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To excel or not to excel: Strong evidence on the adverse effect of smartphone addiction on academic performance

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A B S T R A C T

This study aimed to verify whether achieving a distinctive academic performance is unlikely for students at high risk of smartphone addiction. Additionally, it verified whether this phenomenon was equally applicable to male and female students. After implementing systematic random sampling, 293 university students participated by completing an online survey questionnaire posted on the university's student information system. The survey questionnaire collected demographic information and responses to the Smartphone Addiction Scale-Short Version (SAS-SV) items. The results showed that male and female university students were equally susceptible to smartphone addiction. Additionally, male and female university students were equal in achieving cumulative GPAs with distinction or higher within the same levels of smartphone addiction. Furthermore, undergraduate students who were at a high risk of smartphone addiction were less likely to achieve cumulative GPAs of distinction or higher.

1. Introduction

Smartphones have evolved to the extent where they have become an integral part of university students' lives. The latest data from the Pew Research Center shows that of smartphone owners in the US, 46% said that their smartphone is something “they could not live without” (Smith, 2015). Smartphones are used throughout the day for a multitude of reasons, including communication, productivity, entertainment, utilities, social networking, and gaming (Kwon, Lee, et al., 2013). A huge variety of applications (apps) is available for every possible use, age and preference. The smartphone's capacity allows for thousands of photos, songs, apps, and games, as well as tens of videos, a capability that is indeed gratifying for its users. This digital convergence is one of many reasons why smartphone ownership among American adults increased from 35% in 2011 to 64% in 2014 (Smith, 2015). In addition, 15% of young American adults between 18 and 29 years of age are classified as heavily dependent on smartphones for online access (Smith, 2015). With respect to the undergraduate population in the US, the data from the EDUCAUSE Center for Analysis and Research shows that 86% of undergrad students owned smartphones in 2014, which represents an increase from 76% in 2013 (Dahlstrom & Bichsel, 2014).

This surge in smartphone ownership among university students triggered an interest in investigating the impact of smartphone use in all aspects of university students' lives, particularly academic performance (Karpinski, Kirschner, Ozer, Mellott, & Ochwo, 2013). For example, of undergraduate students who own a smartphone, 99% said that they had used their phone at least once in the previous hour during the course of the study period (Smith, 2015). Another study found that spending a fair amount of time on smartphones by university students while studying negatively affects their Grade Point

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Averages (GPAs) (Junco & Cotten, 2012). A Grade Point Average (GPA) is a standard way of measuring academic achievement by calculating the average result of all the grades achieved by a student. GPA is calculated on a 4 point grading scale where 4 is the highest and 0 is the lowest achievement. Furthermore, there were attempts to identify gender similarities and differences in relation to technology in general, and smartphone use and addiction in particular (Cotten, Shank, & Anderson, 2014; Nazir Hawi & Rupert, 2015; Yen, Ko, Yen, Chang, & Cheng, 2009). In an Australian study, gender was not found to predict overall time spent on mobile phones or problematic use (Bianchi & Phillips, 2005). The only difference this study identified was that females were more likely to use mobile phones for social purposes while men were more likely to use them for business purposes. However, other studies revealed differences in the use of mobile phones between males and females (Baron & af Segerstad, 2010; Fortunati, 2009). A multination study that included samples from Sweden, USA, Italy, Japan, and Korea, found some gender differences in mobile phone usage and attitudinal patterns, but indicated that in some cases culture could be a more explanatory factor than gender (Baron & Campbell, 2012). For instance, the study's results showed that in each sample of the aforementioned countries the higher proportion of heavy texters was for females. As for smartphone addiction, some studies reported that females scored higher risks compared to males (Fargues, Lusar, Jordania, & Sánchez, 2009; Leung, 2008).

Our study aims to verify whether achieving distinctive academic performance is unlikely for students at high risk of smartphone addiction (Junco & Cotten, 2012). Furthermore, it is important to verify whether this phenomenon, which is capable of crippling the productivity of individuals and consequently decreasing the intelligentsia strata, is equally applicable to male and female students.

1.1. Smartphone addiction

Behavioral addiction also classified as impulse control disorder with a behavioral focus resembles substance addiction in many domains such as phenomenology, natural history, neurobiological mechanisms, tolerance, comorbidity, and overlapping genetic contribution (Grant, Potenza, Weinstein, & Gorelick, 2010). Technological addiction, defined by Griffiths (1995) as a non-substance addiction that involves human-machine interaction, is a subset of behavioral addiction that shares similarities with the five core components of addiction including salience, mood modification, tolerance, withdrawal, conflict and relapse. Several studies have addressed different technological addictions and corresponding instruments have been developed to assess these addictions (Shaw & Black, 2008). These technological addictions include Internet addiction or problematic Internet use (Nazir Hawi, 2012; Nazir Hawi, Blachnio, & Przepiorka, 2015; Young, 1998), social networking sites (SNS) addiction and in particular Facebook addiction (Andreassen, 2015; Ryan, Chester, Reece, & Xenos, 2014), online gaming addiction or problematic Internet gaming (Cole & Hooley, 2013; Rehbein, Kliem, Baier, Mößle, & Petry, 2015) and online gambling (Mark Griffiths & Barnes, 2008). Internet addiction for Shaw and Black (2008) is characterized by “excessive or poorly controlled preoccupations, urges or behaviors regarding computer use and internet access that lead to impairment or distress”. Internet addiction as defined by Hawi (2012) is “repetitive usage of Internet-related apps driven by a need, inflicting problems primarily on oneself.” As for Internet gaming disorder, it was introduced as a psychiatric diagnosis in the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (American Psychiatric Association, 2013). With the evolution of mobile phones to smartphones and by encompassing all of the internet features and mobile applications, the technological addictions cited above have been shifting gradually to smartphones. Several terminologies have been used by different researchers to express the phenomenon of problematic mobile phone use (PMPU) (Bianchi & Phillips, 2005; Joel Billieux, Van der Linden, d'Acremont, Ceschi, & Zermatten, 2007), such as mobile phone dependency (Toda et al., 2008), mobile phone addiction (MD Griffiths, 2013), and smartphone addiction (Kwon, Lee, et al., 2013; Lee, Cho, Kim, & Noh, 2015). Nevertheless, it was argued that more research is needed before PMPU can be considered behavioral addiction (Joël Billieux, Maurage, Lopez-Fernandez, Kuss, & Griffiths, 2015).

It is not the smartphone per se or the mobile apps that are addictive in nature. Instead, it is a student deficiency that leads to smartphone addiction (Nazir Hawi, 2012). For instance, Chinese young adults who were mobile phone addicts or possible mobile phone addicts were found to be more vulnerable to have negative emotions compared to non-addicts (Chen et al., 2016). Students may turn to smartphone use to cope with stress, depression, anxiety, strained relationships, loneliness, and bad academic achievement. Studies conducted in Egypt and USA showed that risk for problematic Internet use was significantly increased among those who meet criteria for severe depression (Mobasher, Fouad, Enaba, Shawky, & Moselhy, 2015; Moreno, Jelenchick, & Breland, 2015). Other studies conducted in South Korea and Lebanon showed that those who have lower self-control and those who have greater stress were more likely to be addicted to smartphones (Jeong, Kim, Yum, & Hwang, 2016; Samaha & Hawi, 2016). Whether a cause or an effect, smartphone addiction is detrimental to productivity in general and learning in particular.

1.2. Learning contexts and smartphone multitasking

University students and their smartphones have become inseparable even in learning contexts (Judd, 2014). Whether learning in class, studying outside class, or engaging in homework either alone or as a member of a team, most students tend to smartphone multitask (Jacobsen & Forste, 2011; Junco, 2012). Though smartphones facilitate access to educational resources and collaboration (Chan, Walker, & Gleaves, 2015), studies have indicated that technology-related distractions are negatively related to homework effort and environment (Xu, 2015). In Junco and Cotton's study, 93% of students reported that they actively chatted while performing schoolwork (Junco & Cotten, 2011). Distractions from learning are powered by students' fascination with the multitude of smartphone apps that cater to every aspect of their lives. This fascination is mediated by the need for and the ease of use of apps (Calderwood, Ackerman, & Conklin, 2014; Dietz & Henrich, 2014), and it is supplemented by low interest and low motivation in doing homework (Leone & Richards, 1989). For example, Facebook use is a key contributor to student multitasking while studying (Judd, 2014). Additionally, instant messaging is a major distraction associated with failure to complete schoolwork (Junco & Cotten, 2011). In settings where students are not supervised, it is their responsibility to refrain from smartphone multitasking while studying. However, using smartphones for tasks irrelevant to learning in controlled learning settings such as in classrooms during lectures or while engaging in classwork supervised by instructors without the latter's intervention is alarming. Factors that contribute to this phenomenon, as identified in Griffin (2014), include 1) an inability to concentrate due to physiological factors such as insufficient sleep or anxiety, 2) a constant degree of boredom accompanied by an urgency for non-stop entertainment, 3) an overload of cognitive stimulation and 4) an addiction to technology.

1.3. Smartphone multitasking and academic performance

Several studies have found that spending a considerable amount of time on screen devices leads to either the deterioration of or failure with respect to academic performance (Judd, 2014). In a sample of 480 US university students, those who spent more time engaged in technology use spent less time studying, which had a strong negative relationship on GPAs (Wentworth & Middleton, 2014). Ironically, fifteen years ago, the divide between learning-rich and learning-poor was thought to widen due to emerging communications technologies (Sargant, 2000). Two years ago, mobile technology was hoped to narrow the learning divide (Ally & Samaka, 2013).

A link has been identified between smartphone multitasking and the decline in academic performance. In a sample of 263 US students aged 11–25 years, those who used Facebook and texted while studying had lower GPAs compared with students who did not (Rosen, Carrier, & Cheever, 2013). In a cross-cultural study that compared the effects of accessing social networking sites on academic performance between US ($n = 451$) and European ($n = 406$) university students, only the US sample showed a negative relationship moderated by multitasking (Karpinski et al., 2013). Similar results were obtained from a study of a sample of 1839 US university students, which revealed that Facebook use and text messaging while doing schoolwork were negatively related to college GPAs (Junco & Cotten, 2012). An experimental study further found that students who used Facebook while attending class lectures obtained much lower scores compared with students who did not (Wood et al., 2012).

The adverse effect of smartphone multitasking on academic performance may be explained by the cognitive overload concept (Mayer & Moreno, 2003) whereby nonacademic multitasking in learning contexts aggravates the problem (Foehr, 2006) but does not reduce the cognitive load (Mayer & Moreno, 2003). Another possible explanation is that smartphone multitasking while studying hinders the implementation of an appropriate learning strategy (Lee et al., 2015), which is essential to learning in general and to distinctive academic performance in particular (Nazir Hawi, 2010). Because learning can be difficult and complex, researchers have been relentless in their investigations of required cognitive processes (Mayer & Moreno, 2003) and have suggested specific learning models (Nazir Hawi, 2014). It is evident that smartphone multitasking that is not related to learning while in the process of learning impedes cognitive processes required for learning (Judd, 2014; Lee et al., 2015), thus causing academic performance to decline (Ellis, Daniels, & Jauregui, 2010; Karpinski et al., 2013), even for distinguished students (Junco & Cotten, 2012). Students who are in a state of accepting interruptions by smartphone notifications while learning and responding to them by switching tasks interrupt their learning processes and shift their mental resources to nonacademic tasks (Just et al., 2001), which results in a loss in learning.

1.4. Research questions and hypothesis

Published studies that addressed smartphone addiction and academic performance are limited, especially with respect to high academic performance and gender differences. In our study, we attempt to address the following four hypotheses:

Hypothesis 1. Male and female university students are equally susceptible to smartphone addiction.

Hypothesis 2. Male and female university students' perceptions of smartphone use and related activities are the same.

Hypothesis 3. Male and female university students are equal in achieving cumulative GPAs with distinction or higher within the same levels of smartphone addiction.

Hypothesis 4. Undergraduate students who are at high risk of smartphone addiction are less likely to achieve cumulative GPAs with distinction or higher.

2. Methodology

2.1. Sampling procedure

This cross-sectional study was carried out at Notre Dame University-Louaize, Lebanon. The study was the first in its field in the Arab world. It was based on voluntary participation of university students without any gender, socioeconomic, or nationality restrictions. Systematic random sampling was implemented by randomly picking the first student from the student population ordered by student identification number and then selecting each 3rd student from the list. Newly admitted students were not part of the target population. This sampling strategy was thought to reduce sampling error and bias. Participation was opened on the first day of the registration period of the spring 2014 semester over two months.

2.2. Data collection

Following the university research committee's approval of the research instrument, a hyperlink to the survey was added on the home page of the University's Student Information System (SIS), which allowed the selected students to access the questionnaire. The first webpage of the questionnaire presented the research purpose, informed the students that the survey would require approximately 15 min to complete, stated the authors' assurances of respondent anonymity and confidentiality, and asked respondents whether they permitted the research team to automatically obtain their real actual GPA, since the online survey was made available via the student information system. In all, 86.4% of the respondents gave the approval to obtain their actual GPA, leading to a sample of 293 students.

A trap question was added to every online survey instrument to ensure that respondents were thoroughly reading them and not just clicking through overlooking the content. For instance, SAS-SV included the following trap question: Select "Strongly Agree" for this item. Though this trap question can be easily answered correctly, most probably a speeder will not spot it.

Forty-four respondents answered the trap question incorrectly and were removed from the data set. Three of the remaining 249 participants left just one cell empty. The value 3 was inserted in each one of the missing value cells. In all, three cells were changed. The value 3 was chosen because it is in the middle between 1 and 6. The data were then entered into IBM SPSS 20.0 and analyzed.

2.3. Measures

The survey questionnaire contained two sections. The first section collected demographic information, including gender, age, educational level, and academic major. The second section included the Smartphone Addiction Scale-Short Version (SAS-SV) items. Participants' cumulative GPAs were obtained through the registrar's office.

The SAS-SV (Kwon, Kim, Cho, & Yang, 2013) comprises ten items that assess smartphone use primarily to identify the level of smartphone addiction risk, but not to diagnose smartphone addiction. This scale is a shortened version of the original Smartphone Addiction Scale (SAS) that consists of 33 questions (Kwon, Lee, et al., 2013). The latter was developed based on the Internet Addiction Test (Young, 1998) but was modified to include features specific to smartphones. The SAS-SV responses are given on a 6-point Likert scale ranging from 1 − Strongly Disagree to 6 − Strongly Agree. The total scores ranged from 10 to 60. The SAS-SV revealed strong internal consistency (Cronbach's alpha = 0.849). Other studies have also found good psychometric properties of the SAS-SV, such as those conducted on a South Korean sample, which yielded a Cronbach's alpha of 0.911 (Kwon, Kim, et al., 2013), and two Turkish samples, which yielded a Cronbach's alpha of 0.88 (Akın, Altundağ, Turan, & Akın, 2014; Demirci, Orhan, Demirdas, Akpınar, & Sert, 2014). Males who scored 31 or below and females who scored 33 or below are considered lower risk candidates for smartphone addiction compared with smartphone users who have scores higher than these cutoffs and are considered high-risk candidates for smartphone addiction. These cutoffs scores of 31 for males and 33 for females come from the original development of the scale (Kwon, Kim, et al., 2013).

2.4. Descriptive statistics

Of the 249 respondents, 54.2% were males. The percentage of male students in the population was 59.9%. The average age of the respondents was 20.96 (SD = 1.93). Respondents' ages ranged between 17 years and 26 years. The mean GPA was 2.63 (SD = 0.86). Participants' belonged to all seven faculties, 50 academic majors and 8 academic levels. The faculties were Architecture Art and Design, Business Administration and Economics, Engineering, Humanities, Law and Political Science, Natural and Applied Sciences, and Nursing and Health Science. The 8 academic levels were junior, sophomore, senior, Year I, Year II, Year III, Year IV, and Year V. In this sample, 111 out of 249 participants (44.6%) were at high risk of smartphone addiction. Within the male and female cohorts, 55 out of 135 males (40.7%) and 56 out of 114 females (49.1%) were at high risk of smartphone addiction.

3. Results

The University sets three levels of distinction. Students who obtain GPAs of 3.2–3.49, 3.50–3.79, and 3.80–4.00 are awarded academic recognition of distinction, higher distinction, or highest distinction, respectively. For brevity, in this study, these students are referred to as *the distinction cohort*, and the three academic recognitions are referred to collectively as *distinction*. The *no distinction cohort* refers to all students with GPAs below 3.2.

3.1. GPA by sex

The Kolmogorov-Smirnov Test and Shapiro-Wilk Test showed that the GPA variable was neither normally distributed at the sample level nor at each level of the distinction and no distinction cohorts ($p = 0.000$). Accordingly, the Mann-Whitney *U* Test was selected to test for differences between males and females cohorts on GPA, because the test does not assume any properties regarding the variable under analysis such as its distribution shape (Pallant, 2010). An additional benefit is that Mann-Whitney *U* Test compares medians which is much more robust against outliers. Also, the two requirements of random sampling and independent observations were met. This test revealed a significant difference in GPAs of males (M = 2.43, n = 135) and females (M = 2.86, n = 114) with a medium effect size, U = 4849, z = −5.027, p = 0.000, r = −0.32. Within the no distinction cohort, a significant difference in the GPAs of males (M = 2.18, n = 111) and females (M = 2.50, n = 70) was found with a close to medium effect size, U = 2598, z = −3.750, p = 0.000, r = −0.28. Additionally, within the distinction cohort, the test revealed no significant difference in GPAs between males (M = 3.52, n = 24) and females (M = 3.53, n = 44), U = 485, z = −0.552, p = 0.581. Table 4 categorizes average GPA by sex and with distinction cutoff point.

3.2. Smartphone addiction by gender

The objective was to explore the relationship between SAS-SV risk levels and SAS-SV scores, on the one hand, and between the genders, on the other hand. The chi-square test for independence (with Yates continuity correction) was conducted to determine whether the proportion of males who are at high risk of smartphone addiction is the same as the proportion of females. The cross-tabulation met the requirement of 0 cells having expected counts of less than 5, thereby generating a non-significant difference (chi-square = 1.758, df = 1, p = 0.202). Thus, the chi-square test confirmed Hypothesis 1 − the proportion of males was not significantly different from the proportion of females with respect to SAS-SV risk levels (see Table 1). SAS-SV risk level and gender were independent variables. The same test showed that the proportion of males was not significantly different from the proportion of females on any SAS-SV item except for *won't be able to stand not having a smartphone* (SAS4) and *feeling impatient and uncomfortable when I am not holding my smartphone* (SAS5). The proportions of females on these two items were significantly higher than those of males but with small effect sizes (see Table 2). There appears to be no association between SAS-SV risk level and items, on the one hand, and gender, on the other hand except for SAS4 and SAS5 (Hypothesis 2). Furthermore, within genders, the percentage of males who were at high risk of smartphone addiction (40.7%) was lower than that of females (49.1%) (see Table 1).

3.3. GPA cap and smartphone addiction risk levels

Next, the strongly disagreed, disagreed, and weakly disagreed categories were combined into one category called disagreed. Similarly, the strongly agreed, agreed, and weakly agreed values were combined into one category called agreed. Accordingly, Hypothesis 4 was addressed using a binary logistic regression because GPA was treated as categorical variable of no distinction or distinction. On *missing planned work due to smartphone use*, 1) male students who disagreed demonstrated greater odds, by 18.852 (p = 0.005), of achieving a GPA with distinction compared to males who agreed, and 2) female students who disagreed exhibited a greater probability, by 7.968 (p = 0.000), of achieving a GPA with distinction compared to females who agreed (see Table 3). On *having a hard time concentrating in class, while doing assignments, or while working due to smartphone use*, 1) male students who disagreed had higher odds by 2.946 ($p = 0.033$) of achieving a GPA with "distinction" compared to males who agreed, and 2) female students who disagreed had higher odds by 2.385 ($p = 0.033$) of achieving a GPA with "distinction" compared to females who agreed (see Table 3). On *I will never give up using my smartphone even when my daily life is already greatly affected by it*, 1) male students who disagreed did not have higher odds (OR = 0.903; $p = 0.826$) of achieving a GPA with "distinction" compared to males who agreed, and 2) female students who disagreed had higher odds by 2.990 ($p = 0.008$) of achieving a GPA with "distinction" compared to females who agreed (see Table 3).

Table 1
Crosstabulation of smartphone addiction risk level by sex.

Sex		Smartphone Addiction Risk Level		Total
		Low risk	High risk	
Males	count	80	55	135
% within Males		59.3	40.7	100.0
% within SAS Level		58.0	49.5	54.2
% of Total Sample		32.1	22.1	54.2
Females	count	58	56	114
% within Females		50.9	49.1	100.0
% within SAS Level		42.0	50.5	45.8
% of Total Sample		23.3	22.5	45.8
Total	count	138	111	249
% within SAS Level		100.0	100.0	100.0
% within Total Sample		55.4	44.6	100.0

Table 2
Independence tests between smartphone use and gender.

Variable	Chi-square (1, n = 249)	p	phi	Effect size
SAS1	0.021	0.886	0.017	Irrelevant
SAS2	0.130	0.719	−0.031	Irrelevant
SAS3	1.413	0.235	0.084	Irrelevant
SAS4	4.649	0.031	0.145	Small
SAS5	3.866	0.049	0.133	Small
SAS6	3.120	0.077	0.120	Irrelevant
SAS7	1.138	0.286	0.076	Irrelevant
SAS8	1.455	0.228	0.085	Irrelevant
SAS9	0.016	0.898	−0.017	Irrelevant
SAS10	2.162	0.141	0.102	Irrelevant

Note: SAS1 = Missing planned work due to smartphone use; SAS2 = Having a hard time concentrating in class, while doing assignments, or while working due to smartphone use; SAS3 = Feeling pain in the wrists or at the back of the neck while using a smartphone; SAS4 = Won't be able to stand not having a smartphone; SAS5 = Feeling impatient and uncomfortable when I am not holding my smartphone; SAS6 = Having my smartphone in my mind even when I am not using it; SAS7 = I will never give up using my smartphone even when my daily life is already greatly affected by it; SAS8 = Constantly checking my smartphone so as not to miss conversations between other people on Twitter or Facebook; SAS9 = Using my smartphone longer than I had intended; SAS10 = The people around me tell me that I use my smartphone too much.

Students who were at low risk of smartphone addiction had higher odds by 2.427 ($p = 0.004$) of achieving a GPA with “distinction” compared to those who were at high risk. Male students who were at low risk of smartphone addiction had higher odds by 4.250 ($p = 0.013$) of achieving a GPA with “distinction” compared to those who were at high risk. Female students who were at low risk of smartphone addiction had higher odds by 2.333 ($p = 0.032$) of achieving a GPA with “distinction” (see Table 3).

4. Discussion

Our study is unique in that it addressed gender differences in relation to smartphone addiction and usage with a sample that included university students. It revealed that male and female university students are equally susceptible to smartphone addiction. This result supports a study that showed no gender difference in SAS-SV scores in a sample of adults whose ages ranged between 18 and 53 years and who were selected from companies and universities in South Korea (Kwon, Lee, et al., 2013).

As for the percentage of students at high risk of smartphone addiction (44.6%; 22.1% males and 22.5% females), this result is considered alarming (see Table 1). What is reassuring is that both genders within the with distinction cohort tend to be at a low risk of smartphone addiction, with equal distance from their respective cutoffs. However, the no distinction cohort tends to be at a high risk of smartphone addiction, and the females demonstrated higher risk than did their male counterparts. Nevertheless, though females were at higher risk of smartphone addiction than males in the no distinction cohort, they (females) also had, on average, higher GPAs (see Table 4).

Table 3
Odds ratios and percentages of students obtaining distinction and higher Academic performance using smartphone.

	Females		Males		Total	
	%	OR	%	OR	%	OR
Missing planned work due to smartphone use						
Agree	39.5	Reference	37.8	Reference	38.6	Reference
Disagree	60.5	7.968***	62.2	18.852***	61.4	8.430***
Having a hard time concentrating in class, while doing assignments, or while working due to smartphone use						
Agree	42.1	Reference	45.2	Reference	43.8	Reference
Disagree	57.9	2.385*	54.8	2.946*	56.2	2.551**
I will never give up using my smartphone even when my daily life is already greatly affected by it						
Agree	43.0	Reference	35.6	Reference	39.0	Reference
Disagree	57.0	2.990**	64.4	0.903	61.0	1.620
Constantly checking my smartphone so as not to miss conversations between other people on Twitter or Facebook						
Agree	43.9	Reference	35.6	Reference	39.4	Reference
Disagree	56.1	2.674**	64.4	1.826	60.6	1.977*
Using my smartphone longer than I had intended						
Agree	71.1	Reference	72.6	Reference	71.9	Reference
Disagree	28.9	1.782	27.4	2.222	28.1	1.927*
Overall						
Agree	49.1	Reference	40.7	Reference	44.6	Reference
Disagree	50.9	2.333*	59.3	4.250*	55.4	2.427**

Note: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$; OR = odds ratio.

In fact, within the high-risk smartphone addiction level and within both the no distinction and distinction cohorts, female students academically outperformed the male students in the same cohorts (see Table 4). The reason for this is possibly related to gender differences in multitasking capability. Unfortunately, limited research studies have attempted to prove this assumption. Consistent with this premise, evolutionary psychology has found that women must be better multitaskers to survive (Ellison, 2005). Other research has confirmed that women do multitask slightly more often than do their male counterparts (Foehr, 2006; Schneider & Waite, 2005). In a strictly controlled experiment, females outperformed males on a cognitive test when required to coordinate two tests simultaneously (Ren, Zhou, & Fu, 2009). In another experiment, when men were introduced with a second task, they slowed down significantly compared with women (Cohen's $d = 0.27$) (Stoet, O'Connor, Conner, & Laws, 2013).

The results from the binary logistic regression found that students who are at high risk of smartphone addiction are less likely to achieve distinctive GPAs, thus confirming Junco and Cotten's result (Junco & Cotten, 2012). The latter determined that using Facebook and texting while doing schoolwork negatively affects a student's overall GPA.

Achieving a cumulative GPA with distinction or higher requires a commitment from students to attend classes, engage in class discussions, and spend study time efficiently without disruptions - electronic or other. The greater the risk of smartphone addiction is, the lower the fulfillment of learning commitments (Lee et al., 2015), which eventually leads to a decline of unknown magnitude in GPA. This phenomenon creates a learning divide within the group of people who have access to information and communication technology, which is a direct consequence of the digital divide. The magnitude of the learning divide can be assessed using the electronic multitasking factor abbreviated em-factor. The em-factor is determined by finding the odds ratio for achieving a high GPA by students who multitask in learning contexts. In this study, the male em-factor was 19, and the female em-factor was 8. The learning divide between differing regions of the world is referred to as the global learning divide.

4.1. Implications

Results highlighted the unlikeliness of students at high risk of smartphone addiction achieving distinctive academic performance. This phenomenon has adverse effects not only on individual academic performance and future careers but also on the future and productivity of societies.

The dangers of smartphone addiction lie in the concurrent use of the smartphone while performing tasks at work, learning in educational settings, or driving in traffic. Many traffic laws have recently been established that fine drivers for using smartphones while driving because it is considered a dangerous act that significantly distracts the driver. Accordingly, the use of smartphones in classes, computer labs, and exam halls should be deterred. Although it took a considerable length of time to implement non-smoking rules, it is hoped that it will not take that long for academic institutions to draft policies regarding smartphone use (Chan et al., 2015) as jeopardizing one's opportunity to excel academically may lead to successive failures in acquiring good jobs.

This study contributes to the existing literature by confirming previous results. At the international level, it is the first to compare the effect of smartphone addiction by gender. Regionally, it is the first to be conducted in the Arab world. Furthermore, the study highlights the multitasking gender difference as a possible explanation for the gender-wide differences in odds ratios regarding academic performance.

Education ministries and academic institutions should consider policies that forbid smartphone use for nonacademic activities while learning. However, although such policies are necessary, they are not sufficient. Therefore, civil society should engage in adding legitimacy to these policies to hasten their implementation.

4.2. Limitations and future directions

Though this study did not assert causation between the high risk of smartphone addiction and academic performance, some points emerged from the study's context and the data that suggest causation. For instance, it was conducted in a different context (a university) to previous comparable research, at a different time, in a different country and in a different culture, and it used a different study design, yet it produced consistent results regarding the adverse effects of smartphone multitasking in learning settings on academic performance. Additionally, though causation cannot be determined when

Table 4
Average GPA by sex and with distinction cutoff point.

	GPA < 3.2						GPA ≥ 3.2						GPA		
	Low SA risk			High SA risk			Low SA risk			High SA risk					
	#	M	SD	#	M	SD	#	M	SD	#	M	SD	#	M	SD
Males	60	2.30	0.68	51	2.06	0.84	20	3.56	0.27	4	3.47	0.12	135	2.43	0.87
Females	30	2.50	0.64	40	2.45	0.83	28	3.47	0.24	16	3.59	0.26	114	2.87	0.79
Total	90	2.37	0.67	91	2.23	0.85	48	3.50	0.25	20	3.56	0.24	249	2.63	0.86

Note: SA = Smartphone Addiction.

examining the hypothesized relationship between high-risk smartphone addiction and GPA, the strong odds ratios obtained, which were much greater than five, make it highly likely that the relationships are causal. Furthermore, the temporality of the phenomenon is supportive of causality. That is, smartphone use and engagement in multitasking in learning settings have been indicative of students' GPAs, which are the true measures of academic performance. Moreover, increases in risk levels of smartphone addiction correlate with declines in academic performance ($r = -0.2$, $p < 0.05$), a correlation that is educationally plausible from a learning perspective, and one that is supported by the results of studies that investigated the effects of conventional multitasking on academic performance.

This study has certain limitations. First, it was based on a cross-sectional design. In addition, our results cannot be generalized to the entire population of university students in Lebanon as the sample included students from only one private university. Furthermore, the sampling procedure itself is a limitation in that only students who visited their accounts on the student information system or read the marketing email calling for participation knew about the survey questionnaire. Future research should investigate other universities, high and middle school students, and probably lower stages as nowadays children as young as 7 years old are owning a smartphone. Furthermore, it is worth investigating the type of smartphone applications that lead to decline in academic performance.

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