studies as hypothesized.

Whereas past literature has found associations of motivational aspects to flow experiences, our hypothesized effects were only partly reflected in the results. The standardized coefficients of the independent variables show that only three of the seven predictors had significant contributions to the model. The flow concept was examined across different situations in prior research on cognitive motivation, but not a lot of studies have explored the relation of cognitive aspects and flow in studies. For instance, in a study of flow experiences in a creativity task, medium to strong positive effects for all three dimensions of curiosity on flow was found (Schutte & Malouf, 2020). In the current study, ST had the largest contribution of all the predictors used in the model, while the other dimensions of curiosity were non-significant. A possible explanation for this could be that especially in first-year students, tolerance to stress is an important factor contributing to the ability to get into deep concentration states. As it is their first time going through university-based examination, first-year students are not as experienced in studying and might experience more stress or anxiety. Following this, lower tolerance to stress would constitute for anxiety, since anxiety is an explicit reaction to stress. Higher levels of experienced stress would imply more anxiety, which could be counter active towards flow experiences. To give an example, in a study of flow and anxiety, university students filled out self-report measures on flow experiences and states of anxiety (Mao et al., 2020). Results of the study show that experiences of flow are negatively associated with anxiety and give reason for the assumption of a negative effect of

lower stress tolerance by proxy. Apart from the support for the dimension ST, the hypothesized effect of curiosity on flow on studies was not found. Considering the lack of evidence for JE and DS on flow, our first hypothesis is only partly supported.

NfC showed minor positive effects on changes of flow in studies. This finding supports our hypothesis of a positive relation among cognitive motivation and flow in studies. We hypothesized that the unitary construct of NfC will have a positive association towards flow states in studies by virtue of elevated interest to engage in effortful thinking, which should foster effortless concentration states and its enjoyment. This effect of heightened engagement in learning processes was observed in a meta-analysis of investment traits by Stumm and Ackermann (2013). In contrasts to the current study, investment traits were measured as opposed to motivational factors. Further, it was not the aim to relate NfC to flow, but to examine individual differences on learning processes.

The last construct of motivational aspects included in our study is IAM. Again, we hypothesized a positive association between IAM and flow in studies. The dimensions IMK, IMA, and IME were assumed to predict experiences of flow in studies. The regression model gives support for this assumption by positive regression coefficients for both IMK and IMA. Both predictors present significant contributions in positively predicting states of flow in studies. This reflects findings of earlier research, especially in studies that conceptualize flow utilizing the flow model (Csikszentmihalyi, 1975), which is based on skill and task balance. IAM is not a character trait, like curiosity or NfC, and is more dependent on the specific circumstances of a situation. For future studies, it would be insightful to examen the influence of situational differences. By studying these differences of academic related situations and their associations to flow, we can increase the understanding on how to foster flow in students. Lastly, IME did not significantly predict flow in studies, meaning the hypothesis of IAM as a predictor for flow in studies is not fully met. Taken together, the finding of our

study gives some support for the assumption of a positive association of IAM on flow in studies.

Relations between Motivational Factors

The relations among the motivational aspects, curiosity, NfC, and IAM were observed to gain better understanding of the relations of constructs. From prior literature it appears that there are similarities between the constructs of curiosity and NfC. Ohlson, Camp and Fuller (1984) found medium large relations between curiosity and NfC, which is also reflected in our current study. We hypothesized that the dimensions of curiosity, JE, DS, and ST have positive relations with NfC. Overall, Pearson correlations among the predictors were small, moderate, to large and mostly significant with exception for ST with IMK and IME.

The three dimensions of curiosity that were included in the analysis showed small to medium large Pearson correlations with NfC, with highest correlation with JE and NfC. A possible explanation would be that curiosity is an antecedent of NfC, as raised need for exploration might also embrace engagement in cognitive challenges. Further, we hypothesized that the construct of curiosity is positively correlated with IAM. In an early paper about motivation, Malone (1981) describes the dimensions of curiosity as a part of intrinsic motivation. In our study, JE, and DS both showed medium large correlations with the three measures of IAM. Again, curiosity could foster engagement and thereby lead to higher motivation. The interchangeable use of constructs is apparent in later research, for example in another study of motivation, students were measured on curiosity to make predictions of internal motivation (Treiblmeier & Putz, 2020). It seems that some of the previous literature uses curiosity and internal motivation interchangeably, whereas our present paper makes distinctions, not only between constructs, but the model also the different dimensions of internal motivation.

Lastly, we hypothesized that NfC would have a positive relation to IAM. It could be, that NfC reflects IMK, as it describes a higher need to engage in cognitive activities. A study by Sandra and Otto (2018) shows that higher levels of NfC had a negative relation to intrinsic cost of cognitive effort. This could lead to the assumption that if internal cost is lower, internal motivation is higher. Because if an individual has higher levels of intrinsic motivation, they find cognitive engagement as internally rewarding, which could mean they perceive the engagement as less internal cost.

From these results it is apparent that the motivational aspects curiosity, NfC, and IAM are correlated. This could also explain the rather low explained variance in the model, as the variables used to predict flow in studies show small to large interrelations.

Conclusion

In general, our assumption of motivational aspects as predictors of flow in studies was supported. In the current study, ST was best at predicting students flow experiences in their studies. This result can be implemented to facilitate student well-being, for example by heightening tolerance to stress by teaching coping strategies concerning stress and anxiety. Students could benefit from stress-resilience training in their studies, as enjoyable flow states are possibly easier achieved.

Furthermore, our study measured correlations among the dimensions of curiosity, NfC and IAM, to investigate similarities between constructs. The current study gives insight on interrelations between some motivational constructs. Controversies in the research of human cognition and behavior, like motivation, often arise from ambiguous definitions of concepts. We thereby hope to give insight on similarities between constructs.

Limitations and Future Research

The first limitation in our present research was the sampling. From the planned population, only first-year students answered the survey in a sufficient number leading to the

exclusion of second- and third-year students. This might have implications to the results, for example by lower stress tolerance of students in an early stage of their academic career. Another limitation to the study is that there is an unbalance between male or participants of other genders and female participants, as more females filled out the survey. In a study of socio-demographic correlations of depression, higher levels of stress and anxiety were found in female university students compared to male students (Bayram & Bilgel, 2008). With more females present in our sample and a possible negative effect of anxiety on flow in studies, the results might not reflect ones for the general student population. Our study found ST best at predicting flow in studies, Therefore, it would be interesting to include measures of anxiety in future research, to see if anxiety as a proxy for ST can hinder students from entering flow states in their studies. As earlier research found anxiety levels to be higher in female students, mediation analysis of gender could examine if this effect is also apparent in the current sample.

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Appendix

Figure 1

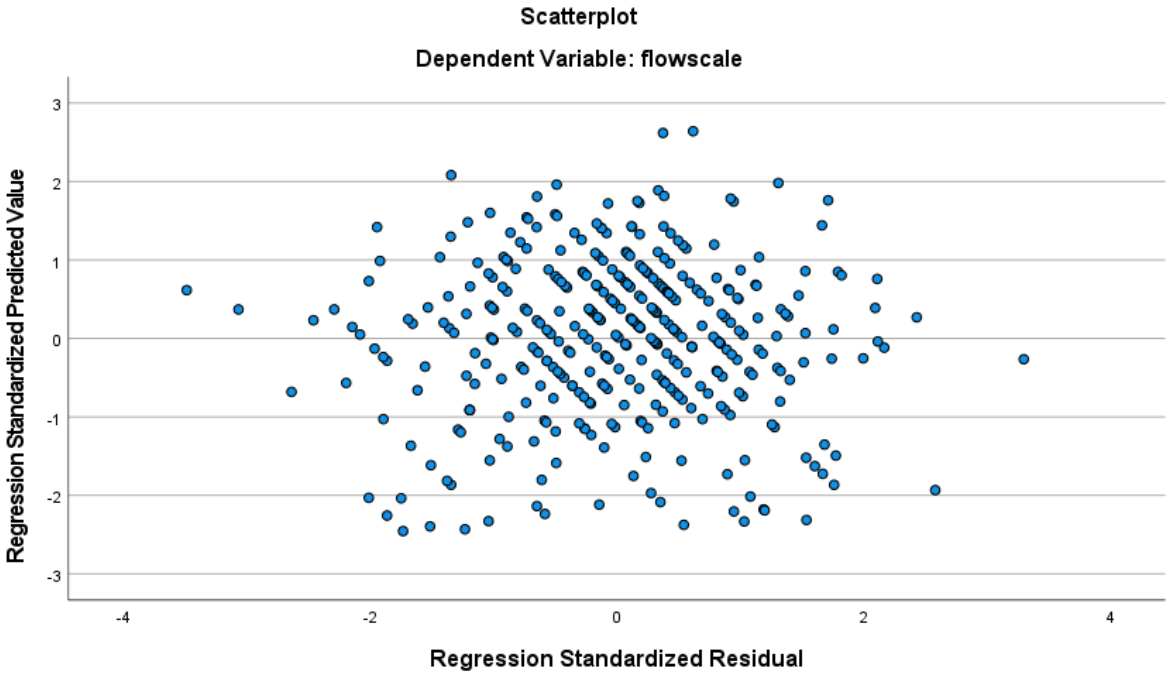

Figure 2