Unraveling the Complex Interplay Between Intrinsic Motivation, Hyperfocus, and

Academic Performance

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Abstract

While intrinsic motivation has long been recognized as a significant predictor of academic success in university students, the underlying cognitive and behavioral mechanisms connecting motivation to performance remain less understood. This study explores hyperfocus, characterized by an intense state of concentration leading to the neglect of external stimuli and personal needs, as a potential mediator between intrinsic motivation and academic performance. Despite theoretical assumptions suggesting a positive association between intrinsic motivation, hyperfocus, and academic success, our cross-sectional online survey (N = 594) among Bachelor of Psychology students challenges these notions. The survey, encompassing scales for academic intrinsic motivation and school hyperfocus, along with direct access to participants' grades, reveals intriguing findings. Although intrinsic motivation positively correlates with both hyperfocus and academic performance, our results indicate that hyperfocus does not mediate the relationship between intrinsic motivation and academic success, nor does it exhibit a direct association with academic performance. This study provides novel insights into intrinsic motivation as a potential precursor of hyperfocus, prompting a reevaluation of hyperfocus as a predictive factor for academic performance. The findings contribute to the understanding of hyperfocus, its interconnections with intrinsic motivation, and their implications for academic success. The study also lays the groundwork for interventions aimed at enhancing student performance, accompanied by discussions on limitations and suggestions for future research.

Keywords: hyperfocus, intrinsic motivation, academic performance, university students

Unraveling the Complex Interplay Between Intrinsic Motivation, Hyperfocus, and Academic Performance

Hyperfocus is commonly described as a state of intense, absorbing attention that patients with attention-deficit/hyperactivity disorder (ADHD) experience (Ozel-Kizil et al., 2016). Within the psychiatric population, it is also connected to autism spectrum disorder and schizophrenia (Ashinoff & Abu-Akel, 2019). Recent studies are pointing toward hyperfocus being a phenomenon the neurotypical population experiences similarly to the neurodivergent population (Hupfeld et al., 2019, Groen et al., 2020). Hyperfocus states are typically attributed to enjoyable tasks, such as watching television programs or playing video games (Ashinoff & Abu-Akel, 2019), but are also mentioned in educational activities (Hupfeld et al., 2019, Groen et al., 2020). While enhanced performance within hyperfocus states has been found for leisure activities (Ashinoff & Abu-Akel, 2019) there is a gap in knowledge on whether this is also the case for educational activities. Academic performance is positively linked to intrinsic motivation (Ryan & Deci, 2000; Vallerand & Bissonnette, 1992), which we believe to be a pre-condition of hyperfocus. Therefore, our present research will look into the connections between hyperfocus, academic performance, and intrinsic motivation and explore whether hyperfocus might be a mediator between intrinsic motivation and academic performance.

Possible explanations for the differences in academic performance among students are of great interest to many researchers within educational psychology, with the most widely used measure of academic performance is grade point average (GPA). Richardson et al. (2012) conducted a meta-analysis on the different variables that influence academic performance in university students. Next to the exploration of traditional correlates of GPA like intelligence and grades from prior education they also considered non-intellective factors like personality traits, motivational factors and students approaches to learning. Performance self-efficacy was the strongest positive predictor of GPA. Two variables that were found to

have a small but significant, positive association with GPA, are academic intrinsic motivation and a deep approach to learning. Intrinsic motivation (IM), being one of the motivation types identified by self-determination theory (Ryan & Deci, 2017), refers to engagement in an activity purely for the inherent satisfaction and interest in the task, unrelated to pressures or rewards. A growing body of research has been showing the positive association between IM and academic performance, highlighting the importance of fostering intrinsic motivation in educational settings for enhancing students' learning outcomes (e.g., Ryan & Deci, 2000; Vallerand & Bissonnette, 1992).

When someone is carrying out an activity with the simple goal of doing this activity it is called autotelic or intrinsically motivated. Intrinsically motivated individuals are more likely to be persistent (e.g., Fishbach & Woolley, 2021), show higher levels of creativity (e.g., Amabile, 1983), and experience a sense of autonomy and satisfaction in their pursuits (e.g., Ryan & Deci, 2017). The four general criteria of hyperfocus that were identified in the review by Ashinoff & Abu-Akel (2019) show a significant overlap with IM. Hyperfocus being described as an intense state of concentration and focus relates to the findings that people experiencing IM are inclined to become deeply engaged in a task due to its inherent appeal or enjoyment (Csikszentmihalyi, 2014). Another identifier of hyperfocus states is the diminished perception of time and the environment that people experience, which (Csikszentmihalyi, 2014) found to be linked to autotelic activities. Interest has been found to lead to IM by arousing the initiation of an activity (Reeve, 1989), and is also one of the four general criteria of hyperfocus (Ashinoff & Abu-Akel, 2021). The fourth criterion for hyperfocus mentioned is that task performance improves, and IM is known to be a medium to strong predictor for performance (Cerasoli et al., 2014). The features of hyperfocus and its connection to IM, give reason to assume that it might influence academic performance. Contrary to the overwhelming evidence for the positive relationship between IM and academic performance

(e.g., Ryan & Deci, 2000; Vallerand & Bissonnette, 1992), the relationship between IM and hyperfocus has been implied, as researchers assume IM to be an antecedent of hyperfocus (Ashinoff & Abu-Akel, 2021), there is yet no empirical evidence for this relationship. Moreover, there has not been empirical research done linking hyperfocus and academic performance. Therefore, the aims of this study are; to investigate the relationship between IM and hyperfocus, whether they predict academic performance, and to explore if hyperfocus mediates the relationship between IM and academic performance.

Intrinsic Motivation

Motivation has been known to be a central determinator of academic success, with researchers extensively studying different motivational theories, such as social cognitive theory (Bandura, 1997), expectancy-value theory (Eccles et al., (1993), and self-determination theory (SDT)(Ryan & Deci, 2000, 2017), to find ways to increase academic performance. Social cognitive theory and expectancy-value theory view motivation as a single, unified concept, similar only to amotivation. In contrast, Self-Determination Theory (SDT) emphasizes that motivation can take various forms, each linked to the satisfaction of three fundamental needs: Competence, Relatedness, and Autonomy (Ryan & Deci, 2017). Competence refers to a person's need to feel successful in their goal pursuit, relatedness concerns the sense of belonging, and autonomy refers to the sense of agency(Deci & Ryan, 2000). One theory within SDT is the basic psychological needs theory (Deci & Ryan, 1985, 2000) which found activities that fulfill the three fundamental needs, facilitate stronger intrinsic motivation, which was found to be the motivational type to predict overall academic performance most strongly (Baker, 2003, Taylor et al., 2014). The organismic integration theory, another theory within SDT, distinguishes various types of motivation, ranging from intrinsic motivation (IM) to multiple forms of extrinsic motivation (EM) and amotivation (Deci & Ryan, 1985, 2000). This can be seen in the so-called autonomy-control continuum

(Ryan & Deci, 2017). The most autonomous motivation type is IM. It arises from actions or behaviors that facilitate individuals' sense of choice, volition, and the inherent satisfaction they produce, without external pressures or rewards. In their meta-analysis, Howard et al. (2021) found that the more autonomous forms of motivation are more positively associated with student success, task persistence, and well-being. Other research in line with SDT has found that IM is positively linked to interest, persistence, deep learning strategies, and higher exam outcomes (Simons et al., 2004). In line with these findings, we came to the following hypothesis:

H1: Intrinsic motivation is positively associated with academic performance.

Hyperfocus and similar concepts

The term hyperfocus is mainly mentioned within the field of ADHD research, and even in this field, it has been rather neglected. Although generally considered a symptom of ADHD, it is not a criterion listed in the DSM-5 next to its three cardinal symptoms: hyperactivity, impulsivity, and inattention. Within the field of ADHD research, hyperfocus has been known as "intensive concentration on interesting and non-routine activities accompanied by a temporarily diminished perception of the environment" (Schecklmann, 2008). So far only one paper has found that participants who didn't have ADHD still experienced hyperfocus at a similar occurrence, frequency, duration, and pervasiveness to participants with an ADHD diagnosis (Groen et. al., 2020).

Most studies investigating hyperfocus base their research on the positive psychology term "flow" (e.g., Grotewiel et al., 2023), with some even concluding that hyperfocus and flow are the same phenomenon (Ashinoff & Abu-Akel, 2019, Sklar, 2000). Hupfeld et al. (2019) suggest that based on former research hyperfocus could be considered part of the flow spectrum, as a kind of "deep flow". When comparing the two terms, one can see that hyperfocus is mostly mentioned regarding the neurodivergent population, whereas flow is

mostly mentioned concerning the neurotypical population. Hupfeld et al. argue that the term flow has a positive connotation within positive psychology (Csíkszentmihályi (1997), whereas hyperfocus has a negative connotation within ADHD literature and that this stigma might influence the way both have been researched. In this study, we want to focus on the experience of hyperfocus for non-ADHD individuals, therefore looking into the concept of flow and its ties to motivation could be helpful when investigating hyperfocus. Moreover, considering hyperfocus being heavily linked to flow throughout research, and literature on flow being way more extensive, we consider it beneficial to review flow literature to understand if and how hyperfocus might be linked to IM and academic performance.

Hyperfocus (flow) and intrinsic motivation

Ashinoff and Abu-Akel (2019) state that one of the conditions for an individual to experience hyperfocus is that the activity has to be interesting or they are engaging in something that they perceive to be fun and instantly rewarding. In other words, the activity must be intrinsically motivating. Similarly, researchers investigating flow found IM to be one of the main predictors for entering a flow state (Norsworthy et al., 2021). Further, they discuss that IM might be linked to an increased depth of flow. The aforementioned categorization of hyperfocus as being a form of deep flow by Hupfeld et al. (2019), suggests that hyperfocus indeed has a similar association to IM. Furthermore, hyperfocus has been conceptualized as an extreme form of sustained attention (Sklar, 2013), which Reeve (1989) linked to IM, suggesting that individuals who are intrinsically motivated are more likely to exhibit sustained attention because their engagement is driven by personal interest and enjoyment. This leads us to the following hypothesis:

H2: Intrinsic motivation is positively associated with hyperfocus.

Hyperfocus (flow) and Academic performance

One of the assumptions of hyperfocus literature is that during such a state, task performance is enhanced (Ashinoff & Abu-Akel, 2021). This assumption stems from the comparison of hyperfocus to the related concepts of "in the zone" and flow (Ashinoff & Abu-Akel, 2021). Esterman et al. (2014) found that participants who were "in the zone" during a sustained attention task performed better than participants who were "out of the zone". They described "in the zone" as a state where attention is narrowly directed toward task-relevant stimuli, whereas "out of the zone" participants struggle to filter irrelevant distractors (Esterman et al., 2014). Research done on flow shows indirect evidence of flow having a positive relationship with performance, as the established relationship is mostly based on the evidence that multiple constructs that makeup flow, like absobtion, effortless control, and intrinsic reward were found to increase performance (Norsworthy et al., 2021). In a later study trait-level flow was found to be a predictor for greater engagement with study materials, better understanding, and higher grades (Smith et al., 2023). A majority of assumptions regarding the relationship between academic performance and concepts like hyperfocus and flow are almost entirely built on indirect and speculative evidence (Ashinoff & Abu-Akel, 2021). To combat this lack of empirical evidence, we want to test the aforementioned assumptions of other researchers that during hyperfocus states task performance increases (Ashinoff & Abu-Akel, 2021). In our study, we want to test whether hyperfocus is associated with academic performance specifically, as hyperfocus does not only occur in leisure activities but also within educational settings (Hupfeld et al., 2019). Additionally considering the evidence that concepts essential to the hyperfocus state description, like interest (Reeve, 1989), and immersion (Georgiou & Kyza, 2018) are linked to academic performance leads us to the following hypothesis:

H3: Hyperfocus is positively associated with academic performance.

The aforementioned assumption that IM might be a precondition of hyperfocus, and the assumption that hyperfocus might lead to increased academic performance while having evidence for IM being a predictor for academic performance (e.g. Howard et al., 2021) leads us to the question of whether hyperfocus might function as a mediator between the two. Therefore, our fourth hypothesis is:

H4: Hyperfocus mediates the relationship between intrinsic motivation and academic

Method

Participants

Our sample consisted of 742 Bachelor of Psychology students at the University of Groningen, the Netherlands. A total of 148 participants were excluded based on predetermined exclusion criteria (see Figure 1 for the complete participant inclusion process). They were excluded if they did not provide consent to participate in the study or to have their grades accessed, if they did not complete the survey, if they failed the attention checks, if they reported not answering the questions truthfully, or if they reported that they did not understand the questions. The final sample consisted of 594 participants. The mean age of participants was 20.19 ($SD = 2.19$). The sample included students of different nationalities: Dutch (53.7%), German (20.7%), and other nationalities (25.6%). Most students were female (73.9%), while 25.8% were male, and 0.3% preferred not to state their biological sex assigned at birth. Furthermore, 28.6% of participants had a part-time job next to their studies. A total of 5.2% of participants have completed another degree (Bachelor's, Master's, or Doctoral).
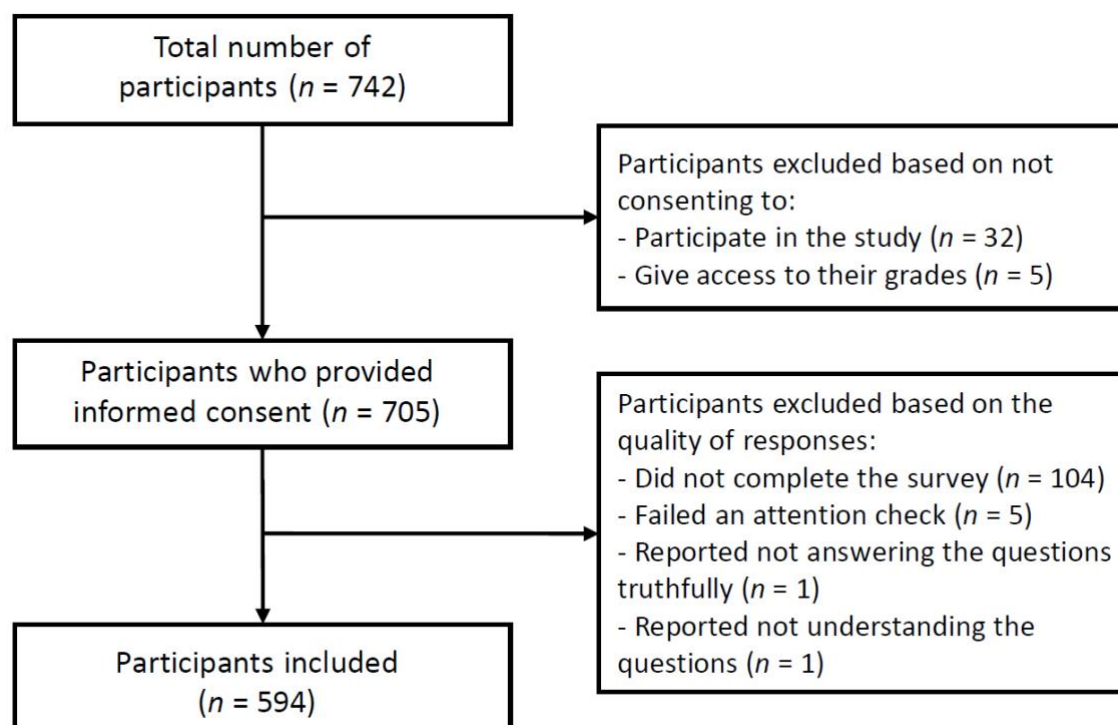
Procedure

The study was approved by the Ethics Committee for Psychology of the University of Groningen. The survey was completed online via Qualtrics between October 2022 and July 2023. Convenience sampling was used to recruit first-year students through the university's internal participants pool of first-year psychology students (SONA), whereas second- and

third-year students were recruited through campus advertisement and/or researcher social networks. Participants were first asked to provide informed consent to use their data and anonymously access their grades and their personal data for payment, in compliance with the General Data Protection Regulation (GDPR) guidelines.

Figure 1

Flow Chart of the Participant Inclusion Process

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┌─────────────────────────┐
│ Total number of         │
│ participants (n = 742)  │
└─────────────────────────┘
         │          ┌──────────────────────────────────────┐
         │─────────▶│ Participants excluded based on not    │
         │          │ consenting to:                        │
         │          │ - Participate in the study (n = 32)   │
         │          │ - Give access to their grades (n = 5) │
         ▼          └──────────────────────────────────────┘
┌─────────────────────────┐
│ Participants who provided│
│ informed consent (n = 705)│
└─────────────────────────┘  ┌──────────────────────────────────────┐
         │                   │ Participants excluded based on the    │
         │──────────────────▶│ quality of responses:                 │
         │                   │ - Did not complete the survey (n = 104)│
         │                   │ - Failed an attention check (n = 5)   │
         │                   │ - Reported not answering the questions│
         │                   │ truthfully (n = 1)                    │
         ▼                   │ - Reported not understanding the      │
┌─────────────────────────┐ │ questions (n = 1)                     │
│ Participants included    │ └──────────────────────────────────────┘
│ (n = 594)                │
└─────────────────────────┘
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Note. n = number of participants.

Participants were then asked to provide demographic information, including their biological sex assigned at birth (Female, Male, Prefer not to say), their age, their nationality (Dutch, German, Other), their current professional status (Student, Working student [student with part-time job], Other), and the highest level of formal education completed (Upper secondary education, Post-secondary vocational education, Short-cycle higher education [vocational or specialized technical], Bachelor's or equivalent, Master's or equivalent, Doctoral or equivalent, Not sure).

The survey was divided into three fixed blocks. The order of the questionnaires in the first and second blocks was randomized to avoid order effects. The first block included scales that measured cognitive motivation (curiosity, need for cognition, academic motivation). The second block consisted of measures of enhanced concentration (hyperfocus during school-related activities, work engagement, and dispositional flow). The third block included scales assessing ADHD in adults, information about a psychological or brain disorder diagnosis, and the use of medication and neuroenhancing substances by the participants.

Materials

Intrinsic Motivation

The English version of the Academic Motivation Scale (AMS; Vallerand et al., 1992), a self-report questionnaire consisting of 28 items, was used to measure various types of academic motivation in participants. Participants are asked to rate to what extent statements about reasons to go to college apply to them. From those ratings, measures of intrinsic motivation, extrinsic motivation, and amotivation are inferred. The IM subscale consists of items that assess IM to know (i.e., "Because I experience pleasure and satisfaction while learning new things"), to accomplish things (i.e., "For the pleasure I experience while surpassing myself in my studies"), and to experience stimulation (i.e., "For the intense feelings I experience when I am communicating my own ideas to others"). Subscales consisting of items assessing EM and amotivation were also included in the questionnaire, but were of no relevance to the current study. Participants were asked to rate items on a 7-point Likert scale ranging from 1 (*Does not correspond at all)* to 7 (*Corresponds exactly*).

For the purpose of our study, a unidimensional IM subscale was created by calculating the overall mean score of items measuring IM to know, to accomplish things, and to experience stimulation. This approach has been similarly followed in previous studies (Otis et al., 2005; Taylor et al., 2014 [Study 2]). The AMS subscales have shown to have satisfactory

internal consistency both in the original French study, with Cronbach's alpha ranging from .76 to .86 (Vallerand et al., 1989), and in the English version, in which Cronbach's alpha ranged from .83 to .86 (Vallerand et al., 1992). Moreover, the correlations between subscale items and motivation antecedents and consequences support the construct validity of the questionnaire (Vallerand et al., 1993). The internal consistency of our computed IM subscale was satisfactory (Cronbach's $\alpha = .90$).

School Hyperfocus

To measure hyperfocus during school-related activities, the School Hyperfocus (SHF) subscale was utilized, which is part of the Adult Hyperfocus Questionnaire (AHQ; Hupfeld et al., 2019). The scale consists of 12 items, which ask participants to rate the frequency of different feelings or experiences relating to hyperfocus states (e.g., "Completely losing track of time while doing work for the class") on a 6-point Likert scale ranging from 1 (*Never*) to 6 (*Always/daily*). In contrast to the original SHF subscale instructions, where participants were asked to rate their experiences and/or feelings of hyperfocus when studying for their favorite school course, the subscale instructions in our study were changed to ask participants to rate their overall feelings and/or experiences of hyperfocus while completing homework or studying, unrelated to a specific university course.

Regarding the internal consistency measures of the AHQ, high reliability scores of the SHF were provided in the original study, with Cronbach's alpha ranging between .95 and .96 (Hupfeld et al., 2019 [Study 1 and Study 2, respectively]). The convergent and content validity of the subscales was also demonstrated in the original validation samples (Hupfeld et al., 2019). For the current study, the internal consistency of the School Hyperfocus subscale was satisfactory (Cronbach's $\alpha = .87$).

Academic Performance

Academic performance was measured by computing students' grade point average (GPA) on a 10-point scale (1 = lowest grade; 10 = highest grade). The grades were accessed directly from the university's system at the end of the academic year. If students received more than one grade in a course (e.g., due to taking a resit exam), only the most recent grade was considered.

Design

The present study employed a quantitative, cross-sectional correlational design by means of a survey. In order to test hypotheses 1 and 2, intrinsic motivation was used as a predictor of academic performance and school hyperfocus, respectively. For testing hypothesis 3, hyperfocus was used to predict academic performance. Regarding our fourth hypothesis, hyperfocus was used as a mediating variable in the relationship between intrinsic motivation (predictor) and academic performance (outcome).

Data analysis

The statistical techniques we utilized included correlational, regression, and mediation analyses, which were performed using IBM SPSS (version 28). The mediation analysis was conducted using the SPSS macro PROCESS (version 4.2; Hayes, 2022). For this study, results were deemed significant if p-values were below .05. Bivariate correlations were considered weak if Pearson's correlation coefficient was close to 0.10, moderate if it was close to 0.20, and strong if the correlation coefficient was close to 0.30, as proposed by Gignac and Szodorai (2016). The mediation effect was deemed significant if the 95% confidence interval for the indirect effect (ab) did not contain a zero value.

Results

Assumption Checks

Before running the regression analysis, we tested the following assumptions: normality, linearity, homoscedasticity, independence of residuals, and lack of interaction

between the predictor and the mediator. Firstly, we conducted normal Predicted Probability plots to test the assumption of normality for GPA, hyperfocus, and IM, which all showed a normal distribution. Visual inspection of the histograms, as well as the skewness and kurtosis values being within the acceptable range, confirm that the assumption of normality is met. The residual plots showed a random pattern indicating linearity and homoscedasticity. As part of the analysis of linearity, we checked for outliers (data points that fell more than two standard deviations away from the mean). After conducting one analysis with outliers and one analysis with all outliers removed, we found no influential differences. Therefore, we decided to use the data set including the outliers in our final analysis. The independence of residuals was assessed using the Durbin-Watson Test (Durbin & Watson, 1951), with a positive autocorrelation between values indicating independence. Altogether, no assumptions were violated so the procedure of interpreting the results from the multiple regression could be executed. Lastly, in regard to the mediation analysis, we tested the interaction between intrinsic motivation and hyperfocus via PROCESS (version 4.2, developed by Hayes, 2022). The result was not significant, therefore no significant interaction between the predictor and mediator could be found.

Preliminary Analyses

Descriptive statistics and bivariate correlations were conducted to explore the relationships between variables, along with means and standard deviations (see Table 1). To mitigate the risk of Type I errors during the calculation of multiple correlations, the Bonferroni correction was applied, establishing a significance level of $\alpha = .0167$. Mean values for academic performance and IM exceeded the midpoints of their respective scales, while the mean for hyperfocus fell below its midpoint. Standard deviations were relatively small, indicating limited variability around the means. Bivariate correlations that showed significance were IM exhibiting a weak positive correlation with academic

performance and a strong positive correlation with hyperfocus. The bivariate correlation between hyperfocus and academic performance was nonsignificant.

Table 1

Means, Standard Deviations, and Pearson's Correlation Coefficients of Intrinsic Motivation, Hyperfocus, and Academic Performance (N=594)

Variable	M	SD	1	2	3
1. Intrinsic Motivation	4.75	.93	-		
2. Hyperfocus	3.03	.82	.33**	-	
3. Academic performance	6.79	1.17	.14**	-.02	-

*Note. **p < .01.*

Main analysis

Our first hypothesis predicted that IM would be positively associated with GPA. The results we got by using multiple linear regression analysis found IM to be significantly positively associated with academic performance (see Table 2). The regression coefficient *B* showed when IM increases by one unit, subsequently this leads to an increase of 0.211 in the mean of academic performance. IM was shown to be a predictor for 2.5% of variability in academic performance. For our second hypothesis HF was found to be significantly positively associated with IM using a simple linear regression with IM as the predictor for HF (see Table 2). The regression coefficient *B* showed that when IM increases by one unit this leads to an increase of 0.292 in the mean of hyperfocus. IM was shown to predict 11% of variability in hyperfocus. For our third hypothesis HF was not found to be significantly associated with GPA (see Table 2).Lastly, we conducted a mediation analysis to examine our fourth hypothesis, proposing that hyperfocus would serve as a mediator in the relationship between IM and GPA. Despite not identifying a significant direct association between hyperfocus and GPA, we decided to use the method introduced by Hayes (2022) called PROCESS for our mediation analysis. Through PROCESS one can find a significant

indirect effect, even in the absence of a direct association between the variables. Through the 5000 samples bootstrapping procedure, the 95% confidence interval of the indirect effects contained a zero value (see Table 2). The findings did not support to our mediation hypothesis.

Table 2

Total, Direct, and Indirect Effects in the Mediation Model

Variable	Path	B	SE	*p*	95%CI		R^2
					LL	UL	
Total effect	IM→GPA	.180	.051	<.001***	.080	.280	.021
	IM→HF	.292	.034	<.001***	.225	.359	.110
Direct effect	HF→GPA	-.105	.061	.089	-.225	.016	.025
	IM→GPA	.211	.054	<.001***	.011	.317	.025
Indirect effect	IM→HF→GPA	-.031	–	–	-.069	.005	–

Note. IM = Intrinsic Motivation; HF = Hyperfocus; GPA = Grade Point Average; B = Model regression coefficient; SE = Standard Error of beta; *p* = p-value of regression model; CI = Confidence Interval; LL = Lower Level; UL = Upper Level; R^2 = Square of coefficient of multiple correlation.

***p <.001.

Discussion

The present study aimed to test whether hyperfocus is a mediating factor for university students with higher IM showing higher academic performance. We found that while IM has a positive association with both academic performance and hyperfocus, hyperfocus was not significantly associated with academic performance and also did not act as a mediator between intrinsic motivation and academic performance. Therefore, hypotheses 3 and 4 were not consistent with the study's results.

As predicted by our first hypothesis, university students who were intrinsically motivated performed better academically. Our results are consistent with the precedent studies (e.g. Howard et al., 2021; Richardson et al., 2012) that found intrinsic motivation to be a predictor of high academic performance. Consequently, our study can be seen as further support for SDT (Deci & Ryan, 1985), which states that students perform better academically when driven by intrinsic motivation, as they perceive school-related tasks as inherently engaging and fulfilling and are not reliant on external rewards. This finding has the practical implication that universities should further prioritize appealing to student's basic needs to increase their IM and subsequently their academic performance. In order to foster the need for autonomy teachers could provide multiple assignment or project options for the students. To enhance the feeling of relatedness, frequent group work and closer collaboration with the teacher could suffice, while constructive feedback rounds with said teacher could additionally increase students' perception of competence.

In line with our second Hypothesis, we found support that IM positively predicts hyperfocus. We based this hypothesis on Ashinoff and Abu-Akel (2019), as according to them one of the conditions for an individual to experience hyperfocus is that the activity has to be interesting, enjoyable, or instantly rewarding. Therefore, we inferred that someone who is intrinsically motivated to study might also experience increased hyperfocus. Our study is the first one to provide empirical evidence for this assumed relationship, suggesting that IM is a potential antecedent of hyperfocus. A recent study defined hyperfocus as a state of deep concentration that's outside a person's control (Ayers-Glassey & Smilek, 2023). Moreover, upon discovering a positive correlation between hyperfocus and dysregulation of positive emotions, they theorized that the challenges in attention control might stem from a dysregulated motivation system that compellingly directs individuals toward engaging in enjoyable tasks. This adds to Reeve's (1989) findings that IM exerts its positive effect on

attention via interest directing one's attention and enjoyment sustaining one's attention. Our results provided empirical evidence for the theoretical assumptions of IM being a predictor for hyperfocus, adding to the notion that hyperfocus is a state one cannot actively control or intentionally induce if the task is not perceived as interesting or enjoyable.

For our third hypothesis, we predicted hyperfocus to be positively associated with academic performance. Our data could not support this hypothesis, as students who experienced high levels of hyperfocus did not seem to have corresponding high academic performance. Therefore, our fourth hypothesis, that hyperfocus would act as a mediator between intrinsic motivation and academic performance, which was highly reliant on the third hypothesis, did not find support in our data either.

These Hypotheses were mostly based on the idea that hyperfocus is closely related to the concept of flow (Hupfeld et al., 2019), which in turn was found to predict increased academic performance (Sumaya & Darling, 2018). Research on hyperfocus in leisure activities found that performance while playing video games increases when one experiences hyperfocus (Ashinoff & Abu-Akel, 2021). This led us to conclude that experiencing hyperfocus while studying would increase academic performance. However, the lack of evidence provided by our data is somewhat surprising. One possible explanation could be that while some aspects of hyperfocus, like high concentration and diminished perception of external stimuli, are rather beneficial, others like difficulty shifting one's attention and forgetting to attend to personal needs could worsen academic performance. Ozel-Kizil et al. (2016) describe that ADHD patients who experience hyperfocus cannot control what they hyperfocus on, but rather 'lock on' to something of interest or new and exciting. Getting stuck on one specific topic that one finds interesting while studying for an exam may be counterproductive, as this could lead to less interesting topics being studied insufficiently.

Furthermore, while testing the frequency of hyperfocus for participants with or without ADHD throughout different situations, Groen et al. (2020) found that most people hyperfocus on two situations on average. The situations where most participants indicated the tendency to hyperfocus were consuming media (40%), work (18%), and creative work (15%). In contrast, hyperfocus during educational activities was not as frequent with only about 11 % of the participants indicating to experience hyperfocus there. When relating these findings to our results one should consider that participants who hyperfocus in educational activities may have at least one other situation where they experience hyperfocus. These findings connected with the notion that hyperfocus entails a lack of control over one's attention (Ayers-Glassey & Smilek, 2023; Ozel-Kizil et al., 2016), could be a possible explanation for our results. According to this, students who have a tendency to hyperfocus during educational activities and consume media might lock on to their phone at times when they should be studying, which in turn would negatively influence their academic performance. Another characteristic of hyperfocus that could be counterproductive to academic performance is the tendency to lose perception of everything 'external'(source). Losing track of time and neglecting personal needs like sleep, food and even going to the bathroom for an extended amount of time can be draining to the extent that someone is not able to perform well during an exam following the hyperfocus episode.

One theory that could bring light onto our surprising lack of significant results is the transfer-appropriate processing theory (TAP, Morris et al. 1977). TAP suggests that memory performance is optimized when the cognitive processes engaged during encoding match those used during retrieval. Based on this, one could theorize that knowledge that was memorized during a state of hyperfocus is harder to retrieve during a non-hyperfocus state, which could lead to diminished academic performance. The nature of most exams makes hyperfocus far less likely, as it interferes with conditions that facilitate hyperfocus. IM, functioning as a

predictor for hyperfocus in our study, was found to be enhanced through autonomy (Deci & Ryan, 1985), interest, and enjoyment (Reeve, 1989) and undermined through external pressures and imposed goals (Ryan & Deci, 2017). Most exams do not contain new and interesting material and hardly ever give the students a choice between assignments, while the importance of achieving a high grade is quite apparent. This makes it quite improbable for people to be intrinsically motivated during an exam, and therefore experiencing hyperfocus is almost unattainable. Our study measured academic performance through GPA, which in turn was mostly made up of one final grade per course. Whether or not they can hyperfocus during the exam itself could possibly influence the results. Similarly to past studies measuring hyperfocus during educational activities, that tested questions regarding studying, exam preparation, and readying for university (Groen et al. 2020), our questions focused on studying and homework and not hyperfocus during the exam itself. Therefore, subsequent studies could try to ask specific questions that focus on hyperfocus during the exam or try to conduct this study with a sample of students from a different university program, where the grade is made up through other means like assignments, group projects, and participation. Replicating the study with a university program where the GPA is more representative of their overall academic performance might result in a different outcome.

Furthermore, the association between hyperfocus and academic performance may be even more complex, due to third variables like ADHD and other comorbidities. While both neurotypicals and people with ADHD experience hyperfocus, people with ADHD tend to experience it more frequently (Grotewiel et al., 2023). Additionally, participants with ADHD indicated hyperfocus significantly less during educational activities than the non-ADHD participants (Groen et al., 2020). Due to other symptoms of ADHD like difficulties in attention regulation, people with ADHD tend to perform worse academically than their neurotypical peers (Henning et al., 2022). Controlling for ADHD and comorbidities like

anxiety disorders, learning disabilities, and sleep disorders (Ribasés et al., 2023) could result in a significant association between academic performance and hyperfocus being shown.

Strengths, *Limitations and future Directions*

To provide a comprehensive evaluation of this study, it is essential to highlight both its strengths and limitations, offering a balanced perspective on the research outcomes. The strengths of the present study lie in both its extensive sample size and its inclusion of students across all three academic years within the psychology bachelor's program. Students' academic motivation tends to fluctuate throught their study experrience (Poteliūnienė et al., 2022), and a sample encompassing participants from all three academic years, enables a more comprehensive exploration of IM and its association with hyperfocus. While this slightly increases the generalizability of this study, it is important to note that some of the variables might be influenced by the sample's demographics.

Firstly, there is an overrepresentation of female participants and previous research showed that females score significantly higher than males on the IM subscales in the Academic Motivation Scale (e.g., Vallerand et al., 1992; Cabras et al., 2023). Furthermore, there is an overrepresentation of Dutch and German participants and several studies found significant cultural differences in the motivational predictors of academic performance (e.g., Cheng, 2019; Cabras et al., 2023). Prior research indicates that for participants form some countries IM is not the motivational type to best predict academic performance. For instance, Taiwanese (Cheng, 2019) and Russian (Cabras et al., 2023) students were found to have significantly higher levels of EM than IM. Therefore, the findings of the present research neither be generalized to other nationalities or cultures, nor to populations with an overrepresentation of males. Follow-up studies should conduct research on a comparably large sample size and participants from all three academic years, but on a more diverse set of students.

Some limitations can also be found in the way we operationalized the studied

variables. Academic performance was operationalized as GPA since it is a reliable and

objective measure of academic performance (Richardson et al., 2012), however, in our case it

is mainly obtained from final exams. The operationalization of hyperfocus through the AHQ

on the other hand mainly focused on school work and homework. One could say that we

measured both variables in different contexts and this might have contributed to our lack of

evidence for the relationship between hyperfocus and academic performance. Future research

could continue measuring academic performance through GPA, but obtained through an essay

instead of a final exam, so it matches the questions featured in the AHQ.

Furthermore, the assessment of hyperfocus using a questionnaire introduces several

limitations. For one, self-report measures are highly suspectable to biases and are therefore

used with caution, especially when it comes to such an abstract concept like hyperfocus.

Moreover, the featured subscale of the Adult Hyperfocus Questionnaire has not been

extensively validated. Further research should evaluate the structural and external validity of

the questionnaire.

Lastly, given our correlational design, we were unable to infer a causal relationship

between IM and hyperfocus. It might be possible that being intrinsically motivated causes one

to experience hyperfocus and to increase academic performance. However, it could also be

possible that high academic performance or frequent experience of hyperfocus cause one to be

more intrinsically motivated. In order to find out which variables are predictors and which are

outcomes, longitudinal studies where fluctuation of the variables and their relationships are

being tracked could give us an insight into their complex relationships.

Conclusion

Our study provided insight into the relationship among intrinsic motivation,

hyperfocus, and academic performance. The results not only reinforced existing findings that

connect intrinsic motivation to academic performance but also verified the hypothesized connection between hyperfocus and intrinsic motivation. Surprisingly, our study did not uncover any support for the idea that hyperfocus increases academic performance or functions as a mediator between intrinsic motivation and academic performance. The data suggest that nurturing students' intrinsic motivation can positively impact their GPA. However, until further research shows otherwise, hyperfocus cannot be endorsed as beneficial to academic success. Future research should delve deeper into the individual aspects of hyperfocus and explore their specific relationships with academic performance. The difference of flow and hyperfocus should also be further explored to explain how these seemingly similar concepts have a rather opposing influence on academic performance.

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doi:10.1177/0013164493053001018.
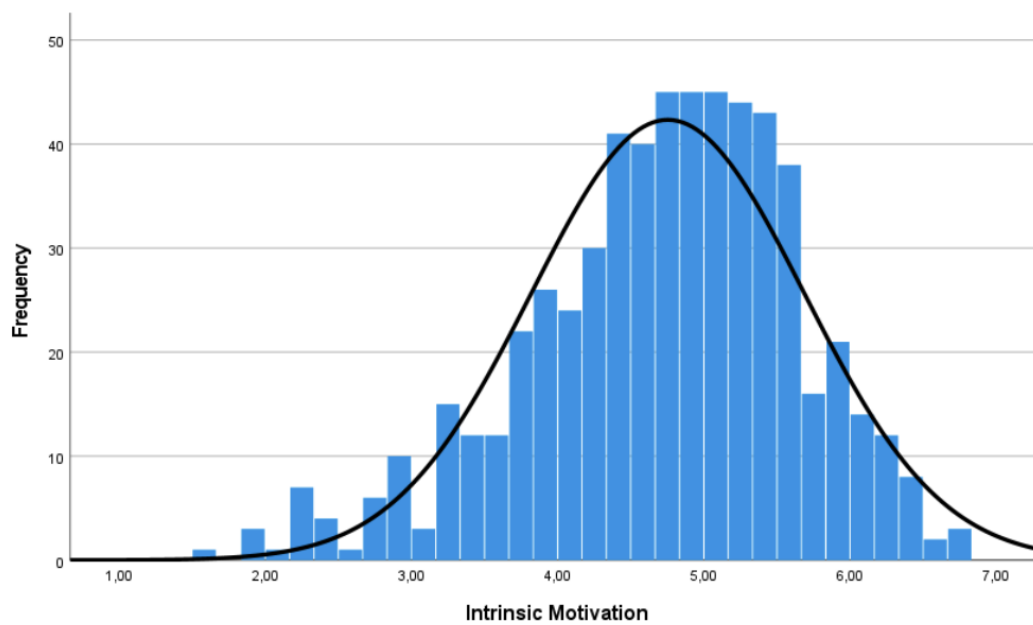
Appendix A

Figure A1

Intrinsic Motivation Histogram
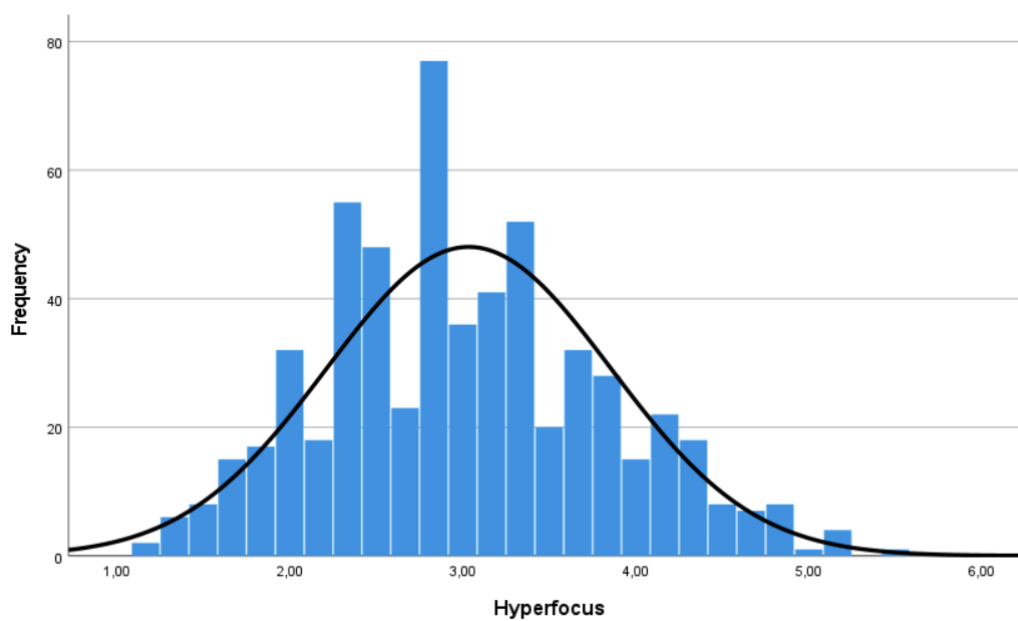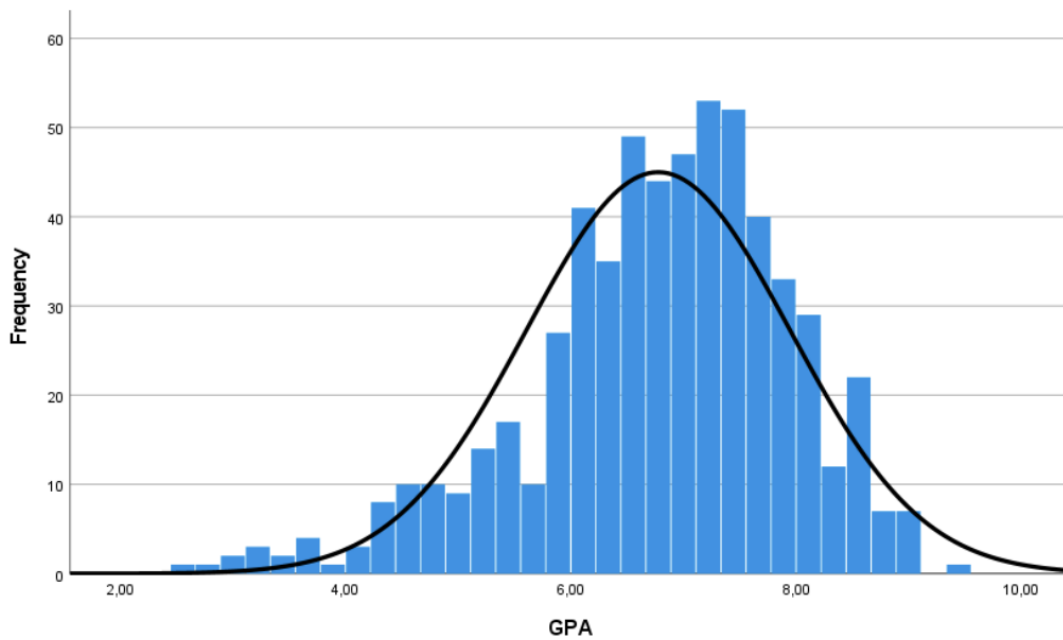

Figure A2

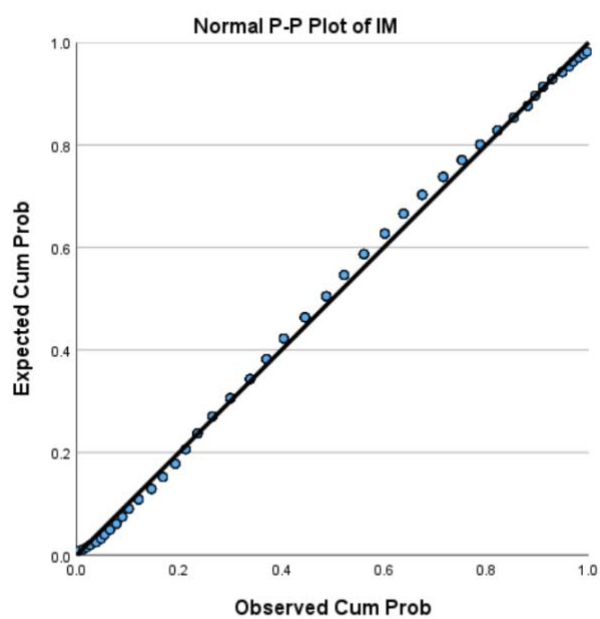*Hyperfocus Histogram*

Figure A3

GPA Histogram

Figure A4

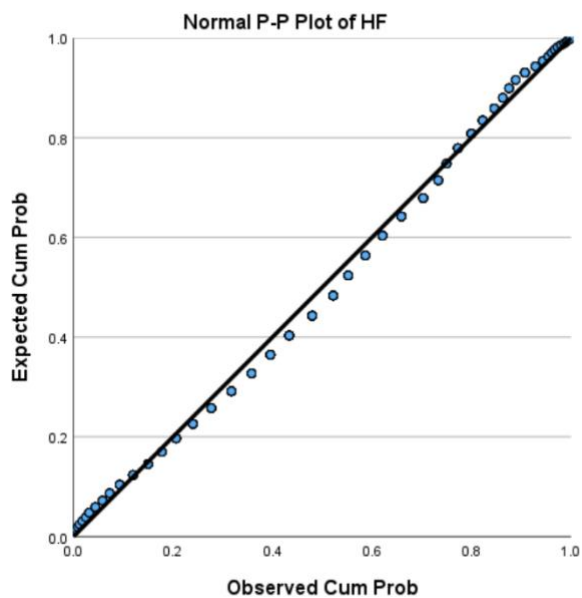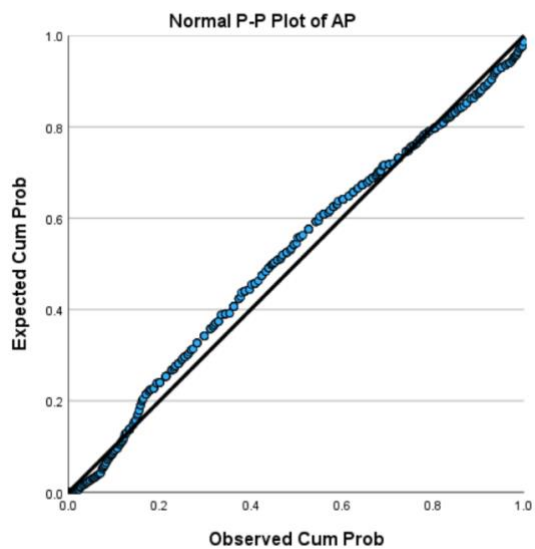*Normal P-P Plot of Intrinsic Motivation*

Figure A5

Normal P-P Plot of Hyperfocus

Figure A6

Normal P-P Plot of Academic Performance

Figure A7

Scatterplot Matrix: Intrinsic Motivation, Hyperfocus, Grade Point Average (GPA)