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**Candy Crush Addiction, Executive Functioning and CGPA of
University Students of Lahore**

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The present paper aimed to investigate the mediating role of executive functioning in the relationship between Candy Crush addiction and the academic performance of younger adults. The sample comprised of $N = 202$ younger adults from different universities of Lahore, Pakistan. The age range of the sample was between 18-23 years ($M = 19.75$, $SD = 1.51$). The Game Addiction Scale (GASA) and the Executive Functioning Questionnaire were administered to all the participants. Findings showed that the variables of gender (male), nuclear family system and less involvement in outdoor activities were supportive of higher scores on Candy Crush addiction. When executive functioning was controlled, the effect from Candy Crush addiction on Cumulative Grade Point Average (CGPA) was significant. When Candy Crush addiction was controlled only the retroactive inhibition, working memory, flexibility, planning and time management were found to significantly correlate with CGPA. Thus, the results showed partial mediational relationship among the study variables. The results have important implications for parents and educational institutes in terms of devising strategies to reduce the addiction to Candy Crush.

Keywords: Candy Crush, addiction, executive functioning, grade point average, young adults

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Online games have become one of the most favorite recreational activities all around the world (Comstock & Scharrer, 2007; Gentile, Saleem, & Anderson, 2007; Kirsh, 2006). Regardless of age, many people play online games to some extent but younger adults are more tethered for becoming addicted to online gaming behavior (Singer & Singer, 2001). Development of exciting and eye-popping features of games immerses youngsters in the games so much so that they become unaware of their surroundings (Wei & Lu, 2014). Spending huge amounts of time in fighting with the obstacles and the excitement to reach the next level of a game, can lead to various psychological, cognitive and academic problems (Ferguson et. al, 2011; Mentzoni et. al, 2013).

Candy Crush is one of the most popular games and is played by 93 million people every day worldwide (Candy Crush Saga, 2015). According to Social Bakers' Statistics (2016), 70 million people in Pakistan play Candy Crush per week. Candy Crush is based on swapping scrumptious candies to make a row or a column of three matching colored candies. The matched candies are then removed from the screen and candies above them fall into the empty boxes. The player continues to match candies in order to reach the next level (Candy Crush Saga, 2015). It is believed that rewards obtained in games like Candy Crush causes the release of dopamine in reward circuits of brain that may pave the way to addictive behaviors (Billieux et. al, 2013; Li & Wang, 2013). The role of dopamine is very important for the learning and development of behavioral responses. The amount of dopamine released seems to depend on how much time we spend in the games we play (Erturkoglu et al., 2015; Hou, 2011; Wei & Lu, 2014). Research has shown changes in brains of gaming addicts such as shrinkage in gray matter areas particularly in the frontal lobe which is responsible for executive functioning (Chen & Leung, 2015; Zhou, et al., 2011; Yuan, et al., 2011; Weng et al., 2013). Intact executive functioning is important in encompassing activities such as organization (Best, Miller, & Jones, 2009), planning (Tonsgard, 2006), problem solving (Cutting et al. 2000),

learning, decision making (Rosser & Packer, 2003), working memory (Blair & Razza 2010) and academics (Lehtonen, Howie, Trump & Huson, 2013; Levine, Materek, Abel, O'Donnell, Cutting, 2006) or career to wellbeing (Cutting et al. 2004) and social relationships (Leung & Lee, 2012, Lezak, Howieson, & Loring & Fischer, 2004). Poor executive functioning can have deleterious effects on academic grades (Asato, Sweeney, & Luna, 2006; Bull, Espy, & Senn, 2004; Miyake et al., 2000; Zelazo, Müller, Frye, & Marcovitch, 2003). Addiction to online gaming has penetrated deeply and swiftly in the lives of younger adults in Pakistan. Despite the fact that Pakistan is a developing country with poor economy, young adults are spending huge amounts on gaming related activities. Due to the ongoing security situation of Pakistan, many parents are restricting outdoor activities for their children because of safety concerns. This provides a large amount of screen time to young adults.

Although, there are limited numbers of studies on the implications of Candy Crush addiction, studies conducted on gaming addiction in general report mixed results in terms of the relationship between gaming addiction, executive functioning and academic performance. Some studies have reported a positive relationship between playing games, executive functioning and academic outcomes (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2014; Suhr, Hernandez, Grimes, & Warschauer, 2015) whereas other have demonstrated negative relationship (Dokterman, 2013; Junco & Cotten, 2012; Morgan & Cotten, 2003; Pempek, Yermolayeva, & Calvert, 2009; Stuart, 2014; Wingfield & Merced, 2014). Given that, limited studies available on Candy Crush addiction, as well as the general contradicting findings within this field, it is important to extend the literature with more nuanced data to better understand how executive functioning and video game addiction play any role in predicting academic performance. The current study aims to investigate the

mediating role of executive functioning in the relationship between Candy Crush addiction and the academic performance of university students of Lahore, Pakistan. Understanding of the effects of Candy Crush will add to the knowledge of the existing literature and may pave the way for the development of effective interventions to reduce the addiction to online games.

After understanding the dynamics of the literature and the implications of relevant variables, two hypotheses were constructed. Firstly, it has been assumed that higher levels of Candy Crush addiction will be correlated with poor executive functioning and lower CGPA. It is also assumed that the executive functioning is likely to mediate the relationship between Candy Crush addiction and academic performance in younger adults.

Method

Sample

The study was conducted in Lahore, the second largest city of Pakistan. The sample comprised of $N=202$ younger adults from different universities of Lahore, Pakistan. The inclusion criteria of the participants was that they should have been playing Candy Crush for a minimum of 30 minutes daily, born and raised in Pakistan and with apparently good physical and mental health. Initially, $N=450$ participants were approached, from which $N = 373$ participants met the inclusion criteria and consented for participation, whereas did not complete the survey; hence, the response rate was 65%. The demographic characteristics of the sample are explained in Table 1.

Table 1
Demographic characteristics of the study sample N=202

Characteristics	<i>f (%)</i>	<i>M (SD)</i>
Age		19.75(1.72)
Monthly family income (PKR)		56443 (27.78)
Gender		
Male	131 (65)	
Female	071 (35)	
Family system		
Nuclear	121 (60)	
Joint	081 (40)	
Outdoor physical activities		
Yes	044 (22)	
No	158 (78)	

Note. Nuclear = a family composed of two parents and one or more children, Joint = a type of extended family composed of parents, their children, and the children's spouses and offspring, grandparents etc. in one household, PKR104.80 = 1 US\$, Outdoor physical activities = at least once in a week.

The Table 1 shows the general characteristics of the sample of the current study.

Measures

Following measures were used in the current study.

The Game Addiction Scale for Adolescents (GASA). The scale was developed by Lemmens, Valkenburg, and Peter (2009). It has seven items with a five point rating scale ranging from never (1) to very often (5). The GASA assesses symptoms of addictive gaming. In the present study, the word game was substituted with Candy Crush. Sample items include: “*How often during the last 6 months?*” and “*Did you play Candy Crush to forget about real life?*” The composite score ranges from 7-35. Higher scores indicate greater Candy Crush addiction. The Cronbach alpha for the GASA was .82 in the present study.

Executive Functioning Questionnaire. It was developed by Dawson and Guare (2013). It has 33 items which assess different domains of executive functioning including response inhibition, working memory, emotional control, flexibility, sustained attention, task initiation, planning\ prioritization, organization, time management, goal-directed persistence and meta-cognition. All subscales have 3 items each and had a 7-point rating scale ranging from strongly agree (1) to strongly disagree (7).

Academic Performance. Academic performance was measured by self-reported Cumulative Grade Point Average (CGPA). In addition to being the most common measure of academic performance in the literature on college outcomes, CGPA is the sole measure of academic performance used in the literature on social media (Junco, 2011; Junco & Cotten, 2012; Kirschner & Karpinski, 2010; Kolek & Saunders, 2008).

Procedure

The study was approved by the Departmental Doctoral Program Committee (DPC) and Advance Studies and Research Board (ASRB) of the University of Punjab, Lahore, Pakistan and funded by the Higher Education Commission, Pakistan under its scheme *International Research Support Initiative Program* (IRSIP. Grant no 1-8/HEC/HRD/2016/6371). Permission for using the respective instruments was granted from respective authors. The researchers visited universities and took permission from respective heads of the institutes to administer questionnaires to the participants. Teachers were requested to allocate time in class for data collection which took place by administering paper versions of the instruments. The participants were informed that their individual information would be kept confidential and were informed about how data would be stored and reported. Participants were thanked however, no monetary rewards were offered.

Results

The Statistical Package for Social Sciences (SPSS 21) was used for descriptive statistical analysis and Pearson product-moment correlation and SPSS macro (Preacher & Hayes, 2004) for mediation were used for analyses.

Table 2

Descriptive Statistics and Internal Consistency Analyses of the Study Variables N=202

Scales	<i>K</i>	<i>α</i>	<i>M</i>	<i>SD</i>	<i>Min-Max</i>
Candy crush addiction	7	0.82	17.61	4.02	10-25
Retroactive inhibition	3	0.81	09.51	4.19	03-017
Working memory	3	0.72	09.55	3.95	04-017
Emotional control	3	0.60	10.26	2.97	04-018
Flexibility	3	0.65	10.32	3.06	05-016
Sustained attention	3	0.81	10.47	3.33	03-017
Task initiation	3	0.92	09.71	3.59	03-016
Planning	3	0.86	10.48	3.47	05-017
Organization	3	0.62	15.21	2.71	09-021
Time management	3	0.42	10.14	4.17	03-017
Goal directed persistence	3	0.84	10.75	4.42	03-019
Meta cognition	3	0.72	12.25	2.49	05-021
Cumulative grade point average	4		03.12	0.52	1.8-3.9

Note. *K* = No of items; *M* = Mean; *SD*= Standard Deviation; *Min-Max* = Minimum and Maximum.

A descriptive analysis was conducted to calculate the means, standard deviations, reliability and minimum and maximum scores. The results showed that all scales have moderate to good reliability.

Table 3
Relationship between Candy Crush Addiction, Executive Functioning and CGPA N=202

	1	2	3	4	5	6	7	8	9	10	11	12	13
1GAS	-	-.57**	-.50**	-.33**	-.46**	-.54**	-.53**	-.60**	-.01	-.61**	-.60**	-.19**	-.72**
2RI		-	.72**	.63**	.67**	.83**	.80**	.76**	-.01	.50**	.52**	.28**	.36**
3WM			-	.59**	.58**	.79**	.84**	.65**	-.05	.47**	.52**	.27**	.41**
4EC				-	.71**	.75**	.73**	.58**	.05	.35**	.36**	.30**	.34**
5FL					-	.77**	.81**	.63**	.02	.40**	.42**	.22**	.39**
6SA						-	.93**	.79**	.01	.54**	.54**	.34**	.42**
7TI							-	.81**	-.03	.48**	.52**	.31**	.42**
8PL								-	.04	.51**	.54**	.28**	.50**
9ORG									-	.11	.12	.03	.10
10TM										-	.79**	.42**	.61**
11GDP											-	.47**	.50**
12MC												-	.17*
13CGPA													-

Note. RI= response inhibition; WM=working memory; EC= emotional control, FL= flexibility; SA= sustained attention; TI= task initiation; PL= planning\ prioritization, time management, goal-directed persistence and meta-cognition). Gaming addiction correlated negatively with CGPA. Executive functioning was positively correlated with CGPA. As the level of Candy Crush addiction increases, younger adults exhibit poor executive functioning and lower CGPA.

Mediational Analysis

The present study used a SPSS Macro (Preacher & Hayes, 2004) and was used to test for the significance of executive functioning as a mediator for the relationship between Candy Crush addiction and CGPA. The bootstrapped ratio of 5000 bootstraps for the indirect effect was used. Demographics (gender, family system and outdoor activities) explained 9.9% of the variance of Candy Crush addiction in the analysis. Being male, nuclear family system and those who were doing less outdoor activities tended to report higher scores on Candy Crush addiction.

In the preliminary analysis, the total effect of Candy Crush addiction on CGPA was significant ($\beta = -0.72, p < .001$). The direct effect of Candy Crush addiction on executive functioning was significant; retroactive inhibition ($\beta = -0.60, p < .001$), working memory ($\beta = -0.50, p < .001$), emotional control ($\beta = -0.25, p < .05$), flexibility ($\beta = -0.35, p < .001$), sustained attention ($\beta = -0.45, p < .001$), task initiation ($\beta = -0.47, p < .001$), planning ($\beta = -0.51, p < .001$), time management ($\beta = -0.63, p < .001$), goal directed persistence ($\beta = -0.65, p < .05$) and meta cognition ($\beta = -.12, p < .05$). When executive functioning was controlled, the effect from the candy crush addiction on CGPA was significant as well ($\beta = -0.58, p < .001$). When Candy Crush addiction was controlled for the following subscales of executive functioning were significant: Retroactive inhibition ($\beta = -0.23, p < .05$), working memory ($\beta = 0.25, p < .05$), flexibility ($\beta = 0.22, p < .05$), planning ($\beta = 0.42, p < .05$) and time management ($\beta = 0.53, p < .05$). The results indicated that indirect effect was significant $\beta = -.08, CI [-0.03, 0.01]$.

Discussion

The main objective of the present research was to assess the mediating role of executive functioning in the relationship between Candy Crush addiction and the Academic performance of University students. The results show that Candy Crush addiction, executive functioning and CGPA are inter-related. Executive functioning was also found to be a significant mediator in the relationship between Candy Crush addiction and CGPA. Thus, the results of the present study supports previous findings the above mentioned literature (DeBerard et al., 2004; Geiser & Santelices, 2007; Williford, Vick, Vitiello, & Downer, 2013). These findings are consistent with the previous researches on gaming addiction as well (Cotten, 2008; Dokterman, 2013; Junco, 2011; Morgan & Cotten, 2003; Pempek, Yermolayeva, & Calvert, 2009; Stuart, 2014; Wingfield & Merced, 2014) showing that addiction to gaming is inversely related to executive functioning skills and academic performance.

Theoretically, time spent on playing Candy Crush might not be problematic however, large amounts of time spent on Candy Crush seems to weaken executive functioning skills and detracts from focusing on studies. In indigenous perspective, spending less time for studies may negatively impact academic success, measured in this study by CGPA. To fulfill the requirements of the Pakistani education system, students are supposed to do a bunch of academic work after university timings but due to these online games, students are unable to focus on their work. Moreover, Pakistani parents are unable to the pace of technological advancements; they are also unable to determine how Smart phones can distract their children from studies. Students use Smart phones and show their parents that they are studying on their mobile phones. Students can easily deceive parents through several recent applications. According to Junco and Cotton (2011), addiction to video gaming was related to learning impairments due to cognitive overload caused by multitasking. Thus, the first and second hypotheses of study are strongly supported by the empirical data and can be supported by cultural context.

Limitations and Suggestions

There are some limitations to the present study that should be noted. First, this is a correlational study whereas an experimental research may further explain the current findings regarding the effects Candy Crush addiction on executive functioning and CGPA.

Self-reported CGPA is another limitation of the study. It is suggested for the future researchers to extract CGPA related data from university records in order to ensure accuracy.

Implications

The connection between Candy Crush addiction, executive functioning and CGPA is a fruitful addition related to the existing literature and lays the ground for further exploration. Looking at the results of this study, game developers and educators should suggest specific measures to integrate education and games. Moreover, this study has important implications for youths in terms of understanding the detrimental effects of too much gaming.

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