What Are The Underlying Cognitive and Academic Motivators Influencing the Frequency

of Hyperfocus State During Studies?

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Abstract

Hyperfocus is the experience of long periods of sustained attention during which performance can be enhanced, this is often about entertaining activities as opposed to intensive ones such as studying. Cognitive motivators are variables that influence the experience of attention, this study focused on three cognitive motivators: intrinsic academic motivation, the need for cognition, and epistemic curiosity. First-year psychology students at the University of Groningen completed an online questionnaire. A multiple regression analysis found that intrinsic motivation and the deprivation sensitivity dimension of epistemic curiosity were strong, positive predictors of hyperfocus, while the need for cognition and the joyous exploration dimension of epistemic curiosity were non-significant. The results indicate that the cognitive motivators are correlated with one another, but only intrinsic motivation and epistemic curiosity sensory deprivation are predictors of hyperfocus in studies.

Keywords: Hyperfocus, hyperfocus in school, academic intrinsic motivation, epistemic curiosity, need for cognition

What Are The Underlying Cognitive and Academic Motivators Influencing

Hyperfocus Frequency During Studies?

Attention is an important facet of everyday functioning, including some degree of sustained attention that is necessary to go about completing tasks for either work purposes or enjoyment. Sustained attention involves the maintenance of persistent attention and continued effort over long periods (Ko et al., 2017), the extreme counterpart of this is hyperfocus. The level of maintained attention and enhanced performance present in hyperfocus states is typically attributed to enjoyable tasks, such as watching television programmes or playing video games (Ashinoff & Abu-Akel, 2019). Despite this, instances of hyperfocus in academia have been documented (Groen et al., 2020). The present research will look into the antecedents of a hyperfocus state during studies, and will assess the research question: what are the underlying cognitive motivators influencing the frequency of hyperfocus in studies? This research looks into three cognitive motivators that appear to support sustained attention and occur in hyperfocus during studies: the need for cognition, intrinsic motivation, and epistemic curiosity.

Hyperfocus

Hyperfocus is a phenomenon referring to the complete fixation on a specific task over an extended period, to a degree that irrelevant external stimulus is ignored (Ashinoff & Abu-Akel, 2021). The most frequent report of hyperfocus states occurring is when individuals are engaged in a task that is enjoyable and interesting to them. Across the literature, the common themes that characterise hyperfocus include an intense state of focus, reduced perception of unrelated external stimuli, a loss of temporal awareness, and heightened performance in the task (Ashinoff & Abu-Akel, 2019; Hupfeld, Abagis & Shah, 2018). This state can be experienced by neurotypical and neurodivergent populations alike (Ashinoff & Abu-Akel, 2019), however, most

often it is reported that clinical populations experience hyperfocus. For instance, ADHD patients experienced hyperfocus states more often than neurotypical patients in a variety of settings including school (Hupfeld, Abagis & Shah, 2019). The experience and persistence of hyperfocus do differ in clinical and non-clinical populations across various contexts, for example, ADHD patients experience hyperfocus less frequently in educational and social settings (Groen et al., 2020). Research into this focused state does not often address underlying determinants of hyperfocus, however, these determinants can be implicitly mentioned instead. This paper will aim to address this gap in knowledge, and explicitly identify and explore these determinants that are likely to facilitate states of hyperfocus in school. By doing so, the study looks into the antecedents of hyperfocus instead of focusing on the preconditioned properties of hyperfocus states.

Hyperfocus has been documented to occur when individuals engage in activities they enjoy, indicating how external cues (activities) in the environment can influence the experience of a hyperfocus state (Ashinoff & Abu-Akel, 2019). Most research has an implicit understanding that entering the hyperfocus state involves some form of cognitive motivation, namely curiosity, motivation, and need for cognition. These cognitive processes fall under the term 'cognitive motivator' and may be antecedents of hyperfocus states. This provides an alternative perspective that hyperfocus is not entirely dependent on contextual factors. As a large body of research into hyperfocus tends to attribute the state to enjoyable activities (Ashinoff & Abu-Akel, 2019), it is under-researched in academia. However, if the determinants of hyperfocus are being addressed, then this state can occur in any context given the identified antecedents are prevalent.

This may provide insight into potential underlying processes of hyperfocus and the motivational properties that could attribute to the experience of it.

Intrinsic Academic Motivation

Motivation can be defined as a process by which goal-oriented behaviour is initiated and maintained (American Psychological Association, 2022), during which periods of sustained attention are expected when completing goal-related activities. Motivation is characterised by what pushes individuals to engage in goal-related activities. This provides two distinct forms of motivation: extrinsic and intrinsic. Intrinsic motivation (IM) is governed by internal rewards of satisfaction from doing something enjoyable or interesting (Ryan & Deci, 2000), which can encourage knowledge-seeking or learning-oriented behaviour.

With the trajectory of this study, the focus narrows to academic intrinsic motivation. Academic motivation can be defined as the desire to perform well in academia when one's competence is perceived against a criterion of excellence, such as good grades (DiPerna & Elliott, 1999). When looking at intrinsic academic motivation specifically, the desire to perform well can be due to internal rewards or satisfaction experienced through learning. Intrinsic academic motivation can be differentiated further into three categories: IM to know, IM to accomplish, and IM to experience stimulation (Vallerand et al., 1992). IM to know is the drive to engage in behaviour due to the inherent enjoyment of performing the activity, especially concerning learning and exploring new things (Vallerand et al., 1989). Students who are invested in their field of study may enjoy learning it and push themself to work harder when introduced to novel information. This enjoyment and motivation can sustain attention for longer periods and lead to a hyperfocus state. IM to know is associated with constructs such as curiosity; as suggested by the exploration of novel information in studies (Vallerand et al., 1989). IM to accomplish involves behaviours motivated by the desire to feel competent and to participate in new tasks, it is seen as the engagement in activities for the satisfaction of accomplishing

something (Vallerand et al., 1992). Students can be motivated by their academic success especially when a criterion is present, by engaging in learning behaviour, students increase their sense of self-competence. This desire to feel accomplished and the satisfaction that is derived from it can lead to a hyperfocus state by motivating individuals to maintain focus on a given task. The final subcategory of intrinsic academic motivation is IM to experience stimulation. This form of IM focuses on the sensations one experiences when engaging in activities, such as sensory pleasure or excitement (Vallerand et al., 1989). Students may be motivated to learn to experience positive sensations in class that leads to cognitive pleasure (Vallerand et al., 1992). For example, positive stimulation from engaging in a class discussion may result in cognitive pleasure that could enhance sustained concentration to maintain that experience.

Epistemic Curiosity

The second cognitive motivator explored in hyperfocus within studies is epistemic curiosity. Epistemic curiosity (EC) is a multidimensional construct with two dimensions involved; deprivation sensitivity and joyous exploration, that may be implicated in the experience of hyperfocus states. Similarly, research into curiosity has indicated that this construct spans various psychological traits, such as the need for cognition (Kashdan et al., 2018), which is another cognitive motivator addressed in the present study.

EC is a motivational force that drives learning (Alexander, 2019) the process of which occurs as people seek information in their environment that is new to them (Berlyne, 1954). This information-seeking behaviour can be driven by a gap between knowledge and reality, which encourages people to reduce incongruity. In this sense, they reduce the knowledge-gap present to satisfy their curiosity (Schmidt & Rotgans, 2020). This presents EC as a driver of information-seeking behaviours (Berlyne, 1962). When a knowledge-gap intervenes in how

individuals can understand a situation or perform optimally (Loewenstein, 1994), feelings of deprivation and frustration may arise. With this understanding, the deprivation sensitivity dimension of EC is defined as the experience of wanting to know because the lack of knowledge is even more frustrating (Litman et al., 2005). EC reduces feelings of deprivation by motivating individuals to learn, which can result in an enhanced state of focus to reduce the knowledge-gap and the feelings of deprivation quickly. This understanding provides insight into curiosity occurring in the absence of enjoyable tasks, therefore, curiosity can also thrive in academic settings. Among students, reducing the gap between pre-existing knowledge in a course and new information needed for their studies motivates them to learn (Day, 1971). When motivated, students are more likely to enter a hyperfocus state as they have the drive to pursue information to reduce feelings of deprivation and may have increased concentration states to achieve this. Overall, EC affects attention because individuals seek out information to resolve feelings of deprivation, thereby removing the uncertainty and tension that occurs with it (Loewenstein, 1994).

The second dimension of EC is joyous exploration, feelings of curiosity are combined with joy and pleasure which produces a favourable reaction to learning (Kashdan et al., 2020). This positive experience of learning and interaction with the world can drive forward the desire to explore and seek out new information (Kashdan et al., 2018). Joyous exploration involves being fascinated by learning about novel things or activities, individuals may be drawn to such things and dedicate mental resources to explore this. The inherent joy and positive experiences of such exploration characterise this dimension of EC (Kashdan et al., 2020). In the context of the present research, if a student notices a novel topic of study, they experience curiosity to explore and learn. By having positive associations and joyful pleasure from learning, students are likely

to have sustained attention during this experience. When students enjoy the process of learning and find pleasure in exploring novel information, learning-seeking behaviour and sustained attention are enhanced. As previous research indicated, hyperfocus can occur during enjoyable tasks, therefore if someone enjoys learning they can enter a hyperfocus state.

Need for Cognition

The need for cognition (NFC) is a psychological construct that refers to the tendency for individuals to "engage in and enjoy thinking" (Cacioppo & Petty, 1982). This contemporary perspective of NFC focuses on individual differences in the indication and gratification of intellectually stimulating cognitive activities, such as knowledge acquisition via studying or learning, and reasoning (Cacioppo & Petty, 1982). This understanding of NFC suggests that individual differences in personal motivations drive cognitively effortful behaviour to satisfy the desire for higher-level cognition.

As NFC relates to the enjoyment of thinking, those who have high NFC are more likely to enjoy situations with problem-solving or reasoning, therefore they have a more positive outlook on such tasks compared to those with low NFC (Cacioppo et al., 1996). Differences in NFC can explain variances in academic motivation (Colling et al., 2022) and other behaviours as the cognitive influences of NFC encourage different learning-seeking behaviours. Those with higher NFC are more willing to engage in a cognitively challenging task and exert the necessary effort to complete it, experiencing sustained attention for longer periods to complete tasks. With this understanding, NFC relates to academic motivation and attention by implementing successful self-regulated learning strategies when studying to process the information on a deeper level (Cazan & Indreica, 2014). Furthermore, it is evident from this why NFC and EC are

related: the desire for knowledge that encourages fruitful thinking and assists in resolving intellectual problems through learning-seeking behaviour (Litman, 2008).

The Present Research

The present research will explore novel hypotheses that look into the determinants of hyperfocus in studies. It will focus on identifying the effect IM, NFC and EC have on the frequency of hyperfocus state and any correlations these variables have with one another. This provides information on the limited literature on hyperfocus, with an explicit focus on cognitive factors as the antecedents of a hyperfocus state, especially in academic settings. Previous studies into hyperfocus in school contain limitations for either not studying student populations (Hupfeld et al., 2019), and those that did assess student populations did not measure hyperfocus in school (Ko et al., 2017).

Furthermore, the present study can provide deeper insight into the cognitive processes of hyperfocus. This can answer the primary research question by presenting support for the presence of underlying determinants of hyperfocus that triggers a hyperfocus state. This would give alternative perspectives to hyperfocus outside of the idea that the context influences hyperfocus. It broadens the understanding of hyperfocus experiences and allows further avenues of research to be explored. This understanding can generate practical methods to induce hyperfocus states geared towards academic productivity and studying for exams or completing assignments. Additional practical implications can be the development of learning techniques through the understanding of underlying factors of hyperfocus for students to trigger and maintain sustained attention.

The study can present the influence and strength of effect IM, NFC, and EC have on hyperfocus, and increase understanding of the relationship these cognitive motivators have to

one another. This will answer the second research question by showcasing the relationships these variables have with one another, and the collective impact on behaviour these cognitions can have. For example, is someone who has high intrinsic motivation and a high need for cognition more likely to enter hyperfocus states compared to others?

This paper will thus answer the primary research question: how are these cognitively motivating variables related to hyperfocus frequency in studies amongst university students? And to assess further relationships between the cognitive motivators, as indicated by the secondary research question: are these cognitively motivating traits related to each other?

To test this, the following hypotheses will be investigated:

H1: The experience of a hyperfocus state can be attributed to a high epistemic curiosity within the context of studying.

H2: The experience of a hyperfocus state can be attributed to high intrinsic academic motivation within the context of studying.

H3: The experience of a hyperfocus state can be attributed to a high need for cognition within the context of studying.

H4: There is a relationship between the cognitive motivators IM, NFC, and EC.

Methods

Participants

A convenience sample of bachelor students was gathered by advertising through social media, hanging flyers around the university, and SONA. Participants were selected based on the inclusionary criteria: students in the first, second, or third year of the BSc of Psychology at the University of Groningen. Therefore, students of Master's and other bachelor's courses were part of the exclusionary criteria. The first-year students were only gathered using the SONA participants pool. The second- and third-year students were collected using social networks (such as WhatsApp) and fliers around the campus. Of the 394 participants who initially filled out the survey, 19 participants (4.82%) were removed because they did not meet the criteria, as 12 participants (3.05%) did not complete the entire questionnaire, six participants (1.52%) finished the survey in under ten minutes, and one participant (0.25%) failed to answer the bogus question. Therefore, our final sample consisted of 375 participants.

Moreover, the sample consisted of 88 male participants (23.57%), 258 female participants (76.0%), and two participants (0.53%) who preferred not to say their biologically assigned sex at birth. The average age of the participants was 19.76 years (SD = 2.10), while the minimum age of a participant was 17 years, and the maximum age of a participant was 35 years. Most of the participants in our sample were Dutch (49.87%). Also, 84 participants were German (22.4%), and 104 had a different nationality (27.73%). 88% of the participants had completed the upper secondary level of education (n= 330). All participants in the first year of their bachelor's degree (SONA participant pool) received SONA credits as an incentive. However, all other

participants, such as second- and third-year students, were rewarded with an incentive of 1.5 euros.

Materials/Measures

The Hyperfocus in School Scale was used to measure the frequency of hyperfocus in the academic context. This questionnaire is a 12-item subscale of the Adult Hyperfocus Questionnaire (AHQ; Hupfeld et al., 2019) centred around hyperfocus in the context of school. Some examples of statements used in this questionnaire included ("Completely losing track of time while doing work for the class.","Not noticing the world around you [e.g. not realising if someone calls your name or if your phone buzzes] if you're working on homework or studying."). The Hyperfocus in School Scale originally made use of a six-point Likert-scale ranging from 'Never' to 'Daily', in the adapted version a 6-point Likert scale is used however it ranges 'Never' to 'Always/Daily'. Further differences relative to the original included a timeframe in the Likert scale, such as 'Rarely / 1-2 times every 6 months', 'Sometimes 1-2 times per month', 'Often / Once a week' and 'Very often / 2-3 times a week'. The purpose of this modification was to ensure results of the AHQ were comparable with other outcome measures in the study. The scores in this scale were computed by calculating the sum of all the items present for a total score of 72. The original questionnaire had an additional instruction for participants to identify their favourite course and keep this in mind when answering the questionnaire ("What is your favourite course that you have taken so far in college? This could be a class that you are currently taking."). In our study, we have omitted this to allow participants to generalise the questions to all university-related work. In the current sample, this scale had a Cronbach's alpha of .87.

The Need for Cognition-6 (NCS-6, Coelho et al., 2020) questionnaire measured the amount of enjoyment people get from engaging in cognitively challenging activities. This is an adapted version of the original Need for Cognition scale. The NCS-6 questionnaire is a six-item survey that uses a five-point Likert scale ranging from 1 (extremely uncharacteristic) to 5 (extremely characteristic). No changes were made to the original NCS-6 when it was used in our survey. The survey contained six statements about Need for Cognition ("Would prefer complex to simple problems.","I really enjoy a task that involves coming up with new solutions to problems."); two of which were reverse-coded ("Thinking is not my idea of fun.", "I would rather do something that requires little thought than something that is sure to challenge my thinking abilities."). This scale was calculated by finding the sum of scores across the six items. The NCS-6 in the present sample had a Cronbach's alpha of .74.

The Five-Dimensional Curiosity Scale (5DC; Kashdan et al., 2018) measured the multidimensional construct of curiosity as well as concepts that are related to curiosity, such as openness to experience. This scale consisted of 25 questions and used a seven-point Likert scale from 1 (does not describe me at all) to 7 (completely describes me). The subscales of the 5DC are Joyous Exploration, Deprivation Sensitivity, Stress Tolerance, Social Curiosity, and Thrill-Seeking. All of these subscales contained five items. Moreover, the Stress Tolerance subscale was entirely reverse-coded. The score of each subscale was calculated by finding the average of each dimension. For the present study, the subscales "Deprivation Sensitivity" and "Joyous Exploration" were used to assess the construct "Epistemic Curiosity." No changes were made to the original scale in the survey of the present study. Statements used for the 5DC Deprivation Sensitivity subscale included ("Thinking about solutions to difficult conceptual problems can keep me awake at night.","I work relentlessly at problems that I feel must be

solved."). Some statements used for the 5DC Joyous Exploration subscale were ("I view challenging situations as an opportunity to grow and learn.","I find it fascinating to learn new information."). Overall, in the sample the 5DC Cronbach's alpha for the Deprivation Sensitivity subscale was .83, while for Joyous Exploration the Cronbrach's alpha was .78.

The Academic Motivation Scale (AMS; Vallerand et al., 1992) was used to measure the motivation of students towards learning. The questionnaire consists of 28 items, and it makes use of a seven-point Likert scale ranging from 1 (does not correspond at all) to 7 (corresponds exactly). Additionally, this questionnaire consisted of seven subscales of motivation, which had four items each: Amotivation, Intrinsic Motivation to Know, Intrinsic Motivation toward Accomplishment, Intrinsic Motivation to Experience Stimulation, Extrinsic Motivation Identified, Extrinsic Motivation Introjected and Extrinsic Motivation External Regulation. For the present study, the intrinsic motivation subscale "Intrinsic Motivation to Know" was used to investigate academic intrinsic motivation. The scale has been adapted to use the term "college/university" as opposed to "school" which was used in the original scale. Participants needed to answer to what extent the statement corresponds to the reason they went to college/university. The scores of this survey were calculated by finding the average of each subscale.

Some examples of statements for the Intrinsic Motivation to Know subscale include: "Because I experience pleasure and satisfaction while learning new things." and "Because my studies allow me to continue to learn about many things that interest me." For Intrinsic Motivation toward Accomplishment some of the questions are as follows: "For the pleasure that I experience while surpassing myself in my studies." and "Because high school allows me to experience personal satisfaction in my quest for excellence in my studies." Some examples of the

Intrinsic Motivation to Experience Stimulation were: "For the pleasure that I experience when I am taken by discussions with interesting teachers." and "Because for me, college is fun." The Cronbach's Alpha of the Intrinsic Motivation to Know subscale is .84.

Procedure

Participants were asked to complete a survey, which took approximately 20 minutes. Each participant was provided with informed consent before the start of the study. The informed consent informed the participants about the incentives they would receive after completing the survey. In addition, the participants were well informed about their anonymous and confidential data. Participants took the survey online (made using Qualtrics) through the barcode provided in the flyers. At the same time, first-year psychology students could access this study in SONA through a link provided to them. Furthermore, the participants were also asked to fill in their student numbers to have access to their academic grades. The study was only conducted after receiving approval from the ethical committee regarding the whole study.

The survey created uses seven questionnaires that cover academic motivation and underlying factors that can contribute to hyperfocus and flow states. The questionnaires present in the survey include the Hyperfocus in School Scale of the AHQ (Hupfeld, Abagis & Shah, 2019), the Dispositional Flow Scale (Jackson, Martin & Ecklund, 2008), the Need for Cognition-6 scale (Coelho, Hanel & Wolf, 2020), the Utrecht Work Engagement Scale (Seppälä et al., 2009), the Five Dimensional Curiosity Scale (Kashdan et al., 2018), the Academic Motivation Scale (Vallerand et al., 1992) and the Adult ADHD Self Report Scale v1.1 (Kessler et al., 2005). For the present study, we focus on the Hyperfocus in the School Scale of the AHQ, the Need for Cognition scale, the 5-Dimensional Curiosity Scale, and the Academic Motivation Scale.

The survey consists of several blocks to collect demographic information, education information, Five-Dimensional Curiosity scale, Need for Cognition, Academic Motivation, Utrecht Work Engagement, School Hyperfocus scale of the AHQ, Dispositional Flow Scale Short, Adult ADHD Self Report Scale and medical and personal information, and the measures of the predictor variables and the outcome measures. Two main randomizations occur in the questionnaire; the first randomization will alternate the order in which the predictor variable measures are introduced to participants with the Scales for Need for Cognition, Academic Motivation, and the Five-Dimensional Curiosity Scale. The second randomization occurs for the outcome measures; participants will be presented with the Utrecht Work-Engagement Scale, the Hyperfocus in School Scale of the AHQ, and the Dispositional Flow Scale. It was done to avoid all the participants having the same sequence of questions and reduce biases.

Design

This study used two types of research designs. To test our first hypothesis, we used a correlational cross-sectional design to investigate if the three motivational factors, together and separately, had a significant effect on the frequency of experiencing a hyperfocus state. To test our second hypothesis, we implemented a correlational design to investigate if the three individual motivational factors had significant correlations with each other. This quantitative study served to explore the proposed association of the three motivational independent variables with the dependent variable regarding the frequency of experiencing a state of hyperfocus.

Our independent variables consisted of the three cognitive traits (need for cognition, epistemic curiosity, and intrinsic motivation), all using their respective questionnaires. For the sake of analysis, epistemic curiosity was divided into two separate variables: Joyous Exploration and Deprivation Sensitivity. The dependent variable, school hyperfocus, was collected in the

same way as the IVS, namely with its respective questionnaire. Techniques for data analysis

consisted of Pearson's coefficient, multiple regression analysis, partial correlations, and ANOVA

outputs.

Results

During the analysis of linearity, an assessment of outliers was conducted. To find this, the score of each scale per participant was calculated, after which the descriptive statistics for the four scales was conducted. From this, any participant who scored three standard deviations away from the mean on any of the four scales would be excluded from the final sample. Based on this criteria, no univariate outliers were detected. Once the data cleaning has been completed, the reliability and assumption checks for the dependent variables and relevant independent variables occurred.

Table 1

Descriptive Statistics of Regression Model

	Mean	Std. Deviation	Cronbach's Alpha	N
Hyperfocus	3.1069	0.83979	0.87	375
NFC	3.5773	0.63291	0.74	375
IM to Know	5.6500	0.87064	0.83	375
EC Joy	5.1157	0.88996	0.78	375
EC Dep	4.3467	1.24038	0.74	375

a. Predictors: (Constant), NFC, IM to Know, EC Joy, EC Dep

Assumptions Check

All the assumptions of multiple regression have been assessed and were met. The following figures for the assumption checks can be found in Appendix 1. The normality assumption of multiple regression has been met in this study, as indicated by a normally distributed histogram of residuals as showcased in Appendix 1. The homoscedasticity

assumption can be assumed through the inspection of the residual plot in figure 2, revealing a randomised equal pattern of response values. Similarly, linearity can be assumed as indicated by the P-P plot in figure 3. The data of the study has met the independence of residual assumptions as tested by the Durbin-Watson (*Durbin-Watson Value*= 1.917). Finally, a variance inflation factor (VIF) test was conducted, showing no evidence of multicollinearity across the four independent variables (*VIF* < 2).

Main Analysis

In order to analyse the results and test the hypothesis that the three independent variables contribute to the experience of the dependent variable, a multiple regression analysis was conducted. The regression model ($F(4, 370)= 27.629, p = <.001$) consisting of four independent variables is statistically significant.

Table 2

Model Summary of Regression Model[b]

Mode l	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.480[a]	0.230	0.222	0.74089

a. Predictors: (Constant), NFC, IM to Know, EC Joy, EC Dep

b. Dependent Variable: Hyperfocus

All four predictor variables had a positive correlation with hyperfocus, however, these appeared to be weak to moderate relationships. Hyperfocus appeared to have the weakest relationship with EC joyous exploration (r= 0.189) and the strongest relationship with EC deprivation sensitivity (r=0.452). NFC and IM to know had a weak relationship with hyperfocus, however IM to know showed a slightly stronger relationship (r=0.275) with hyperfocus in

comparison to NFC (r=0.224). The table in Appendix 1 displays the correlations of the regression coefficients, the partial and semi-partial correlations along with the confidence interval.

Of the four independent variables used in this regression analysis, intrinsic motivation (sr^2=0.022), and deprivation sensitivity (sr^2=0.139) had a strong statistically significant effect on hyperfocus, suggesting these are significant predictors of hyperfocus. In contrast, NFC (sr^2=0.001) and joyous exploration (sr^2=-0.003) were non-significant predictors in the model, with NFC having the weakest effect on hyperfocus. Table 3 displays the regression coefficients of the study's model.

Table 3

Regression Coefficients[a]

Model		Unstandardized Coefficients		Standardised Coefficients	t	Sig.	Part Squared
		B	Std. Error	Beta			
1	(Constant)	1.122	0.285		3.937	.000	
	NFC	0.058	0.080	0.044	0.721	.472	0.001
	IM to Know	0.172	0.052	0.178	3.286	.001	0.022
	EC Joy	-0.081	0.060	-0.086	-1.348	.179	0.003
	EC Dep	0.281	0.034	0.414	8.207	.000	0.139

a. Dependent Variable: Hyperfocus

In order to assess the fourth hypothesis of the study regarding whether a relationship is present between the cognitive motivators, a correlation matrix of the regression coefficients was generated. The correlation between each independent variable with one another appeared to be

statistically significant at a p-value of 0.05, however the strength of the correlation differed

between variables. The independent variables EC Joy and NFC had the strongest positive

correlation amongst all the independent variables (r(373)=0.629, p=0.000). Similarly, EC Joy

and IM to know had the second highest positive correlation (r(373)=0.520, p=0.000). The two

EC subscales had a moderate positive correlation (r(373)=0.372, p=0.000), while EC Dep had a

moderate positive correlation with NFC (r(373)=0.383, p=0.000) but a weak positive correlation

with IM to know (r(373)=0.297, p=0.000). Finally, IM to know and NFC appeared to have a

moderate positive correlation (r(373)=0.422, p=0.000). This offers support for the hypothesis

that a relationship does exist between the variables, as indicated by positive correlations,

however it cannot be determined whether the presence of one variable influences the strength of

the other.

Table 4

Correlation Matrix of Predictor Variables

		NFC	IM to Know	EC Joy	EC Dep
Pearson	NFC	1.000	0.422	0.629	0.383
Correlation	IM to Know	0.422	1.000	0.520	0.297
	EC Joy	0.629	0.520	1.000	0.372
	EC Dep	0.383	0.297	0.372	1.000

Discussion

The present study aims to study two research questions into hyperfocus, with four hypotheses to address. The first three hypotheses predict that the experience of hyperfocus during studying can be attributed to each cognitive motivator: epistemic curiosity, intrinsic academic motivation, and need for cognition. The final hypothesis predicts that a relationship is present between the cognitive motivators.

A multiple regression analysis provided partial support to the claim of the first research question, by which intrinsic motivation (IM) and the epistemic curiosity deprivation sensitivity (EC Dep) dimension are shown to be statistically significant with hyperfocus experiences during studies. However, the need for cognition (NFC) and the epistemic curiosity joyous exploration (EC Joy) dimension appeared to have a non-significant effect on the experience of hyperfocus while studying. While the regression model including these four cognitive motivators is statistically significant, the model explains only 22% of the variance in hyperfocus. This suggests that the independent variables in the model do not fully explain the differences in the dependent variable: hyperfocus experiences when studying. This can be due to numerous factors such as the identified independent variables do not have as strong an effect on hyperfocus as theorised. Previous research had implicitly suggested motivation is a predictor of hyperfocus (Ryan & Deci, 2000). The present study provides novel findings that IM and EC Dep can predict hyperfocus. Interestingly, only one dimension of EC was found to predict hyperfocus in studies, which suggests that feelings of deprivation and frustration towards knowledge-gaps is a greater predictor of hyperfocus in studies than feelings of joy towards learning. These findings fully support the second hypothesis of the study, the first hypothesis is partially supported as one dimension of EC was seen as a predictor.

One clear aspect from the results is that the cognitive motivators; intrinsic motivation, need for cognition and the two epistemic curiosity dimensions, are correlated with one another. This provides support for the fourth hypothesis that investigates whether there is a relationship between the independent variables. The correlation matrix indicates that while the relationships appear statistically significant, the degree and strength in which different independent variables are related differs. The conclusions drawn from the correlation matrix come from the categorisation of correlational strength between two variables appointed by these values: correlations between 0.1 and 0.29 have a weak relationship, correlations between 0.3 and 0.49 have a moderate relationship, and correlations between 0.5 and one have a strong relationship (Cohen, 1988).

From the correlation matrix, it is clear that joyous exploration, a dimension of epistemic curiosity, has a strong correlation to each of the other variables. These relationships follow similar patterns presented in the current body of literature. Overall, there is a positive correlation between NFC and the two EC scales as found in Litman and Spielberger (2003). In the research by Kashdan et al. (2018), joyous exploration is strongly correlated with NFC and IM, both of which are reflected in the correlation found in the present study. However, the present study does not share the same degree of strength found in the Kashdan et al. (2018) study. Similar to Kashdan et al. (2018), the present study found the weakest positive correlation between deprivation sensitivity with NFC and IM (r=0.44). The difference in the strength of correlation between EC and IM in literature and the present study is interesting to note, this is because IM to know is correlated with curiosity (Vallerand et al., 1992). One overall difference is that the correlations in the present study are weaker than that of the literature. This provides support for the second research question regarding the relationship between cognitive motivators. These

constructs have similar impacts on attention and, due to the cognitive nature of these variables, share an interconnected element.

An important note is that this paper cannot establish whether one of these independent variables causes the experience or strength of another independent variable. The secondary purpose is to see whether the cognitive motivators identified in hyperfocus experiences can be associated with one another. While the variables are moderately correlated with one another and correlated with hyperfocus, not all the independent variables were predictive of hyperfocus in the regression model. This could be related to the unique variance explained by the predictors. EC Joy had a very small unique explained variance of hyperfocus experiences ($sr^2=0.003$), which is reflected in the weak association between EC Joy and hyperfocus. NFC had a stronger association with hyperfocus but had the smallest unique explained variance of hyperfocus in studies ($sr^2=0.001$). From this understanding, the third hypothesis was not supported by the data in this study and will not be accepted, however, the fourth hypothesis regarding the relationship between the predictor variables can be accepted.

The present study itself is not a replication of previous research. The purpose is to assess whether the identified cognitive motivators implicitly mentioned in the current research body can explain the experience of hyperfocus in academia. With the research complete and the data collected and analysed, several criticisms can be made about this study.

The hypotheses created were based on a review of the literature on hyperfocus and cognitive motivators, during which the most important variables were selected. The present study excluded some variables from the analysis, such as interest, that were part of the literature reviewed. If these variables were included in the model, it is possible that the model would have increased the explained variance.

The study used data from first-year undergraduate psychology students at the University of Groningen, a majority of which were Dutch (49.8%), while the remaining sample consists of German and other nationalities. Due to this, the results cannot be generalised to other nationalities and are restricted to the experience of hyperfocus in first-year university students. This can pose several issues. Academic motivation tends to fluctuate from when students first start university to when they complete their degree (Poteliūnienė et al., 2022). By having first-year students only, the assessment of IM would not reflect the full scope of variance in IM across students. This may have an impact on the predictive power of hyperfocus. By having a sample consisting of second and third-year students, IM could explain more variance in hyperfocus.

Similarly, a larger, more heterogeneous sample of university students may have provided greater insight into the research question. Some of the independent variables are influenced by demographics, such as NFC which is highly dependent on gender (Tanaka et al., 1988) as is motivation (Vallerand et al., 2016) as females scored higher than males on the IM subscales in the Academic Motivation Scale (Kashdan et al., 2018). As 76% of the sample consisted predominantly of female students, this may be a confounder of the study that impacted the influence of NFC. To improve upon this limitation, a larger heterogeneous sample should be attained during which the sample pool includes undergraduate and postgraduate students from various nationalities if possible. In that event, it increases the likelihood of the study's generalisability.

NFC may have been a non-significant predictor due to various confounds in the student environment. For instance, the questionnaire was released towards the end of the first block and before the first mid-term exams the first-year students would sit at a University level. This could

influence their responses for NFC in particular due to the stressors of exams making the consideration of cognitive challenging tasks daunting. Arguably, this may not impact IM and EC to the same degree as students are studying for their exams, therefore closing any knowledge gap (EC) they may have and are intrinsically motivated to learn and succeed.

During the data cleaning process, a criterion of excluding responses has been set, this included those who complete the survey in under 10 minutes, as the survey takes an average of 20 to 25 minutes. This exclusion introduced a form of systemic bias that resulted in the inclusion of participants who can endure a long survey. This creates a bias against participants with low attention spans or with ADHD that have filled in the survey. Future research can improve upon this limitation by having a shorter survey. Shorter measures can reduce the risks longer scales have on participants, such as reduced participant fatigue, dropout rates, boredom, and inattention (Coelho et al., 2018).

A strength of this research is the use of multiple subscales to represent EC, a multidimensional construct. The EC Joy and EC Dep subscales provided valuable insight into EC and its relation to hyperfocus, particularly how part of EC can predict hyperfocus while others cannot. Deprivation sensitivity is a stronger predictor of hyperfocus in studies than joyous exploration, which implies that the frustration of uncertainty has a strong EC. Future research could look into why some dimensions of EC appear to predict hyperfocus in studies, while others do not.

Future Research

Hyperfocus has garnered great interest from the public but is still under-researched in the field of psychology. By increasing the body of research into hyperfocal experiences, particularly in relation to education and study, many practical, theoretical, and societal benefits can arise. For

example, new teaching techniques that emphasise the development of intrinsic academic motivation, or study techniques that help maintain concentration for longer periods. This can open up avenues for future research to explore hyperfocus in diverse contexts. This can develop greater self-understanding as people become aware of what works best to sustain attention, and experience hyperfocus states in productive contexts such as education or completing challenging tasks.

Future research can look into other variables influencing the experience of hyperfocus in studies, such as interest or openness to ideas. Alternatively, an experiment into methods that induce and maintain cognitive motivators affecting hyperfocus when studying can be beneficial for clinical and non-clinical populations alike during education.

In conclusion, hyperfocus can be predicted and influenced by cognitive motivators, particularly intrinsic motivation and epistemic curiosity: deprivation sensitivity. These cognitive motivators predict the experience and persistence of hyperfocus states in studies and are positively correlated with one another. Therefore, these variables share a relationship that can strengthen the effect these underlying factors have on hyperfocus experiences. These conclusions provide valuable insight into the hyperfocus literature and have practical value to students. For instance, encouraging students to pursue degrees they enjoy or promoting intrinsic motivation as a stronger, consistent motivation for studying and attention.

References

Alexander, P. A. (2019). Seeking common ground: Surveying the theoretical and empirical

    landscapes for curiosity and interest. *Educational Psychology Review*, *31*(4), 897–904.

    https://doi.org/10.1007/s10648-019-09508-x

American Psychological Association. (n.d.). *APA Dictionary of Psychology*. American

    Psychological Association. Retrieved October 31, 2022, from

    https://dictionary.apa.org/motivation

Ashinoff, B. K., & Abu-Akel, A. (2019). Hyperfocus: The Forgotten Frontier of Attention.

    Psychological Research, *85*(1), 1–19. https://doi.org/10.1007/s00426-019-01245-8

Bandura, A. (1991). Self-regulation of motivation through anticipatory and self-reactive

    mechanisms. In Diestbier, R. (Ed.), Nebraska symposium on motivation 1990:

    Perspectives on motivation (Vol. 38, pp. 69–164). Lincoln and London, University of

    Nebraska.

Berlyne, D. E. (1962). Uncertainty and epistemic curiosity. *British Journal of Psychology*, *53*(1),

    27–34. https://doi.org/10.1111/j.2044-8295.1962.tb00811.x

Berlyne, D. E. (1954). A theory of human curiosity. *British Journal of Psychology. General

    Section*, *45*(3), 180–191. https://doi.org/10.1111/j.2044-8295.1954.tb01243.x

Bertrams, A., & Dickhäuser, O. (2012). Passionate thinkers feel better. *Journal of Individual

    Differences*, *33*(2), 69–75. https://doi.org/10.1027/1614-0001/a000081

Beswick, D. G. (2017). *Cognitive motivation: From curiosity to identity, purpose and meaning*.
Cambridge University Press.

Brown, T. E. (2006). Attention deficit disorder: The unfocused mind in children and adults.
Choice Reviews Online, *43*(05). https://doi.org/10.5860/choice.43-2832

Cacioppo, J. T., & Petty, R. E. (1982). The need for cognition. *Journal of Personality and Social Psychology*, *42*(1), 116–131. https://doi.org/10.1037/0022-3514.42.1.116

Cacioppo, J. T., Petty, R. E., Feinstein, J. A., & Jarvis, W. B. (1996). Dispositional differences in cognitive motivation: The life and times of individuals varying in need for cognition. *Psychological Bulletin*, *119*(2), 197–253. https://doi.org/10.1037/0033-2909.119.2.197

Cazan, A.-M., & Indreica, S. E. (2014). Need for cognition and approaches to learning among university students. *Procedia - Social and Behavioral Sciences*, *127*, 134–138. https://doi.org/10.1016/j.sbspro.2014.03.227

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

Cohen, J. (1988). Set correlation and contingency tables. *Applied Psychological Measurement*, *12*(4), 425–434. https://doi.org/10.1177/014662168801200410

Cook, D. A., & Artino, A. R. (2016). Motivation to learn: An overview of contemporary theories. *Medical Education*, *50*(10), 997–1014. https://doi.org/10.1111/medu.13074

Colling, J., Wollschläger, R., Keller, U., Preckel, F., & Fischbach, A. (2022). Need for cognition and its relation to academic achievement in different learning environments. *Learning and Individual Differences*, *93*, 102110. https://doi.org/10.1016/j.lindif.2021.102110

Day, H. I. (1971). The measurement of specific curiosity. In H. I. Day, D. E. Berlyne, & D. E. Hunt (Eds.), *Intrinsic motivation: a new direction in education*. Hold, Rinehart, & Winston.

DiPerna, J. C., & Elliott, S. N. (1999). Development and validation of the Academic Competence Evaluation Scales. *Journal of Psychoeducational Assessment*, *17*(3), 207–225. https://doi.org/10.1177/073428299901700302

Feather, N. T. (1982). Expectancy-Value Approaches:present Status and Future Directions. In *Expectations and actions: Expectancy-value models in psychology* (pp. 260–288). essay, ROUTLEDGE.

Groen, Y., Priegnitz, U., Fuermaier, A. B. M., Tucha, L., Tucha, O., Aschenbrenner, S., Weisbrod, M., & Garcia Pimenta, M. (2020). Testing the relation between ADHD and hyperfocus experiences. *Research in Developmental Disabilities*, *107*, 103789. https://doi.org/10.1016/j.ridd.2020.103789

Hupfeld, K. E., Abagis, T. R., & Shah, P. (2018). Living "in the zone": Hyperfocus in adult ADHD. *ADHD Attention Deficit and Hyperactivity Disorders*, *11*(2), 191–208. https://doi.org/10.1007/s12402-018-0272-y

Jackson, S. A., Martin, A. J., & Eklund, R. C. (2008). Long and short measures of flow: The construct validity of the FSS-2, DFS-2, and new brief counterparts. Journal of Sport and Exercise Psychology, 30(5), 561–587. https://doi.org/10.1123/jsep.30.5.561

Kashdan, T. B., Disabato, D. J., Goodman, F. R., & McKnight, P. E. (2020). The five-dimensional curiosity scale revised (5DCR): Briefer subscales while separating overt and covert social curiosity. *Personality and Individual Differences*, *157*, 109836. https://doi.org/10.1016/j.paid.2020.109836

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

Keller, U., Strobel, A., Wollschläger, R., Greiff, S., Martin, R., Vainikainen, M.-P., & Preckel, F. (2016). A need for cognition scale for children and adolescents. *European Journal of Psychological Assessment*, *35*(1), 137–149. https://doi.org/10.1027/1015-5759/a000370

Kessler, R. C., Adler, L., Ames, M., Demler, O., Faraone, S., Hiripi, E., Howes, M. J.,

Ko, L.-W., Komarov, O., Hairston, W. D., Jung, T.-P., & Lin, C.-T. (2017). Sustained attention in real classroom settings: An EEG study. *Frontiers in Human Neuroscience*, *11*. https://doi.org/10.3389/fnhum.2017.00388

Litman, J. A. (2008). Interest and deprivation factors of epistemic curiosity. *Personality and Individual Differences*, *44*(7), 1585–1595. https://doi.org/10.1016/j.paid.2008.01.014

Litman, J. A., Collins, R. P., & Spielberger, C. D. (2005). The nature and measurement of

Sensory Curiosity. *Personality and Individual Differences*, *39*(6), 1123–1133.

https://doi.org/10.1016/j.paid.2005.05.001

Litman, J. A., & Spielberger, C. D. (2003). Measuring epistemic curiosity and its diversive and

specific components. *Journal of Personality Assessment*, *80*(1), 75–86.

https://doi.org/10.1207/s15327752jpa8001_16

Loewenstein, G. (1994). The Psychology of Curiosity: A review and reinterpretation.

Psychological Bulletin, *116*(1), 75–98. https://doi.org/10.1037/0033-2909.116.1.75

Poteliūnienė, S., Emeljanovas, A., & López Sánchez, G. F. (2022). Changes in the academic

motivation and satisfaction with studies of pre-service physical education teachers during

the study period. *Universitas Psychologica*, *20*, 1–17.

https://doi.org/10.11144/javeriana.upsy20.cams

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and

New Directions. *Contemporary Educational Psychology*, *25*(1), 54–67.

https://doi.org/10.1006/ceps.1999.1020

Ryan, R. M., & Deci, E. L. (2017). Self-determination theory: Basic psychological needs in

motivation, development, and Wellness. https://doi.org/10.1521/978.14625/28806

Schmidt, H. G., & Rotgans, J. I. (2020). Epistemic curiosity and situational interest: Distant

Cousins or identical twins? *Educational Psychology Review*, *33*(1), 325–352.

https://doi.org/10.1007/s10648-020-09539-9

Seppälä, P., Mauno, S., Feldt, T., Hakanen, J., Kinnunen, U., Tolvanen, A., & Schaufeli, W. (2009). The construct validity of the Utrecht Work Engagement Scale: Multisample and longitudinal evidence. Journal of Happiness Studies, 10(4), 459–481. https://doi.org/10.1007/s10902-008-9100-y

Tanaka, J. S., Panter, A. T., & Winborne, W. C. (1988). Dimensions of the need for cognition: Subscales and gender differences. *Multivariate Behavioral Research*, *23*(1), 35–50. https://doi.org/10.1207/s15327906mbr2301_2

Vallerand, R. J., Pelletier, L. G., Blais, M. R., Briere, N. M., Senecal, C., & Vallieres, E. F. (1992). The Academic Motivation Scale: A Measure of Intrinsic, Extrinsic, and Amotivation in Education. Educational and Psychological Measurement, 52(4), 1003–1017. https://doi.org/https://doi.org/10.1177/001316449205200

Vallerand, R. J., Blais, M. R., Brière, N. M., & Pelletier, L. G. (1989). Construction et validation de l'échelle de motivation en éducation (EME). *Canadian Journal of Behavioural Science / Revue Canadienne Des Sciences Du Comportement*, *21*(3), 323–349. https://doi.org/10.1037/h0079855

Walters, E. E. (2005). The World Health Organization adult ADHD self-report scale (ASRS): A short screening scale for use in the general population. Psychological Medicine, 35(2), 245–256. https://doi.org/10.1017/S0033291704002892

Appendix 1

The present appendix will include further details on the data analysis of this study, in particular, figures on the multiple regression assumption checks.

Figure 1A

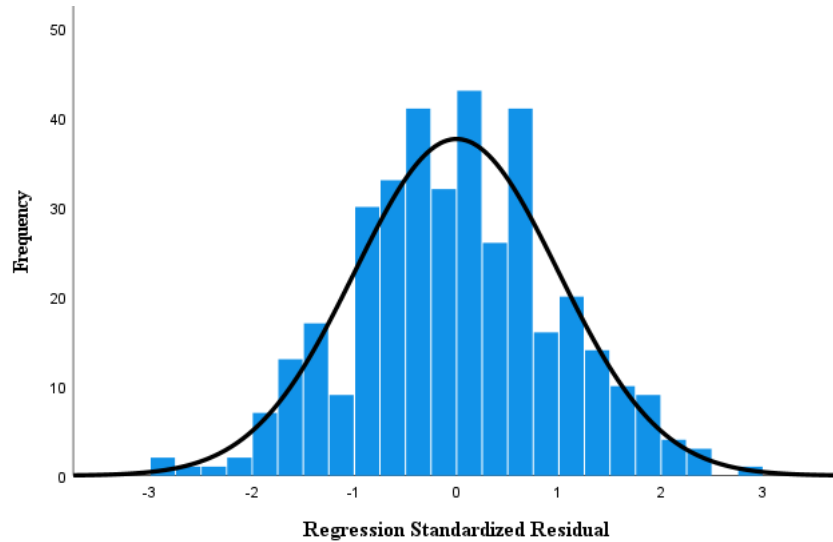*Histogram for Normality Assumption Check*

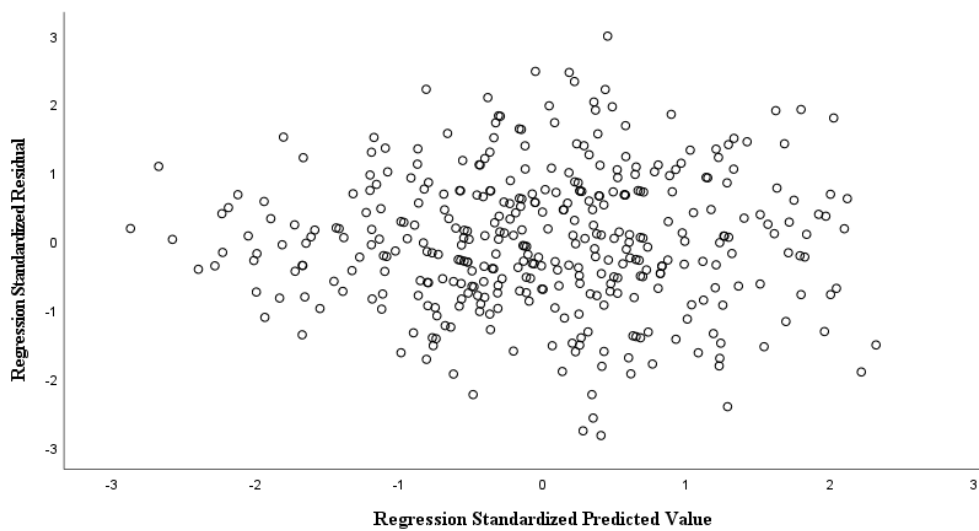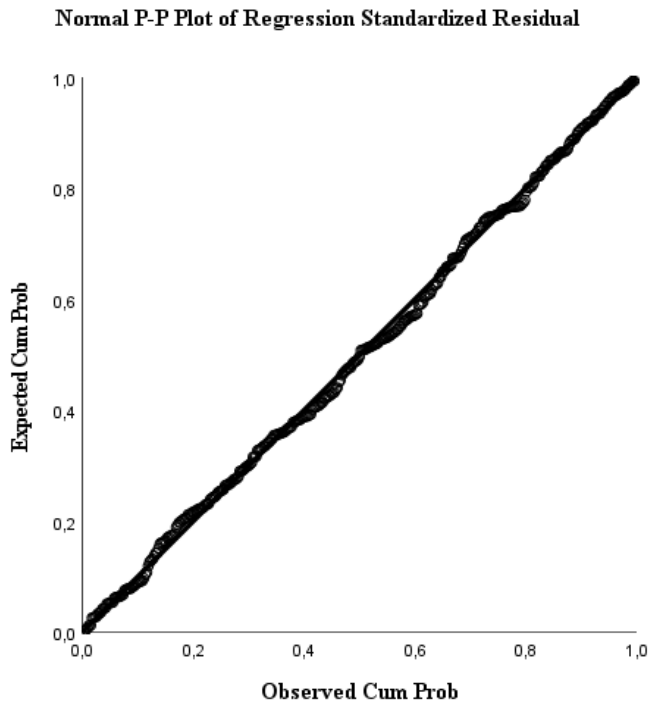

Figure 2A

Residual Plot to Assess Homoscedasticity

Figure 3A

P-P Plot to Assess Linearity

Normal P-P Plot of Regression Standardized Residual

Table 1A

Confidence Intervals and Correlations for Regression Coefficients[a]

Model		95% Confidence Interval for B		Correlations		
		Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	0.562	1.683			
	NFC	-0.100	0.215	0.224	0.037	0.033
	IM to Know	0.069	0.275	0.275	0.168	0.150
	EC Joy	-0.199	0.037	0.189	-0.070	-0.061
	EC Dep	0.213	0.348	0.452	0.392	0.374

a. Dependent Variable: Hyperfocus