The Influence of Extrinsic and Intrinsic Motivation on Academic Success With Flow as a Mediator

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PSB3E-BT15: Bachelor Thesis

2324_1b_05 EN

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March 28, 2024

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Abstract

Our research involved 742 psychology students at the University of Groningen who filled in a questionnaire. This questionnaire included the AMS scale, assessing both extrinsic and intrinsic motivation, as well as the short DFS-2 scale, measuring flow. Student's grade point averages (GPAs) were used to determine academic achievement. Using regression and mediation analysis in PROCESS, we determined whether intrinsic and extrinsic motivation relate to academic achievement and if flow explains this relation. Moreover, we assessed whether both types of academic motivation relate to flow occurrences. Of the 554 participants remaining after applying the exclusion criteria, the sample included mostly first year students (N= 417) who were female (N=430) and Dutch (N= 311) or German (151). The design was correlation and we aimed at running two mediation models for both predictors. Our study shows that flow partly explains the relation between high levels of intrinsic motivation and academic performance and that high levels of intrinsic motivation lead to more flow occurrences. All these results were significant. Extrinsic motivation was not related to academic performance which is why we did not compute a mediation analysis with flow. This is surprising as previous research on the subject found extrinsic motivation to predict academic achievement. Extrinsic motivation was not related to flow either. Our results point to the importance of cultivating intrinsic motivation in academic settings instead of focusing on extrinsic motivation. The role of flow between intrinsic motivation and academic achievement is relevant for understanding the mechanisms leading to academic performance and can be used to improve student's outcomes by aiming at increasing its occurrence for example through training. However, as the relation is only partial, other variables might also contribute to this relation and deserve further research.

Keywords: intrinsic motivation; extrinsic motivation; academic achievement; flow occurrences.

The Influence of Extrinsic and Intrinsic Motivation on Academic Success With Flow as a Mediator

The more you do, the more you want to do. However, one need the drive to get started in the first place. This role can be attributed to motivation. Motivation is central in our lives as it is a guide to achievement. This is also the case in academic settings where academic motivation is essential for performance. But why is it that motivation keeps us going and does it directly relate to success? This study aims to clarify how academic motivation influences achievement and whether the relation between academic motivation and success is explained by flow. Moreover, this study will add to a growing body of research on how flow relates to motivation in academic settings. Understanding the dynamic between these variables is essential for improvement and organisation of the learning system in order to reach better achievement.

Academic motivation can be divided in different types, which we will explain below, followed by our conceptualization of flow.

Intrinsic motivation

Intrinsic motivation is motivation “from within”. Academic intrinsic motivation can be differentiated in three parts: the motivation to know, to accomplish and for stimulation (Vallerand et al., 1992). The motivation to know encompasses the desire to understand and to learn. For the motivation to accomplish, the focus lies on the process and the pleasure associated with accomplishment rather than the outcome. Finally, the motivation for stimulation is related to the pleasure and cognitive sensations associated with the challenging activity (Vallerand et al., 1992).

Extrinsic motivation

Academic extrinsic motivation is motivation that comes from external sources and can be grouped in four parts: external regulation, introjected regulation, identified regulation

and integrated regulation (Deci & Ryan, 1985). External regulation correspond to EM as is normally understood in literature: the external influences of behaviour such as avoidance of punishment or search of rewards (that are externally controlled) (e.g., students not wanting their parents to be mad because they did not study). The second regulation is introjected regulation which is a state driven by internal dynamics related to self-esteem (such as guilt, shame avoidance or pride). In this form of EM, the individual starts to internalize the reasons for the behaviour (e.g. studying because they fear to disappoint their parents). Next, identified regulation drives individuals to behave in a way that is based on perceived personal value and meaning even if these behaviours are not inherently enjoyable (e.g. thinking that studying is important). It is a self-determined form of motivation where the external reasons have been internalized. Finally, there is integrated regulation which is a form of extrinsic motivation that is highly self-determined (Howard et al., 2021; Vallerand et al., 1992). Only the first three are measured by the AMS-scale used in this paper (Vallerand et al., 1992). This is because school students (around the age of 16) are said to be too young to be able to assimilate the behaviour as part of their identity which is why there is little research done on integrated regulation in academic settings (Howard et al., 2021). However, this might be specific to younger students and does not apply to university students.

Flow

Flow is a complex phenomenon that has first been conceptualized by Csikszentmihalyi (1990). Different dimensions have been associated with flow either as antecedent, experience components and outcomes of flow. It is a state of deep engagement that is so absorbing that everything else seems to disappear. It is an enjoyable experience that normally make investment feel effortless (Adil et al., 2020). In this paper we will use the nine dimensions defined by Csikszentmihalyi (1990) and adapted by Norsworthy (2021). The dimensions are described in the method section as measured by the Short Dispositional Flow

scale (DSF-2) (Jackson et al., 2008). There are differences in how researchers conceptualize and measure flow and how different dimensions are defined.

Self-Determination Theory

Since the self-determination theory (SDT) of Deci & Ryan (1985), interest in intrinsic and extrinsic motivation has grown, especially in academic and sport settings (Gea-García et al., 2020; Goldberg & Cornell 1998; Gottfried, 1985; Schüler & Brandstätter, 2013). The self-determination theory proposes that motivation lies on a continuum based on how well it has been internalized within the self. It suggests that people have three basic needs: autonomy, competence, and relatedness. When these needs are met, individuals are more motivated, happy, and have a sense of well-being. How much a person's social context meets these needs determines their position on the internalization spectrum.

Following the SDT, different outcomes have been associated with different forms of intrinsic and extrinsic motivation, but their exact role is still disputed. According to SDT, intrinsic motivation has a longer lasting impact on motivation than extrinsic motivation as it comes from within (Deci & Ryan, 1985) and has repeatedly been associated with academic performance (Froiland & Worrell, 2016; Howard et al., 2021). Some forms of extrinsic motivation (e.g. identified regulation) have also been found to be associated with academic success, sometimes even more than intrinsic motivation (Howard et al., 2021) whereas other forms (e.g. external regulation) relate to poor academic outcomes. Extrinsic motivation is possible for tasks that are uninteresting making it useful in settings that lack the enjoyment associated with intrinsic motivation. Many school tasks are of this kind. They are not necessarily enjoyable but are considered important by students. This could lead to high identified regulation (Howard et al., 2021) and result in more learning behaviour generating higher grades.

How motivation relates to academic success is still disputed. We know motivation starts behaviour that leads to performance where academic motivation refers to the psychological drive (for internal or external reasons) to engage with the learning material and to put effort in achieving in school. This leads to increase involvement and engagement in learning behaviour that (possibly) results in academic success. On one hand, some researchers claim that motivation directly predicts academic success (Greene & Miller, 1996; Miralles-Armenteros et al., 2021). On the other hand, other researchers claim more variables need to be considered to explain this relation (Froiland & Worrell, 2016; Goldberg, 1996) such as engagement, which is found to be an important mediator between intrinsic motivation and academic achievement (Skinner et al., 2009); Walker et al., 2006).

Flow Theory

The connection between student engagement, learning and motivation is growingly recognized. However, there still is a need for more research concerning the processes of this relationship. A concept that might help clarify the dynamics of engagement is flow. Flow is achieved when the balance between the intellectual or physical challenge and the individual's skills is optimal (Csikszentmihalyi, 1990; Norsworthy et al., 2021), In academics, students are able to enter a flow state when they are completely absorbed in their learning activities producing enjoyment and a distorted sense of time. According to Csikszentmihalyi (1990), those optimal learning experiences result from intrinsically motived students and enhance cognitive processing through emotional and cognitive engagement. Interest is important in this relation because it is difficult for someone to enjoy a learning activity when it does not interest them. If there is no enjoyment in the task and it is not perceived as challenging or pleasurable, it will be hard to achieve a state of deep concentration (Mustafa et al., 2010). Flow has repeatedly been found to predict academic success (Adil et al., 2020; Norsworthy,

2021; Smith et al., 2023; St Clair-Thompson & Devine, 2023) probably because it immerses the students in their learning tasks leading to better absorption of the material.

The subjective experience of being concentrated, aroused, and able to excel at a task might result in differences in mild or deep flow (Norsworthy, 2021; Smith et al., 2023) where the flow intensity depends on the level of challenge and skill (higher intensity level relates to higher challenge/ skill level). This means that optimal learning experiences will be reached only through a high level of challenge/ skills balance combined with interest in the learning material which in turn results in more engagement and improved performance (Mustafa et al., 2010). Nevertheless, while in academic settings sole extrinsic motivation usually lacks interest and enjoyment in the learning activity (Howard et al. 2021), there are also indications for an important role of extrinsic motivation in flow occurrences (Burgueño, et al., 2017; Gea-García et al., 2020; MacNeill & Cavanagh, 2013; Schüler & Brandstätter, 2013; Wilson et al., 2006). Therefore, we expect intrinsic motivation and extrinsic motivation to be both related to flow occurrences. As intrinsic motivation is an essential component of engagement and enjoyment of the learning activity, it will lead the students to a state of deep effortless concentration (flow states) making them engrossed with their learning task. This will result in higher grades. Likewise, we expect extrinsic motivation to be related to flow occurrences although the student might lack the enjoyment and interest in the learning activity. For both predictors we expect flow to explain its influence on academic achievement.

Mustafa et al. (2010) proposed a motivational model (see Appendix A10), with flow as a mediator, much similar to what we are testing in our research. In their paper, they claim there is a need of deep engagement to be able to translate motivation in actual academic performance and underline the importance of interrelated variables. They propose that a state of flow can be achieved if six motivational forces (future time reference, achievement needs, learning goal, self-efficacy, self-determination and expectancy values) work together, leading

to the emergence of flow which in turn leads to academic achievement. In short, flow arises because of the motivational forces at play, and act as a mediator between these forces and academic success. Subsequently, flow predicts academic achievement. The subjective experience of challenge and skill balance and the enjoyment associated with the flow experience are central and lead to enactment of behaviour that produces achievement. This model has not been tested yet.

The Present Study

In this study, we will assess whether intrinsic motivation and extrinsic motivation predict flow occurrences and if flow explains the influence of intrinsic motivation and extrinsic motivation on academic achievement as proposed by the model of Mustafa et al. (2010). Moreover, we will examine if there is a difference between intrinsic and extrinsic motivation in their relation to flow and to academic success. We aim in this study to gain a better understanding of how academic motivation predicts academic achievement and which role flow plays in this relation.

This study has both practical and theoretical relevance. In academic settings, understanding how academic achievement results from motivation and flow can lead to implementation of better guidelines that combine extrinsic and intrinsic motivation or are more specifically focused on the one that proves to have most impact on academic achievement. We want students to reach their full potential, so it is important to adapt the courses in a way that optimizes their motivation and subsequently how they achieve. Moreover, this study is relevant for understanding the role flow plays in the relation between academic motivation and performance and will lead to a better comprehension of the processes at play in academic achievement. Finally, it adds to the body of research on the different dimensions and antecedents of flow.

Our primary research question is the following: does academic (extrinsic and intrinsic) motivation predict academic performance in university students and does flow mediate this relation? Moreover, we want to research whether extrinsic motivation and intrinsic motivation are related to flow, leading to academic success, and if they differ in their relation to flow. We hypothesize the following:

Hypothesis 1. Intrinsic motivation is a positive predictor of GPA.

Hypothesis 2. Intrinsic motivation positively predicts flow occurrences.

Hypothesis 3. Flow positively predicts GPA.

Hypothesis 4. Flow positively mediates the relationship between intrinsic motivation and GPA.

Hypothesis 5. Extrinsic motivation is a positive predictor of GPA.

Hypothesis 6. Extrinsic motivation positively predicts occurrences of flow.

Hypothesis 7. Flow positively mediates the relationship between extrinsic motivation and GPA.

Methods

Participants

The participants in this study initially included 742 Bachelor of Psychology students at the University of Groningen. First-year participants were recruited through the compulsory SONA program, earning points for course completion, while second and third-year students not participating via the same program were recruited through a paid SONA system, social networks of student researchers, and advertisements on campus and received a small monetary reward for their involvement.

We excluded participants based on the following predefined criteria: non-given consent, wrongly answered pseudo items that tested if the participants were paying attention, non-completion of all the scales we used, unavailability of data about their grade, age

eligibility with the ASRS scale's requirement for adults and questions about honesty and language proficiency. After the first question regarding consent to participate, 32 participants were excluded, followed by an additional 34 after the second question concerning the consent for processing student numbers for grade access. Subsequent scale completions further narrowed the sample: 30 participants did not complete the AMS scale, one participant did not complete the DFS2 scale, and another one did not complete the ASRS scale. We decided to exclude any non-completed questionnaire data due to concerns about the general validity of that specific data set. Quality checks following scale completions resulted in five exclusions for participants who answered the pseudo item in the AMS scale incorrectly, while no exclusions were made for the pseudo item in the ASRS scale. Additional checks for honesty led to the exclusion of two participants. The check for perceived English proficiency resulted in no further exclusions. Exclusion based on age eligibility, aligning with the ASRS scale's requirement for adults, led to the elimination of 13 participants. An additional 39 participants were excluded due to the unavailability of data about their grades. After these steps, 585 participants remained, each with complete data across all scales, including information about academic performance.

Demographically, the final sample was diverse. Among them, 430 indicated their biological sex assigned at birth as female, 153 as male, and two participants preferred not to disclose their biological sex assigned at birth. Nationalities varied, with 311 participants being Dutch, 125 German, and 149 representing other nationalities. The age range was 18 to 35, with a mean age of 20.2479 (SD = 2.1641). Occupationally, 417 participants were full-time students, while 168 were working students. The distribution across academic years included 469 participants in their 1st year, 40 in their 2nd year, and 76 in their 3rd year of studies. Educational backgrounds ranged from upper secondary education to Master's or equivalent degrees. Among the participants, 508 finished upper secondary education - high

school, six finished post-secondary vocational education preparing for labour market entry, 10 finished short-cycle higher education, 29 participants had already obtained a Bachelor's degree or equivalent, and two had obtained a Master's degree or equivalent. None of the participants had obtained a Doctoral or a higher degree, and 30 were unsure about their highest completed level of formal education.

Materials/ Measures

An online self-report was used with Qualtrics, containing seven scales, namely, Hyperfocus in School Scale of the AHQ, Short-Dispositional Flow Scale, Need for Cognition, The Utrecht work engagement scale for students, Academic Motivation Scale, Adult ADHD Self-Report Scale, and Five-Dimensional Curiosity Scale. The self-report was formulated in English. To address the primary research question, two of these questionnaires were utilized, the Short Dispositional Flow Scale and the Academic Motivation Scale.

The Academic Motivation Scale (AMS) included 28 items measuring motivation toward education on a Likert scale (Vallerand et al., 1992). AMS is a translation of the 1989 French Echelle de Motivation en Education (EME) by Vallerand et al. (1992). Within AMS, there are seven subscales, assessing three types of intrinsic motivation, three types of extrinsic motivation, and amotivation. More specifically, it measures intrinsic motivation to know (e.g. a student that goes to school for the pleasure of learning something new), intrinsic motivation toward accomplishment (e.g. the motivation of a student to surpass themselves and the enjoyment associated with it), intrinsic motivation to experience stimulation (e.g. students who go to class to experience the excitement of stimulating class discussions), extrinsic motivation-identified (e.g. “I’ve chosen to study tonight because it is something important for me”), extrinsic motivation-introjected (e.g. “I study the night before the exams because that is what good students are supposed to do”), extrinsic motivation-external regulation (e.g. “I study the night before the exams because my parents force me to”), and

amotivation, with four items in each subscale. We combined the scores of the subtypes of IM and separately of those measuring EM to transform them into a mean score of extrinsic and intrinsic motivation per student. We calculated the internal reliability for both our subscales, intrinsic motivation, and extrinsic motivation. The internal reliability of IM yielded a Cronbach's Alpha of .89 while the Cronbach's Alpha of EM was .85 in our sample. Internal reliability for the seven subscales has been shown by previous studies and typically ranged from .83 to .86, apart from the Identification subscale which yielded a lower internal reliability score from .62 to .78 (Vallerand et al., 1992). Additionally, investigating the AMS subscales yielded fairly strong discriminant and convergent reliability, providing evidence of the distinctiveness of the seven subscales (Fairchild et al., 2005).

Flow was measured through the Short Dispositional Flow scale (DSF-2) (Jackson et al., 2008). It is a modified version of the DSF-2 scale, which is shortened from 36 to nine items, representing each of the nine flow dimensions conceptualized by Csikszentmihalyi (1990). The nine dimensions are the following: (1) challenge-skills balance, (2) merging of action and awareness, (3) clear goals, (4) unambiguous feedback, (5) concentration on the task at hand, (6) sense of control, (7) loss of self-consciousness, (8) transformation of time, and (9) autotelic experience. The short DSF-2 scale measures one item per flow dimension on a five-point Likert scale. The students were asked to imagine themselves in a studying situation by the following sentence: "When I'm studying…" followed by a description of one of the nine dimensions of flow. The students had to respond on a five-point Likert scale about how much they experienced that dimension. The introductory sentence is our modification from the original DSF-2 scale and operationalized for the academic setting. Previous research showed a reliability score for this scale of around .80 after cross-validation, and a high internal consistency score from .78 to .90. The shortened dispositional scale is reliable, and more effective than the long DSF-2 for multimethod studies due to its shortened length

(Jackson & Eklund, 2002) which made it a better choice considering the students needed to fill in other scales as well.

The internal reliability of the DSF-2 scale yielded a Cronbach's Alpha of .73 in our sample. To measure academic success, the grades of the students were collected from the student office. We calculated the grade point average by calculating the mean of the grades achieved by the students. In the questionnaire, we included four attention-check questions to confirm if the participant paid attention to the questions and did not answer randomly.

Procedure

After the approval by the Ethics Committee of the Psychology Faculty of the University of Groningen, the data collection started. The participants were asked to fill in an online questionnaire of around 20–25 minutes. The participants were informed of the goals of the study and no deception was involved. Participation for the students was voluntary, and they could quit at any time. Students then had to fill in the consent form to take part in the study after which they received several questions about their personal data and demographic characteristics (age, sex). Then, the scales we used were introduced as questions about "hunger for knowledge" and included all the items of the AMS scale and the DSF-2 scale. Students were told that no negative consequences of participation were expected, and that the data is pseudonymous. Finally, an honesty question was included to ask participants if they filled in the questionnaire truthfully, a question confirmed English capabilities and asked participants if they think their English is good enough to answer the questionnaire reliably.

Design

Our research design is correlational. We are planning to use two mediation models as there is multicollinearity between our predictors and using two separated models enables us to differentiate easily between the unique explained variance of both predictors. We measured the variables through the different scales and assessed the grades of the

participants. The measured variables are the following. There are two predictors, extrinsic and intrinsic motivation, one mediating variable, flow, and a dependent variable, academic success.

Results

Assumptions Check

We used mediation analysis via PROCESS (Hayes, 2013) to examine the data. Prior to conducting the analysis, we verified the assumptions to ensure we could perform linear regression analysis. To test for normality, we computed a Q-Q plot for every variable which showed all the variables were normally distributed (see Appendix A1-A4). We then examined the linearity using a P-P plot (see Appendix A5-A8), all the variables showed a linear pattern, so we accepted the linearity assumption. We assessed a scatterplot of standardized residuals of GPA to check for homoscedasticity. We found no discernible pattern, indicating homoscedasticity in the data (see Appendix A9). Next to these three assumptions, we checked for outliers with Cook's distance 4/n= 0.00683760683, 31 participants had higher Cooks' distances and were eliminated, which left us with a sample size of N = 554. Finally, we tested the assumption of absence of interaction between the predictors and flow. The interaction was far from significant, meaning that it was possible to use a mediation analysis.

Analysis of the Descriptive Statistics

We examined the descriptive statistics of the variables of interest. Extrinsic motivation had a mean of M = 5.2, SD = 0.9 and intrinsic motivation a mean of M = 4.8, SD = 0.9 based on a 7-point Likert scale with 7 being the highest option. For both intrinsic and extrinsic motivation, students had high scores, in general, considering that 1 SD difference from the respective means still resulted in above average scores. Flow had a mean of M = 3.4, SD = 0.5 based on a 5-point Likert scale, and the mean GPA was M = 6.9, SD = 1.0 based on the Dutch grading system where 10 is the highest grade achievable and students need a 5.5 to

pass the course. Concerning the GPA, the mean shows that, in general, the students scored above average. A grade of 6.9 is good and considering the SD = 1.0, more than 68% of the students had a sufficient grade. These statistics show that the students in our sample are, in general, high academic achievers with relatively high scores on all the measured variables, IM, EM and flow. The standard deviations are also considerable, and all variables were normally distributed (see Appendix A1-4).

Results Based on Hypotheses

Hypothesis 1. Intrinsic motivation and GPA

We used PROCESS to determine the total effect of IM on GPA. We found a significant positive effect of .19, at $p < .001$, with SE = .05, 95% CI [0.10, 0.28]. The regression analysis, showed that 3.1% of the variance in academic achievement is explained by intrinsic motivation as a predictor while being statistically significant at $p < .001$, $R^2 = .031$ $F(1, 552) = 17.75$. This means that our hypothesis is supported by the data, intrinsic motivation positively predicts GPA.

Hypothesis 2. Intrinsic Motivation and Flow

We used a simple regression analysis to assess the relation between intrinsic motivation and flow. The unstandardized regression coefficient was $\beta = .23$ which was statistically significant at $p < .001$, with SE = .02, 95% CI [0.19, 0.27]. We found that 17% of the variance in flow is explained by intrinsic motivation while being statistically significant at $p < .001$, $R^2 = .17$, $F(1, 552) = 113.07$, $p < .001$. The effect is between small and typical. Our hypothesis is therefore supported by the data, and we conclude that intrinsic motivation predicts flow occurrences.

Hypothesis 3. Flow and GPA

We used the multiple regression analysis in PROCESS to analyse the relation between flow and academic performance while controlling for the effect of IM. A significant effect

was found between flow and GPA of .29, at $p < .001$, with SE = .90, $p < .001$, 95% CI [0.12, 0.47]. We found that 5% of the variance in academic performance is explained by flow, $R^2 = .05$, $F(2, 551) = 14.35$, $p < .001$. When running a simple regression in SPSS, we found a correlation between flow and GPA of $r = .20$, $p < .001$. This is not surprising as the regression coefficient is also influenced by mediation and multicollinearity. This means that the data supports our hypothesis that flow positively predicts academic performance.

Hypothesis 4. Flow as a Mediator Between Intrinsic Motivation and GPA

We used a mediation analysis in PROCESS to test the indirect effect of intrinsic motivation on academic success which is mediated by flow. We found a significant indirect effect of flow as a mediator of .07 between IM and GPA, SE = .02, 95% CI [0.03, 0.11]. As the 95% confidence interval shows, the indirect effect was significantly different to zero at a significance level of $p < .001$, so we can conclude that flow mediates the relation between intrinsic motivation and academic performance. This mediation is moderate, as flow accounts for around 35% of the effect between intrinsic motivation and academic performance. This was calculated by dividing the mediation (indirect) effect by the total effect. After accounting for the mediation effect of flow, we still found a direct effect of IM on GPA of .13, $p < .05$, SE = .05, 95% CI [0.03, 0.22] which means that although there is a mediation effect of flow on the relation, intrinsic motivation also directly predicts academic performance.

Hypothesis 5. Extrinsic Motivation and GPA.

We used a correlation analysis to test the relation between EM and GPA. A non-significant negative effect was found between EM and GPA of $r = -.005$, $p = .452$. This means that our hypothesis is not supported by the data and must be rejected. Extrinsic motivation is not correlated with GPA. After running a regression analysis, 0% of the variance of GPA was explained by extrinsic motivation.

Hypothesis 6. Extrinsic Motivation and Flow

We used a correlation analysis to determine the relation between extrinsic motivation and flow. There was no significant correlation between both variables, r =.05, p = .266. Extrinsic motivation is not correlated with occurrences of flow. This is not in line with our hypothesis, so we reject it.

Hypothesis 7. Flow as a Mediator Between Extrinsic Motivation and GPA

As we found no correlation between extrinsic motivation and GPA, we decided not to perform a mediation analysis as there cannot be mediation between variables that do not correlate. We expected flow positively mediate the relation between extrinsic motivation and flow. As this relation is inexistent, we abandon the hypothesis altogether.

Discussion

In this study we researched how intrinsic motivation and extrinsic motivation influence academic performance and the possible mediation role of flow in this relation. We first found that students with high levels of intrinsic motivation moderately predict high grades (hypothesis 1) and that they tend to have high levels of flow experience (hypothesis 2). More flow occurrences positively predicted higher grades (hypothesis 3) and flow occurrences partly explain how high intrinsic motivation leads to higher academic achievement (hypothesis 4). Next, we found that students with high levels of extrinsic motivation did not necessarily receive better grades than students with low extrinsic motivation (hypothesis 5) and therefore we did not test if flow influenced this relation. High levels of extrinsic motivation were not associated with more flow occurrences (hypothesis 6). These results do not support our hypotheses. We expected extrinsic motivation to be positively related to flow occurrences and it is surprising that extrinsic motivation is not at all related to academic achievement which contradicts previous literature on the subject (Howard et al., 2021; Mustafa et al., 2010).

Interpretation

The total effect of intrinsic motivation on academic achievement while controlling for the effect of flow (hypothesis 1) mean that students who are highly intrinsically motivated achieve higher grades, which is partly explained through flow (hypothesis 4) but not completely. These results are consistent with previous literature as intrinsic motivation has been associated with academic achievement (Goldberg & Cornell, 1998; Howard et al., 2021). This relation also supports the SDT (Deci & Ryan, 1985), as intrinsic motivation is internalized motivation and should have a longer lasting impact on behaviour than extrinsic motivation which probably leads to higher performance.

We expected flow occurrences to influence this relation and to increase our understanding of how motivation is related to academic achievement (hypothesis 4). Flow is a partial mediator and explains 35% of the relation. This is a moderate effect and coincides with the model proposed by Mustafa et al. (2010). Flow occurrences seem to be conducive to higher academic achievement, probably because the subjective experience of deep involvement, concentration, optimal arousal from perceived challenges and the enjoyment associated with it, leads to improved performance and more involvement with the learning material resulting in higher grades (Mustafa et al., 2010). This is in line with earlier research (Adil et al., 2020; Norsworthy, 2021; Smith et al., 2023; St Clair-Thompson & Devine, 2023).

Intrinsic motivation is a good predictor of flow and influences flow occurrences (hypothesis 2). This is interesting because it highlights the importance of IM for reaching a state of flow. We cannot conclude based on our analysis if the relation is causal. In line with the literature, intrinsic motivation can be an antecedent or a dimension of flow (or both of them) (Norsworthy et al., 2021). According to Adil et al. (2020), if a student experiences flow in their academic activities, learning may become rewarding, and the student will be likely to repeat the studying behaviour, which may lead to improved academic performance. Based on previous literature, we expect this relation to take place in a feedback loop where intrinsic

motivation and flow reinforce each other (Goldberg & Cornell, 1996; Smith et al. 2023). MacNeill & Cavanagh (2013) even point out that there might be a constant two-way biofeedback loop and that motivation and flow should always be identified with two-ways arrows. Therefore, the relation between these variables is probably not solely one-sided.

Although we expected high levels of extrinsic motivation to lead to academic performance (hypothesis 5), no such relation was found. This is surprising as extrinsic motivation has previously been associated with academic success, although it might depend on the type of extrinsic motivation that is measured (Howard et al., 2021). In our research, we made a mean of the three types of extrinsic motivation, but previous research of Howard et al. (2021) showed that two types of extrinsic motivation (i.e. identified and introjected), are more strongly associated with academic motivation than external regulation who was negatively associated. By combining them, the negative effects could have balanced out the positive effect of identified and introjected motivation.

People who indicated high levels of extrinsic motivation did not necessarily experience flow states (hypothesis 6) which means that flow is probably not influenced by extrinsic motivation. This not in line with our expectations as we expected extrinsic motivation to relate to flow. Indeed, some studies did find that extrinsic motivation predicts flow occurrences (Burgueño, et al., 2017; Gea-García et al., 2020; MacNeill & Cavanagh, 2013; Schüler & Brandstätter, 2013; Wilson et al., 2006). These contradictory results might be explained by the fact most research linking extrinsic motivation with flow occurrences took place in sport settings or other contexts than the academic one. Enjoyment and interest for the activity are important components in order to reach flow states and are not necessarily found in academic extrinsic motivation. Moreover, Mustafa et al. (2010) explicitly mention that there is a need of deep engagement to be able to translate motivation in actual academic

performance. If the engagement through extrinsic motivation is not “deep” enough, this could explain the absence of relation, or at least the absence of reporting flow occurrences.

Implications

There are several implications that follow from this study. First, the finding that high levels of intrinsic motivation lead to more frequent experiences of flow states is relevant in research on the different antecedents and dimensions of flow. Research points to deep and effortless control as a central component of flow experience (Smith et al., 2023, Marty-Dugas & Smilek, 2019). Our research implies that intrinsic motivation is also central in flow occurrences or/and that there is mutual influence between occurrences of flow and intrinsic motivation. Further research could investigate the direction of influence between intrinsic motivation and flow states, or explore the possibility of a feedback loop, as suggested by MacNeill & Cavanagh (2013). In educational, work and personal settings, one can develop strategies to achieve flow by prioritizing the cultivation of intrinsic motivation for example by letting students reflect on why they want to learn the material. This will enhance the likelihood of experiencing flow and vice versa.

Second, flow does partially mediate the relation between intrinsic motivation and academic achievement which is an important finding for research on academic success aiming at understanding its underlying mechanisms. It provides evidence for the model proposed by Mustafa et al. (2010). This means that it would be wise to increase the attention on the role of flow in academic achievement by informing teachers and students about its positive effects. Aiming at reaching a state of flow is recommended and might improve one’s academic outcomes. This could be implemented in educational settings for example through training. However, as the mediation is only partial, more research should be done to explore other variables that explain this association.

Concerning extrinsic motivation, our results contradict the suggestion of Mustafa et al. (2010), that the combined motivational forces must include both kinds of motivation. Our results show that extrinsic motivation does not lead to high academic achievement, meaning that it is not a core aspect of the motivational components leading to academic achievement. However, more research should be done while differentiating the types of extrinsic motivation or combining intrinsic and extrinsic motivation as they might work together and reinforce each other (Mustafa et al., 2010). In this study we did not include integrated motivation as a variable but there is promising research on students or young adults pointing to the role integrated motivation might play in performance (Burgueño, et al., 2017; Gea-García et al., 2020; Wilson et al., 2006). This deserves more attention.

The finding that extrinsic motivation does not lead to more flow occurrences is relevant in research aiming at understanding the antecedents and dimensions of flow. Apparently, only intrinsic motivation and not extrinsic motivation is essential in reaching flow states. This should be kept in mind in educational settings.

Understanding what influences academic achievement might help to narrow the focus and implement new methods that stimulate motivation. In practice, our research implies that the focus should lie on intrinsic motivation, and not on extrinsic motivation as is usually the case, as the overall effect of extrinsic motivation is minimal and might even be detrimental for intrinsic motivation. Extrinsic motivation such as rewards is widely used as a motivational tool, if the effect is inexistent, the use of these tools should be questioned or at least adapted to be more in line with different forms of extrinsic motivation instead of aiming at motivating students through purely external motivators. The knowledge of the role of intrinsic motivation in reaching flow states and subsequent achievement should be applied in practice by fostering individuals' motives for achieving a course and focus on making courses interesting and interactive, increasing student participation and interest in the course material.

Limitations

Our research has some limitations. First, only psychology students completed the survey which makes it difficult to generalize our results to other faculties as psychology students differ from other faculties by having a *numerus fixus* (which possibly included higher intrinsically motivated or higher achieving students). This might lead to different results in another faculty. Second, there was a selection bias as students could decide to participate for a reward (credits or money). This could have affected our results because mostly the students who were motivated to pass the course participated which have resulted in a higher percentage of (intrinsically or extrinsically) motivated students. The students who participated for money were possibly also prone to be influenced by extrinsic motivation unlike the people who did not fill in the survey. Third, there might be a methodological problem with how we defined flow. In our scale we measured the nine dimensions of flow as Csikszentmihalyi (1990) defined them and used their sum to determine the level of flow. However, not all dimensions are found in every experience of flow, and some dimensions might have more weight in the experience of flow. Marty-Dugal & Smilek (2019) criticize this approach by claiming that to imply equal contribution of each facet is not realistic and that flow is more than the sum of its parts. They propose that the essence of flow lies in a single concept: the subjective experience of "deep-effortless concentration". Intrinsic and extrinsic motivation might be more or less related to different dimensions of flow and combining all the dimensions might have resulted in smaller flow measurements than would be the case if we measured it as for example deep effortless concentration. Our methodology might not have been sensible enough to the specific dimensions of flow and it would be interesting to determine if their relation to IM and EM changes based on which dimension is researched. Similarly, by combining all the types of extrinsic motivation our research could not differentiate the possible opposite effects. Previous research found external regulation to

relate with poor academic outcomes whereas introjected and identified regulation have been found to predict high academic performance (Howard et al., 2021). As no effect was found in our research, it is possible that the negative effects have balanced out the positive prediction of specific types of extrinsic motivation. In the same manner, this could have affected the reported occurrences of flow. It is possible that some type of extrinsic motivation is internalized enough to be able to reach flow states.

Conclusion

Using mediation analysis, our results show the importance of flow in explaining how highly intrinsically motivated students achieve higher grades. This gives insight in the mechanisms underlying academic achievement and the importance of reaching flow states through training or increase of student's intrinsic motivation to enhance performance. As the influence is partial, we expect other variables to contribute to this relation as well which should be clarified further. Moreover, our results point to the importance of intrinsic motivation in reaching flow states in the context of academic achievement. In the light of flow predicting academic success, this shows, once again, the necessity of keeping students interested in their courses (e.g. by making it interactive). The relation between intrinsic motivation and flow states could be the result of mutual reinforcement (i.e. a feedback loop). This is still unclear and could be the object of future research. Extrinsic motivation seems not to be related to academic achievement, which is surprising and contradicts earlier research. Extrinsic motivation was not related to flow occurrences either. Our methodology combined the three different types of extrinsic motivation, but differentiating between them could possibly yield different outcomes. Future research could differentiate between different types of motivation and flow dimensions to determine more specific influences between motivation, flow and academic achievement. This will sharpen our knowledge on the

processes leading to academic success and could result in more specific interventions in the educational context.

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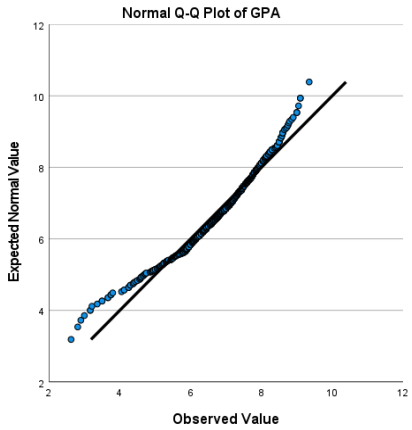
Appendix

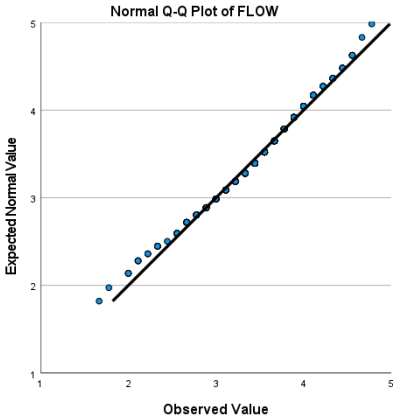
A1

Normality Check of GPA



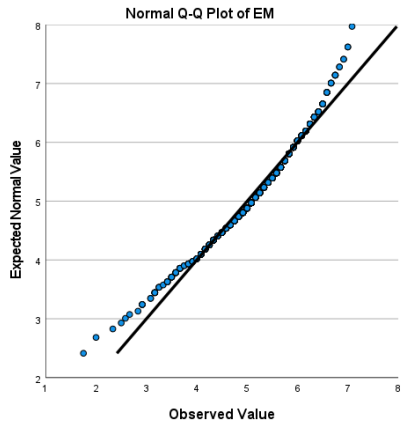
A2

Normality Check of Flow



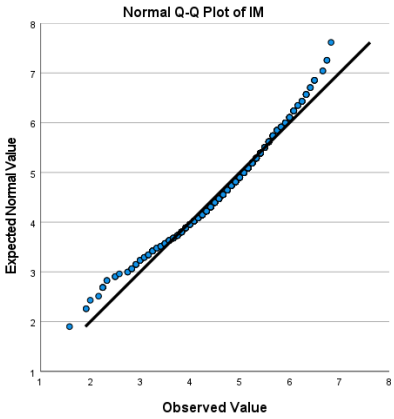
A3

Normality Check of EM



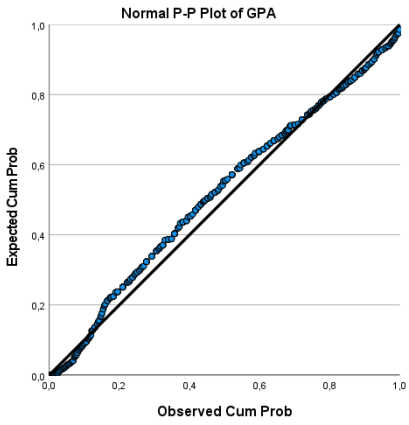
A4

Normality Check of IM



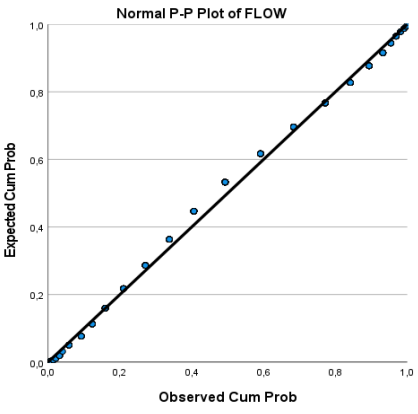
A5

Linearity Check of GPA



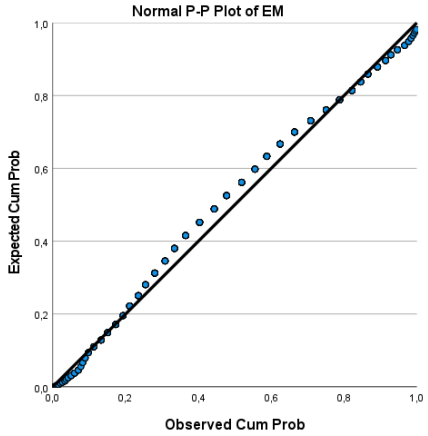
A6

Linearity Check of Flow



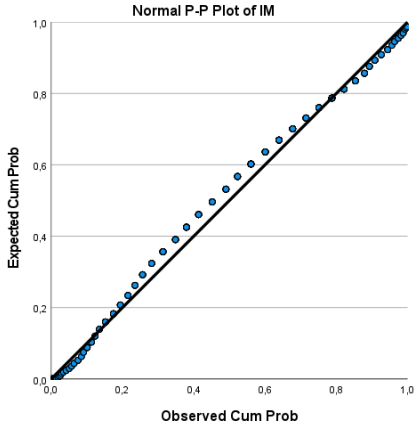
A7

Linearity Check of EM



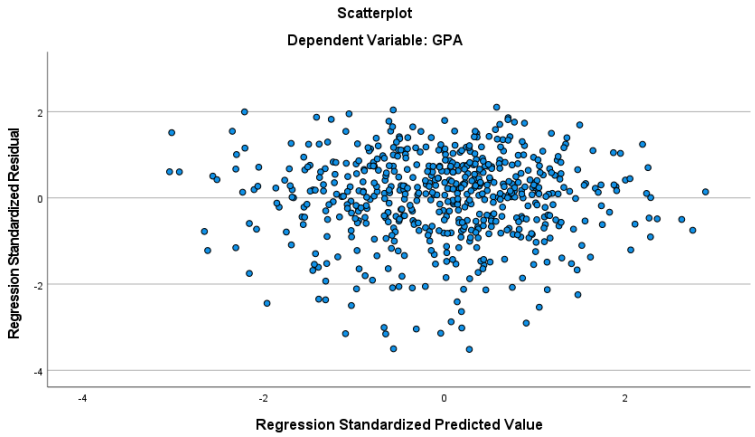
A8

Linearity Check of IM



A9

Homoscedasticity Check



A10

Motivational model by Mustafa et al. (2010)