GRANT journal
ISSN 1805-062X, 1805-0638 (online)
Vol. 11, issue 02

EUROPEAN GRANT PROJECTS | RESULTS | RESEARCH & DEVELOPMENT | SCIENCE

The predictive importance of executive functions and internet use to identify academic procrastination during adolescence

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Grant: FPPV-33-2022
Název grantu: Prediktívny význam vybraných exekutívnych funkcií a problematického užívania internetu pre identifikáciu aktívnej a pasívnej prokrastinácie v období adolescencie.
Oborové zaměření: AN - Psychologie

Abstrakt In the present study, we analyze selected predictors of academic procrastination in a representative sample of adolescents consisting of 159 respondents (64.2% females and 35.8% males). The age range of the respondents is from 16 to 25 years, with a mean age of 20.9 years (SD=1.95). Questionnaire methods were used to collect data, namely Lay's Procrastination Scale, Generalized Problematic Internet Use Scale 2, Internet Addiction Questionnaire, and Behavioral Self-Assessment of Executive Function Scale. The results indicate the predictive importance of executive functions as: Shifting, Emotional Control, Automonitoring, Initiative (Sig.<0.001), Monitoring of tasks (Sig.<0.01), Working Memory (Sig.<0.05). Further, the results indicated the predictive significance of the problematic internet use subscale Negative Outcomes (Sig.<0.05).

Klíčová slova academic procrastination, executive functions, Internet use, predictive importance, adolescence

1. INTRODUCTION

Executive functions have been shown to play a significant role in the planning and problem-solving process, hence their association with the concept of procrastination is highly significant. On the other hand, the link between academic procrastination and problematic Internet use is very significant. Despite the topicality of this issue, it is not sufficiently investigated how the problematic use of the Internet is related to students' academic procrastination, in the same way, the level of investigation of the interconnections between executive functions and academic procrastination is considered insufficient, so we decided to investigate this issue in the study.

1.1 Academic procrastination in relation to problematic internet use

Academic procrastination develops mainly during young adulthood, with several studies (Ferrari, Johnson, McCown, 1995; Gabrhelík, 2008) confirming that procrastination develops most around the age of twenty and tends to decline until around the age of sixty. Research (Steel, 2007; Kim, Seo, 2015; Doktorová, Kochanová, 2021) yields findings that approximately 80 to 95% of students are affected by academic procrastination, the essence of which is deliberate and unnecessary delay in starting or completing tasks. Research shows that this is a problematic behaviour that tends to be repetitive in university students, despite the fact that up to 95% of students want to reduce procrastination behaviour in their studies (Steel, 2007).

In recent years, the Internet has become an important element in relation to the responsibilities and needs of everyday life for all people, but especially for students, as through the Internet it is easy to access the materials and information that students need (Ya, Zhong, 2014). However, the Internet becomes a means for students to escape, avoid and distract themselves from their responsibilities and academic tasks (Thatcher et al., 2008; Kurajda, Doktorová, 2022). In our research to date, we observe that there is a relationship between procrastination and problematic Internet use, and thus it can be argued that the more participants use the Internet, the greater their level of academic procrastination, however, the predictive significance of problematic Internet use has not been confirmed (Kochanová, 2020). Similarly, Hayat, Kojuri, and Amini (2020) found in their studies that there is a positive relationship between Internet addiction and academic procrastination, finding that Internet addiction negatively affects behaviors such as doing homework, studying for exams, and preparing for school. Gürültü (2016) found a positive significant relationship between social networking addiction and academic procrastination and found that social networking addiction explained approximately 19% of procrastination behaviors. There are also studies in the literature

suggesting that academic procrastination is increased by problematic internet use (Günlü, Ceyhan, 2017). Another study found that when procrastination behaviors were reduced in adolescents, internet addiction and depressive symptoms were also reduced (Hernández et al., 2019). Overall, these findings suggest that various uses of the Internet appear to be one of the most common alternative activities used by procrastinators and may partially account for the negative associations between procrastination and adolescents' psychological functioning.

1.2 Academic procrastination in relation to executive functions

Procrastination has been linked and studied in a variety of contexts, for example, in relation to environment, task type, and personality, but it is surprising that research on its relationship with executive functioning has only recently begun. These recent studies (Rabin et al., 2011; Schweigerová, Slavkovská, 2015) suggest that these functions are significantly impaired in procrastinating individuals. Executive functions are defined by Williams, Suchy, and Rau (2009) as a set of diverse neurological processes that enable novel problem solving, behavioral change in response to new information, planning and generating strategies for action, and self-regulation of cognitions, behaviors, and emotions. Thus, executive functions serve as a label for a few cognitive functions such as planning, working memory, attention, inhibition, self-observation, self-regulation, and initiative. Executive functions are skills essential for mental and physical health, success in school and in life, or cognitive, social, and psychological development. We can consider Rabin, Fogel, and Nutter- Upham's (2011) research as the first ever to address the relationship between executive functions and academic procrastination. Their research showed that some subscales of the BRIEF-A were associated with procrastination. This observation was previously made by Schouwenburg (2002), who found that the level of procrastination was non-linearly related to a systematic approach to duties. Further, his research yields the finding that an individual who procrastinates is characterized by poor organization, which manifests itself in improper planning and time management. Schweigerová and Slavkovská (2015) found that there are significant differences in executive functioning between procrastinators and non-procrastinators. As we can see indicating the degree of academic procrastination through executive functioning has been very little researched so far, despite the topicality of this topic. Yet, executive functions play a crucial role in understanding the self-regulatory failure of procrastination. Effective stimulation of executive functions can prevent procrastination. Conversely, difficulties with executive functions may lead to the development of some psychopathological disorders, such as the emergence of procrastinatory behavior in this case. Several studies (Lavoie and Pychyl, 2001; Odaci, 2011; Thatcher et al., 2008) have addressed the detrimental effects of Internet use on the onset or exacerbation of procrastination, but not universally valid and definitive findings have yet been uncovered for us to examine in this paper. Similarly, the effect of executive functions on the emergence of Internet addiction has not yet been sufficiently explored. Therefore, the present study is aimed at elucidating the issue of academic procrastination in a population of students and to verify the predictive factors that act in its increase, and thus to investigate and verify the association of academic procrastination with Internet addiction and executive functions through a questionnaire method.

2. METHODS

2.1 Research sample

The research sample consisted of university and high school students. Respondents participated in the research voluntarily by completing an anonymous battery of questionnaires in written or electronic form. Prior to completing the questionnaire battery, respondents were briefed on the purpose of the research as well as other information about the research. A more detailed description of the research sample is presented in Table 1. The average age of the participants was 20.9 years. The individual age distribution of the respondents is presented in Table 2.

Tab. 1 Characteristic of research sample based on gender, study and the using of the Internet

		Frequency	%
Gender	male	57	35.8
	female	102	64.2
Study	university students	126	79.2
	high school students	33	20.8
Time of using internet	10-60 min	7	4.4
	1-3 h	66	41.5
	More than 3h	62	39
	I can´t judge	24	15.1
Preferred internet activity	Playing online games	21	13.2
	Online communication	107	67.3
	Browsing the sites	21	13.2
	Online shopping	1	0.6
	Browsing pornographic sites	2	1.3
	study	7	4.4

Tab. 2 Age distribution of the respondents

Age	Frequency	%
16	5	3.1
17	6	3.8
18	6	3.8
19	14	8.8
20	26	16.4
21	40	25.2
22	35	22.0
23	10	6.3
24	14	8.8
25	3	1.9
Total	**159**	**100**

2.2 Measures

According to the set objectives, we have chosen an adequate methodology to carry out the research. The test battery consisted of several methods, including basic socio-demographic data (gender, age, study, time of using internet,..), the Procrastination Scale for Students, the Generalized Problematic Internet Use Scale 2, the Internet Addiction Questionnaire and the Behavioral Self-Assessment of Executive Function Scale. Full instructions were given in the header of the questionnaires and took no more than 30 minutes to complete in total. As all the selected methods were taken from the English original, it was necessary to translate the methods and check their validity. The translation of each method was reviewed by a translator and then assessed by independent expert psychologists. The methods thus underwent both linguistic and

professional proofreading by experts. Through these actions we ensured the validity of the methodologies. After data collection, the psychometric parameters of the methods will be verified, through Cronbach's alpha.

The constructed test battery consisted of the following parts:

1. Author's questionnaire - to find out basic demographic information about the respondents.
2. Procrastination Scale for Students- PSS (Lay, 1986) which was used to map academic procrastination. Using it, we get information whether an individual possesses and to what extent he possesses procrastination. It contains 20 questions that relate to procrastination of activities not only related to school duties. Cronbach's alpha reached a value of 0.881, on the basis of which we can consider the questionnaire internally consistent.
3. Generalized Problematic Internet Use Scale 2- GPIUS2 (Caplan, 2010), which is a screening tool for identifying problematic Internet use in adolescents and young adults. It contains 15 items that are divided into five subscales (Internet communication preference, mood regulation, cognitive bias, compulsive Internet use, and negative consequences). The Cronbach's alpha of the questionnaire was 0.902, and the Cronbach's alphas for each subscale were as follows: internet communication preference- 0.867, mood regulation- 0.870, cognitive bias- 0.836, compulsive internet use- 0.902, and negative consequences- 0.878. Based on the above Cronbach's alpha values, we can consider the questionnaire as internally consistent. Further, we used the Internet Addiction Test (IAT) questionnaire (Young, 2009), which consists of 20 items, to map the extent of Internet addiction. The Cronbach's alpha of the questionnaire was 0.930, based on which we can consider the questionnaire as internally consistent.
4. The Behavioral Self-Report Scale of Executive Functioning - BRIEF (Roth, Isquith and Gioia, 2005) was used to map executive function. It is one of the most recent instruments to measure executive functions. It is composed of 9 subscales: inhibition (8 items), cognitive flexibility (6 items), self-observation (6 items), emotional control (10 items), planning (10 items), initiative (8 items), task monitoring (6 items), working memory (8 items), and organization of materials (8 items). The Cronbach's alpha of the questionnaire was 0.964, and the Cronbach's alphas for each subscale were as follows: inhibition- 0.804, cognitive flexibility- 0.776, emotional control- 0.930, self-monitoring- 0.803, initiative- 0.800, working memory- 0.836, planning- 0.795, task monitoring- 0.671, and organization of materials- 0.899. Based on the above Cronbach's alpha values, we can consider the questionnaire as internally consistent.

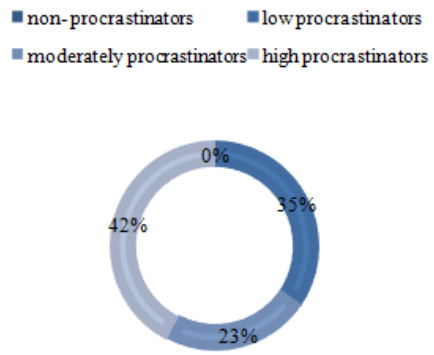
2.3 Procedure

The research has an exploratory-correlational quantitative design, with data collected through questionnaire methods. Part of the questionnaires were distributed offline through personal contact with the respondents on the campuses of their colleges and high schools, while another part of the questionnaires was distributed online through online data collection by means of an online questionnaire. Further, the data were statistically analyzed using IBM SPSS Statistics 23.0 for Windows mathematical and statistical software (descriptive statistics, regression analysis).

3. RESULTS

In the following chart we show the representation of forms of procrastination. As we can see in Graph 1, there is no respondent in our research sample who does not procrastinate. Also, we can see that there are 54 low procrastinators, 36 moderately procrastinators and 66 high procrastinators.

Graph 1 Prevalence of academic procrastination



Linear regression analysis was used to test the predictive significance of the executive functions in relation to academic procrastination (Table 3). In general, the model appears to be appropriate (F= 24.863; Sig.<0.001). The variables that significantly contribute to the increase or decrease of academic procrastination are shifting (β=-0.476), emotional control (β=0.358), automonitoring (β=-0.382) and initiative (β=0.596) at Sig.<0.001 level of significance, task monitoring (β=0.327; Sig.<0.01) and working memory (β=0.265; Sig.<0.05). Since the research sample consists of 159 participants, which represents enough participants for comparing the magnitude of each predictor (Green, 1991), we can conclude that the most significant predictor of academic procrastination, when considering the influence of other predictors, is initiative. The other executive functions, namely inhibition, planning and organization of materials appear to be insignificant in relation to academic procrastination.

Tab. 3 Regression model for individual executive functions as predictors for academic procrastination analyzed by the Enter method

Predictors	R	R^2	B	β	t	Sig.
Inhibition	0.775	0.576	-0.192	-0.087	-0.702	0.484
Shifting			-1.385	-0.476	-5.637	**0.000**
Emotional control			0.523	0.358	3.935	**0.000**
Automonitoring			-1.136	-0.382	-3.963	**0.000**
Initiative			1.306	0.596	6.959	**0.000**
Working memory			0.581	0.265	2.584	**0.011**
Planning			-0.082	-0.041	-0.421	0.674
Monitoring of tasks			1.111	0.327	3.413	**0.001**
Organization materials			0.053	0.030	0.381	0.445

We then analyzed the predictive significance of areas of problematic Internet use and Internet dependence on academic procrastination (Table 4). The model appears to be appropriate (F= 15.827, Sig.<0.001). As it appears, only negative consequences of Internet use led to an increase in academic procrastination (β=0.219; Sig.<0.05).

Tab. 4 Regression model for subscales of problematic Internet use and Internet addiction as predictors for academic procrastination analyzed by the Enter method

Predictors	R	R^2	B	β	t	Sig.
Preference for communication via the internet	0.407	0.133	-0.182	-0.066	-0.817	0.415
Mood regulation			0.275	0.115	1.277	0.204
Cognitive preoccupation			-0.170	-0.065	-0.507	0.613
Compulsive internet use			0.223	0.090	0.688	0.493
Negative outcomes			0.665	0.219	2.202	**0.029**
Internet addiction			0.174	0.176	1.407	0.161

4. DISCUSSION

Based on the presented results, we can say that the prevalence of academic procrastination in our research was approximately 64%, which means that more than half of the students find their procrastination problematic, which is consistent with previous research (Steel, 2007; Kim, Seo, 2015, Doktorová, Kochanová, 2021). On the other hand, research (Rabin et al., 2011) found that only about half of students regularly procrastinate. Research (Doktorová, Kochanová, 2021) point that up to 44.2% of the research sample represented group of moderately procrastinators, followed by low procrastinators (27,3%) and high procrastinators (25,6%). Only 2,9% of the sample represented non- procrastinators. In our research, we found that the most represented group of procrastinators are high procrastinators, followed by low procrastinators and moderately procrastinators. Compared to the study of Doktorová and Kochanová (2021) in our research none of the students were non- procrastinators. We can conclude that procrastination becomes a dominant and problematic issue for students since almost half of the students postpone their duties.

The executive functions that emerged as significant predictors for academic procrastination in our research were Shifting, Emotional Control, Automonitoring, Initiative, Task Monitoring, and Working Memory, with executive functions explaining 57.6% of the prevalence of academic procrastination. Similarly, Rabin, Fogel, and Nutter- Upham (2011) found that executive function such as initiation, plan/organize, inhibit, self-monitor, working memory, task monitor, and organization of materials were significant predictors of academic procrastination. Further, the research (Schweigerová, Slavkovská, 2015) confirmed the reduced level of executive functions such as inhibition, shifting, automonitoring, initiative, working memory, planning, monitoring of tasks and organization materials in procrastinating students. Like the study by Gutiérrez-García et al. (2020), students who procrastinated the most had difficulty planning and organizing their school activities. People who do not show a great deal of shifting may find it difficult to start work and need to be more proactive or use more prompting to get started on an activity they should be doing (e.g., preparing for an exam). Since it is the lower level of self-monitoring that has been shown to be significant for higher levels of procrastination, it is possible that these individuals approach their own tasks in a non-systematic way and thus become overwhelmed when faced with large amounts of information (Roth et al., 2005). Higher levels of dysfunction in the areas of ability to monitor one's tasks and working memory predict higher rates of academic procrastination. Better self-monitoring, which represents one's ability not to succumb to momentary ideas and impulses, and better ability to process information thus represent a protective factor against procrastination, as they allow for better control over one's own behavior. Persons who do not succumb to momentary ideas and do not prioritize short-term benefits over long-term benefits (Tice, Baumeister, 1997). The presented results indicate the importance and necessity of working with students to improve the skills of more effective self-regulation as well as strategies for planning and solving problems of their duties.

Academic procrastination is generally described as the inability of adolescents to complete school-related tasks in a timely manner (Steel, 2007), with adolescents increasingly resorting to the virtual world (Aslan, 2019), which accounts for the positive relationship between Internet addiction and academic procrastination. Although there is a relationship between these variables, the studies addressing the predictive significance of problematic Internet use for the occurrence of academic procrastination is under-researched. The subscales of problematic Internet use or Internet addiction that emerged as significant predictors for academic procrastination in our research was only subscale Negative outcomes explaining 13.5% of the prevalence of academic procrastination. The predictive significance of another subscales and Internet addiction was not confirmed in our research, despite several studies (Lavoie, Pychyl, 2001; Reinecke et al., 2018) considering Internet applications and the Internet itself as a cause of procrastination. Odaci (2011) argues that academic procrastination is a predictor of problematic Internet use among college students, but he finds that procrastination does not significantly contribute to problematic Internet use but speaks to the possible opposite effect of these variables. Thus, it is possible that this variable is not a cause but a consequence of procrastination. The literature confirms that academic procrastination is one of the significant predictors of Internet addiction (Uzun, Önal and Tokel, 2014). However, the truth remains that there are variables that increase the rate of procrastination, such as imbalances in behavior, control, and planning that can develop because of uncontrolled Internet use (Casey et al., 2005). Recent research has found that students who experience academic procrastination experience academic anxiety and have low self-regulation skills, increasing their problematic smartphone use (Yang, Asbury, Griffiths, 2019). Thus, it can be said that the time students devote to internet use affects their academic success stems from the fact that there is endless data on the internet and the benefits of students in this regard, with their academic procrastination consisting of putting off homework and assignments by spending their free time on the internet.

4.1 Limits

We consider self-assessment scales to be the most significant limit, especially the detection of executive functions through a questionnaire, where we relied on the respondents' ability to assess themselves. With this limit comes another limit, namely misunderstanding of the assignment, or dishonest answers in the rating scales and to the questions. We also consider an insufficiently large sample as a limit, while increasing the research sample could decreases the degree of generalization to the entire population.

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