The relationship between Curiosity, Academic Intrinsic Motivation and Need for Cognition predict the flow experience in university students

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Abstract

This study aimed to investigate the relationships between frequency of flow experience in studies and the cognitive motivational factors of Need for Cognition (NFC), Curiosity and Academic Motivation (AM). Furthermore, it aimed to analyse the relation between these motivational factors themselves. The final sample analysed consisted of 370 first-year students of the Psychology Bachelor in the University of Groningen. Statistical analyses included standard multiple regression analysis, factorial ANOVA as well as correlational analyses. Results suggested a complex relation between these motivational factors and flow, with NFC and some dimensions of Curiosity and AM being positively correlated with flow, while other dimensions of these predictors showing no significant correlation with flow. Furthermore, analysis of correlations between motivational predictors themselves also produced mixed results, wish some negative correlations contradicting our initial results.

The relationship between Curiosity, Academic Intrinsic Motivation and Need for Cognition predict the flow experience in university students

The state of flow is a subjective experience expressed through a deep sense of focus as one engages in a given task and defined according to nine dimensions (Barthelmäs & Keller, 2021; Csikszentmihalyi, 2014; Harmat et al., 2016; Norsworthy, Jackson and Dimmock, 2021): 1) A balance between the skills of an individual and the challenge of the task at hand (Bless and Keller, 2018); 2) the merging of action and awareness, also translated to a mindful presence in the moment (Harmat et al., 2016); 3) understanding of clear goals of the given task (as well as a clear path to reach these goals); 4) clear feedback of the individual's performance; 5) a deep sense of focus on and absorption in the task (Marty-Dugas & Smilek, 2018); 6) a sense of control over the task or its outcomes, as individuals immerse themselves in said task (Czikszentmihalyi, 2014); 7) loss of self-consciousness, 8) distorted time perception (i.e. time seems to go faster or individuals forget about time), 9) a feeling of intrinsic reward from enjoyment of the activity itself (Rheinberg, 2020; Norsworthy et al., 2021).

The research for this thesis was conducted under the scope of a broader project focusing on the relationship between motivational aspects and flow experience, as well as the role of flow in educational performance in university students. Flow has been found to account for excellent performance in areas like sports (Swan et al., 2017), suggesting it could account for variance in academic performance but this specific link is not investigated in detail in our project. This relationship however illustrates the relevance of knowledge about flow for real-life application, when considering the potential consequences of this psychological state. Barthelmäs and Keller (2021) describe various potential consequences of flow on different areas, including performance, affective, cognitive and even physiological.

A concept revisited by Beswick (2017), was Bandura's claim (1981) that cognitive processes are core drives of motivation. He categorized these motivators into three different forms, relating each to a different theory of cognition: causal attributions to attribution theory, outcome expectancies to expectancy-value theory and cognized goals to goal theory. In his research, Beswick (2017) re-emphasised the role of cognitive processes, such as curiosity, intrinsic motivation, need for cognition and need for closure on a macro level. Indeed, revising the literature on this topic revealed a lot of theoretical overlap between not only the dimensions of flow previously discussed and different motivational aspects, but also among the motivational factors themselves, suggesting that a cognitive motivation approach to flow could be beneficial. However, there remains a gap in knowledge in research on the role of cognitive motivational factors in flow, which drove this thesis focus to two main research questions: 1) Do the cognitive motivational traits of NFC, Curiosity and AM play a significant role in the experience of flow? And 2) Are there significant relations between these motivational traits themselves?

Curiosity

According to Pekrun (2019), curiosity can be defined as a state where one is intrinsically driven to solve a knowledge gap, accompanied by a belief that this is possible to achieve. Other authors also pointed out the information gap as a root of curiosity (Singh & Manjaly, 2021; Lieshout et al., 2021), as well as a component of uncertainty (Swan et al., 2017). When analysing research on this topic we find overlap between curiosity and other constructs like interest. For example, Donnellan et al. (2021) distinguish between different forms of manifestation of curiosity and interest: trait-like forms and experiential states. They claim that in both these forms, the constructs share some characteristics, such as both being motivators of behaviour, particularly related to acquiring new information. However, at an experiential level it becomes clearer that these are distinct concepts. While curiosity is largely driven by the need to close an information gap by searching new knowledge, interest involves the drive to obtain information related to already existing knowledge, with a stronger pleasure component. According to these authors, curiosity is best considered a special case of interest. Based on this knowledge, it was considered more relevant to our research to examine curiosity, but not interest, as a predictor of flow.

In addition, the more comprehensive trait-like characterization of curiosity by Kashdan et al. (2018) was an essential basis of inference for this thesis. These authors consider curiosity as a human motive composed of five subdimensions: Joyous Exploration (JoyExp), Deprivation Sensitivity (DS), Stress Tolerance (ST), Social Curiosity and Thrill Seeking which will be used in discussing the potential role of each of these in the experience of flow. Firstly, JoyExp is associated with openness to experience and experiencing more pleasure when engaging in said experiences or acquiring new knowledge. It could therefore be logically inferred that higher scores in this subscale could be associated with greater frequency of flow experience, due to the intrinsically rewarding feeling of said experience. Secondly, DS relates to one's tendency to engage in complex mental tasks and actively reduce knowledge gaps. This could be associated with flow, especially in academic settings, considering the task at hand would be studying or learning. With a higher tendency to engage in complex thought and solve problems, one would also theoretically have higher chances of reaching the deep state of concentration involved in flow. Thirdly, ST consists of one's ability to cope with negative feelings of distress which may accompany novel, uncertain, unexpected situations. Higher ST could therefore assist flow when considering the potential distress and uncertainty involved in completing a task, especially an unfamiliar one. Moreover, Social Curiosity represents one's desire to learn and know more about what other people are doing or thinking. Lastly, Thrill Seeking focuses on one's tendency to seek for intense and varied experiences, even when it may involve risk-taking, being associated with impulsive behaviours. These last two subdimensions did not seem to show any overlap with the dimensions defining of flow.

Academic Intrinsic motivation

According to Decy and Ryan (2000), intrinsic motivation relates to a drive associated with the inherently rewarding nature of an activity or a behaviour of any sort. In other words, to engage in a task out of intrinsic motivation means to do so for the rewarding feeling of enjoyment associated with the engagement in the task, rather than external perceived consequences. According to Murayama (2019), the reward-learning process underlying both interest-driven behaviour and behaviour driven by extrinsic reward is the same. However, it seems that the experience of flow is not so much reliant on external reward, as it is associated with a feeling of intrinsic reward (Bless and Keller, 2018; Deci et al., 1991; Huskey et al., 2018). However, considering this research is dealing with university students, it seems more valid to explore the role of academic intrinsic motivation in flow experience. Based on Vallerand et al. (1992), the constructs composing academic intrinsic motivation are: 1) Intrinsic Motivation to Know (IMKnow), consisting of the intrinsic motivation to engage in tasks involving learning or exploring novel information; 2) Intrinsic Motivation toward Accomplishment (IMAcc), the intrinsic motivation to engage in an activity for the rewarding feeling which accompanies accomplishment; 3) Intrinsic Motivation to Experience Stimulation (IMExp), the intrinsic motivation to engage in tasks for the stimulating sensations involved in the task. It seems logical that scoring higher in these three subdimensions of academic motivation would be associated with more frequent flow experiences, considering they can explain behaviour associated with intrinsically rewarding feelings, such as flow. These authors also describe different forms of extrinsic motivation which we do not consider in our study, considering these are associated with external reinforcement/punishment, not relevant to flow experience (Decy & Ryan, 2000).

The three constructs of academic intrinsic motivation could also be related to curiosity's element of a drive to solve a knowledge gap mentioned earlier. People with stronger tendencies to seek for knowledge, accomplishment and stimulation could be experiencing a stronger drive to acquire new knowledge and engage in complex mental tasks, both processes involved in academic work.

NFC

According to Furnham and Thorne (2013), NFC can be seen as form of intrinsic motivation to engage in cognitive processing and has been found to be associated with processes like memory, learning and problem-solving, among others. NFC can be further defined as one's trait-like tendency to engage in complex, effortful cognitive tasks, accompanied by enjoyment of engaging in such tasks (Gorges & Schmidt, 2022; Cacioppo et al., 1996). Considering that flow can be largely characterized by its component of deep focus on a task (Marty-Dugas & Smilek, 2019), higher motivation to engage in cognitive processing could be mean one engages in deep concentration more frequently and/or effortlessly. This therefore means that NFC could contribute to the experience of flow, by influencing processes essential to flow, such as those dimensions of attention and concentration.

Focus of this project

Based on this literature, different predictions were made about the role of each cognitive motivator, along with their subdimensions and flow, as well as about how the motivators relate to each other. Regarding the first research question three main hypothesis are proposed: 1) NFC will be positively correlated with frequency of flow; 2) Each subdimension of Curiosity will be positively correlated with frequency of flow; 3) Each subdimension of AM will be positively correlated with the frequency of flow experience. Additionally regarding the second research question three hypotheses are proposed: 1) NFC will be positively correlated with each subdimension of Curiosity; 2) NFC will be positively correlated with each subdimension of AM; 3) Each subdimension of Curiosity will be positively correlated with each subdimension of AM.

Methods

Participants

The population of interest in this study are first-, second- and third- year psychology students at the University of Groningen. Thus, our sample was gathered from the mentioned population. The second- and third year student participants of this study were recruited via flyers placed around the faculty of Behavioural and Social Sciences buildings or a WhatsApp link shared in psychology group chats. First year students could only join via SONA, a research platform the University of Groningen uses where first year psychology students earn credits by participating in research studies. The first-year psychology students were rewarded with SONA points, the second- and third-year students were rewarded with a financial compensation of 1.5 Euro. We will not include the data of the second- and third-year student participants of this study in the data analysis, in order not to introduce a systematic source of variability due to the insufficient data collected.

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

Materials

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

To measure flow experiences, the study utilizes the short version of the Dispositional Flow Scale (DFS-2; Jackson, Martin & Eklund, 2008). The DSF-2 includes nine items on which participants indicate the frequency of experienced flow states. Modifications to the instructions were implemented in order to align the scale to the aim of the current study. Instructions were changed from asking about specific experiences of flow from a recently executed activity to general flow experiences in studies. Participants were requested to rate "thoughts and feelings [they] may experience during [their] studies" on the basis of frequency of these experiences. The scale included questions such as "When I am studying… I am competent enough to meet the demands of the situation", which participants then ranked on a five-point Likert scale ranging from 1 (never) to 5 (always / everyday). As to obtain a single value for the unidimensional flow construct, the mean average of the participants' scores on the nine items was calculated and used as the dependent variable.

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.

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 indicated 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.

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.

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 relationship between cognitive motivational aspects and experienced flow frequency in the student population of the Psychology programme. 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.

Results

In order to understand whether it was possible to run a multiple regression analysis on the collected data, basic assumption checks were carried out. As made clear by Figures 1 and 2 (see Appendix C), distribution of the residuals suggests that the data follows the assumptions for linearity, homoscedasticity and normality, suggesting that an unbiased regression model could be produced. Additionally, multicollinearity between predictors was ruled out considering that Variance Inflation Factors (VIF) were all under five, meaning these predictor variables were not contributing largely to the standard error in regression.

As shown in Table 1, standard multiple regression analysis revealed which predictors were the most effective at explaining variance in flow: JoyExp, DS, ST, IMKno, IMAcc, IMExp and NFC. With R^2 = .304 but R^2 *adj* = .291, these predictors explained around 29% of variance in frequency of flow experience, after taking into account the variability by chance introduced by each variable, which is a low to moderate amount of variance explained. With an F-statistic of F(7,362) = 22,631 the model was found to be significant at $p < .001$. The standard error of regression was SE = 0.430, which seems to be a low value, with standard deviations for each variable with the commonly accepted range.

Concerning the first research question, there is evidence (see Table 1) suggesting we can reject some of the null hypotheses but not all. Firstly, a *t*-test suggested ST to be a significant predictor of variance in flow at $p < .001$ from the five curiosity subdimensions, which was not fully in line with our hypotheses. This result is further reinforced by the semi-partial correlation values between each dimension and flow, supporting the idea that ST was not only a significant predictor but the strongest predictor of flow from all the variables included in the model. Regarding academic intrinsic motivation, *t*-tests revealed that the weak/moderate positive predictive power of IMKno and IMAcc was significant at $p < .001$, a result also supported by weak/moderate positive semi-partial correlations between these predictors and flow. This suggests that scoring higher in IMKno and IMAcc could relate to higher frequencies of flow but not for all of these subdimensions, considering IMExp was not found to be a significant predictor. In addition, significant at $p < .005$ was the low standardised coefficient estimate for NFC. This means we cannot fully reject the null hypothesis regarding NFC and flow, but evidence to support a positive correlation between these constructs is not strong. These results suggest more complex relations between the cognitive motivational factors and flow than initially predicted, which will be further explored in the discussion section of this paper.

Table 1

Regression Coefficients

		Unstd. Coefficients		Std. Coefficients			95% CI for B		Correlations		
Model		B	SE	Beta	t	Sig.	LB	UB	Zero-order	Partial	Part
1	(Constant)	1.349	,180	-	7.476	<,001	,994	11,704	-	-	-
	JoyExp	-,042	.037	,072	-1,116	,265	-,115	,032	,325	-,059	-,049
	DS	-,017	,024	,043	-,720	,472	-,065	,030	,182	-,038	-,032
	IMKno	,171	,050	,259	3,387	<,001	,072	,270	,406	,175	,148
	IMAcc	,136	,030	,271	4,542	<,001	,077	,195	,387	,232	,199
	IMExp	-,047	,024	,113	-1,960	,510	-,094	,000	,242	-,102	-,086
	NFC	,140	,048	,171	2,934	,004	,046	,234	,355	,152	,129
	ST	,114	,020	,281	5,695	<,001	0,75	,154	,326	,287	,250

[a] Dependent Variable: flowscale

Regarding the second research question, it is not possible to fully reject the null hypotheses, based on the Pearson correlations matrix in Table 2. Firstly, for the relationship of NFC additional moderate negative correlation was found between NFC and JoyExp, completely contrary to what was initially expected. Secondly, expected findings show that NFC very weakly positively correlated with IMAcc,. Nonetheless, NFC unexpectedly showed weak negative correlations with both IMExp and IMKno. Thirdly, regarding the relation between AM and Curiosity, moderate negative correlations were found for IMKno and DS, along with JoyExp. Further weak negative correlations were found between IMKno and ST, IMExp and ST, IMExp and JoyExp and JoyExp and IMAcc. The only expected relationships found regarding this last hypotheses were the ones of IMAcc with ST and DS, as well as

IMExp and DS. There were weak positive correlations. Once again these mixed results must be further explored in the discussion.

Table 2

Pearson Correlation Matrix

Model		1	2	3	4	5	6	7
1	ST	1.000	,103	,289	-,177	-,004	-,239	-,061
2	IMAcc	,103	1.000	,047	,018	-,287	-,050	-,381
3	DS	,289	,047	1.000	-,190	,136	-,036	-,484
4	NFC	-,177	,018	-,190	1,000	-,107	-,393	-,029
5	IMExp	-,004	-,287	,136	-,107	1,000	-,107	-,259
6	JoyExp	-,239	-,050	-,036	-,393	-,107	1,000	-,259
7	IMKno	-,061	-,381	-,484	-,029	-,259	-,259	1,000

Discussion

To interpret these results, let us first revisit the hypotheses here proposed: 1) NFC will be positively correlated with frequency of flow; 2) Each subdimension of Curiosity will be positively correlated with frequency of flow; 3) Each subdimension of AM will be positively correlated with the frequency of flow experience. Additionally regarding the second research question three hypotheses are proposed: 1) NFC will be positively correlated with each subdimension of Curiosity; 2) NFC will be positively correlated with each subdimension of AM; 3) Each subdimension of Curiosity will be positively correlated with each subdimension of AM.

Regarding the first research question, in order for the results to support the hypotheses initially postulated, we would expect to observe significant moderate standardised regression coefficients of each predictor and frequency of flow, accompanied by significant positive partial and semi-partial correlations between not only each predictor and flow These statistical values described in the results section suggest that there is some evidence in favour of our initial hypotheses, but not all predictors are significant predictors of flow, nor do they all correlate positively and significantly to each other.

Regarding the first main hypothesis, NFC's low predictive power of flow does not provide strong evidence for the correlation between these constructs. It only explains a low amount of variance in flow at a higher significance level of $p = .005$, which is still generally accepted in the community of behavioural sciences, it is just not as low as significance values for other significant predictors. Furthermore, the semi-partial correlation was positive but relatively low. However, evidence is also not clear enough to completely reject the notion that NFC and flow are correlated constructs. There was a knowledge gap regarding this relationship and so uncertainty about how these constructs function together remains.

Secondly, flow only seemed to be related to ST from the three curiosity subdimensions considered in this thesis. The fact that DS and JoyExp did not appear to be significantly related to flow could indeed mean that ST is the only variable significantly predictive of flow. However, this could also be the result of treating flow as a unidimensional construct. Averaging the scores of the nine dimensions of flow like it was done in this research could be a reductionist approach which assumes that each dimension of flow contributes equally to the experience. There is evidence suggesting that this may not be the case. Marty-Dugas and Smilek (2019) suggest that focus could be the most defining characteristic of flow, more relevant than any of the other eight often proposed. More complex and specific models of flow are also emerging, such as Beswick's (2017) proposition of categorizing dimensions of flow into antecedents, boundary conditions and consequences. propose more complex theories separating antecedents In summary, there may be other relevant dimensions of flow not here explored which could relate to these dimensions of curiosity in a way that could help us better understand the cognitive motivational factors involved in flow, and would increase predictive power of our model. Further research on this specific topic is advised.

Thirdly, relating to Intrinsic Academic Motivation, IMExp was not a significant predictor of frequency of flow, suggesting that IMKno and IMAcc are the only two relevant predictors in explaining variance in frequency of flow so far. This could be explained by the fact that, when dealing with flow in studies, motivation to acquire knowledge and to accomplish goals are more closely related to the challenges of academic studies than the motivation to experience stimulation.

Regarding the second research question, for support in favour of the hypotheses here postulated one would expect significant moderate to high correlations. There were some actual significant negative correlations between predictors completely contrary to initially predicted, such as that one of NFC and JoyExp or IMAcc and IMExp. A negative moderate correlation was also found for JoyExp and ST, unexpected especially due to the theorized value of ST for exploring new situations. There is not an explanation for this link formulated yet. The only significant positive correlations potentially of interest would be those between IMAcc with ST and DS, as well as IMExp and DS, and these were weak. These could suggest that Curiosity and Academic Intrinsic Motivation share some underlying mechanisms but this relationship is still not clear enough.

In spite of the results presented in this thesis, it is important to note that there are limitations to the generalisability of these findings to other populations. The sample here investigated was composed of only students of the Psychology Bachelor in Groningen, meaning results may not be fully applicable to other age groups or study programmes. Furthermore, with over 70% of the sample having their nationality in Western European countries (mostly Dutch and German), these findings may not be valid for other nationalities.

Other limitations relate to the nature of this research project's design. Although the multiple regression analysis conducted provides additional information about the role of motivational factors in flow, it remains a sort of more complex form of correlational analysis. As with correlational research there are issues in establishing causal directions, we still do not have all the information about how these cognitive processes affect each other.

This study also showed strengths such as a decently-sized sample. Furthermore, treating curiosity as a five-dimensional construct allowed to obtain deeper insights into the fact that not all facets of this motivation to acquire new knowledge seem to contribute equally to flow. The results of ST's predictive value in frequency of flow indicate that this is a dimension of Curiosity which could be useful when attempting to stimulate flow experience. Perhaps developing this trait could promote flow experience and the positive consequences that accompany this state of mind.

A better understanding of the more specific cognitive mechanisms underlying the experience of flow can help provide a better insight of what factors can be impacted in an academic setting to promote the experience of flow. Implementing such strategies and increasing frequency of flow among students of all ages could potentially translate into enhanced well-being of the students as well as improved academic performance.

Conclusion

To summarize the results of this research and their interpretation, results are not fully in line with our original hypotheses. Firstly, regarding academic intrinsic motivation, only IMKno and IMAcc significantly explain variance in flow. Secondly, regarding curiosity, only ST significantly explained variance in flow and it explained the most variance from all predictors. Thirdly, the role of NFC to flow remains unclear. Additionally, significant positive correlations were only found among some aspects of curiosity and academic intrinsic motivation. Some subdimensions appeared to be significant correlated, ranging from very low positive correlations to moderate negative ones. This means that results partly provide evidence for our initial hypotheses, but these relationships seem to be more complex than initially estimated. Specifically for results relating to the second research question, some evidence seems to even contradict our hypotheses. This means that further research on the role of cognitive motivators and motivating traits is warranted, as findings could impact our current broadly accepted views and core definitions of some of these constructs. Hopefully, the positive consequences of flow will also keep being explored at a cognitive, affective and physiological level, in addition to performance, in order to further understand additional benefits of implementing strategies to stimulate flow in the classroom, or for individual self-enhancement.

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Appendix A

Table 1a

Table of results for Cronbach's alpha

Frequentist Scale Reliability Statistics

Estimate	Crohnbach's
Point estimate	,812

Table 2a

Reliability Statistics

Scale	Cronbach's Alpha	N of Items
Need for Cognition	,726	6
Joyous Exploration	,769	5
Deprivation Sensitivity	,832	5
SocCur	,794	5
Thrill Seeking	,826	5
Intention to Know	,825	4
Intention to Acc	,779	4
Intention to Explore	,820	4
Stress Tolerance	,810	5

a. Listwise deletion based on all variables in the procedure

b. None of the cases were excluded, N = 370 (100 %)

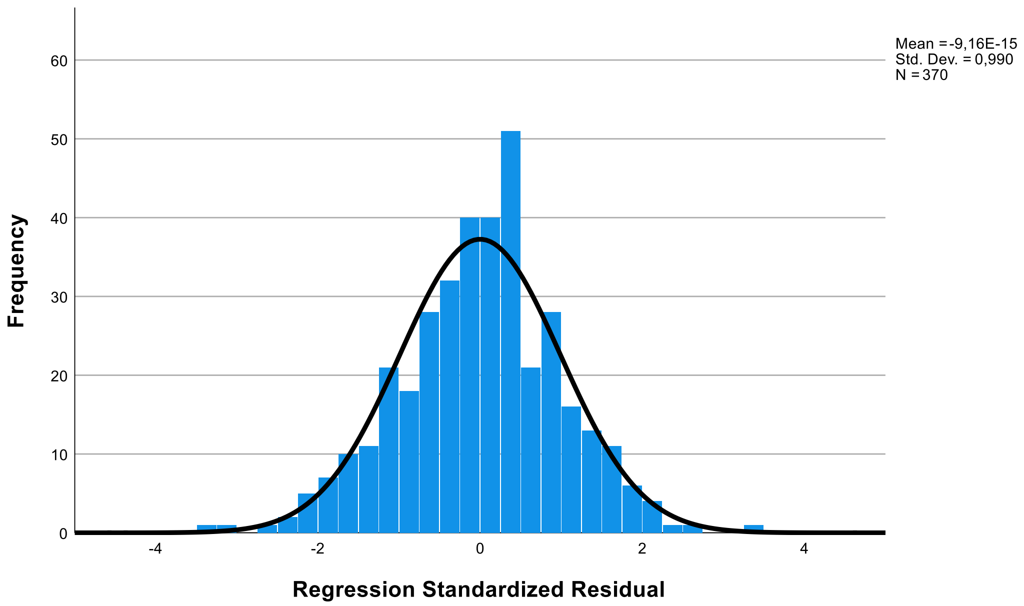
Table 3a

Descriptive Statistics

	Mean	Std. Deviation	N
flowscale	3,435	0,510	370
JoyExpo	5,108	0,883	370
DeprSens	4,354	1,245	370
INTtoKnow	5,376	0,774	370
INTtoAcc	4,757	1,016	370
INTtoExp	4,113	1,233	370
NFCnew	3,576	0,623	370
StressTolerance	4,361	1,256	370

Figure 1

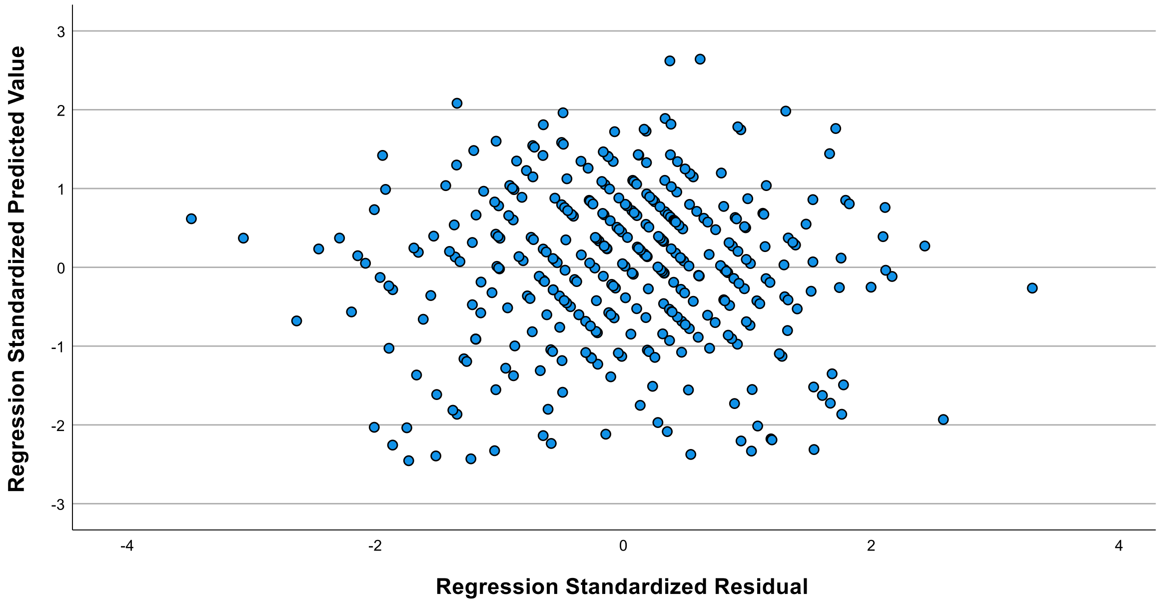
Normality histogram of standardised residuals



a. Dependent variable: flowscale

Figure 2

Scatterplot of standardised residuals and predicted values



a. Dependent variable: flowscal

Appendix B

Table 1

ANOVA

Model		Sum of Squares	dF	Mean Square	F	Sig.
1	Regression	29,235	7	4,176	22,631	<,001
	Residual	66,805	362	,185	-	-
	Total	96,040	369	-	-	-