Smartphone use and study behavior: A Korean and Australian comparison

Heather Winskel [a,*], Tae-Hoon Kim [b], Lauren Kardash [a], Ivanka Belic [a]

[a] Psychology, Health and Human Sciences, Southern Cross University, Coffs Harbour, NSW, 2450, Australia
[b] Psychology, Kyungnam University, Changwon, South Korea

ABSTRACT

Smartphone use amongst university students is widespread and a common practice while studying. However, this usage can lead to academic performance costs. This study examined the relationship between smartphone use during study, problematic smartphone use and academic performance in Korean and Australian university students. 119 Korean and 270 Australian students aged between 18 and 26 years completed a survey comprised of a smartphone usage questionnaire, smartphone addiction scale and self-report of their current GPA score. Average smartphone use and problematic smartphone use were found to be significantly higher for Korean compared to Australian students. A positive relationship was found between smartphone use and problematic smartphone use. For Australian students, a negative relationship was found between smartphone use and GPA. Results indicate that smartphone use and smartphone addiction proneness are currently higher for Korean students compared to Australian students. Furthermore, the more time a student spends using their smartphone, the more at risk they are for problematic smartphone use and possible academic performance costs.

1. Introduction

In contemporary society, smartphones are an integral part of everyday life. With multi-function capabilities, their presence has transformed and shifted the way people engage in their personal and professional lives. In addition to acting as a mobile phone, the smartphone gives users mobile access to the internet and a wide variety of applications. The number of people who own a smart device is growing not only in advanced economies, but also in emerging economies. From approximately a quarter of people across the globe reporting to own a smartphone in 2013–14, the ownership rate has now risen to over half the population (Poushter, 2016; Poushter et al., 2018). However, not surprisingly, the highest rates of ownership are exhibited by people in wealthier countries. Notably, South Korea and Australia emerge amongst the countries with the highest rates of ownership at 94% and 82% respectively (Poushter et al., 2018). Furthermore, smartphone ownership amongst young adults (18–36 years old) appears much higher compared to older adults (Poushter et al., 2018). As smartphones are used in all aspects of daily life, they appear to be creating a new culture of their own (T. Y. Lee and Busiol, 2016). For students specifically, smartphone use and multitasking during class and study appears to be becoming increasingly accepted despite growing concerns about possible detrimental consequences (Bowman et al., 2010; Levine et al., 2012).

1.1. Multitasking and study behaviour

Students are a population that multitask on a regular basis (Bowman et al., 2010; Sumathi et al., 2018). However, it has been empirically established that humans are imperfect multitaskers (Bowman et al., 2010; Koch et al., 2018; Ophir et al., 2009). The term multitasking encompasses both dual-task performance and task switching. Here, dual-task performance is defined as the engagement in multiple tasks simultaneously such as listening to music whilst studying (David et al., 2015). In comparison, task switching is described as the temporary disengagement of attention from one task to focus on another (David et al., 2015). For example, pausing to read a text message whilst studying. It has been demonstrated that divided attention between multiple tasks results in increased task completion time and decreased performance on one or both of the tasks (Finley et al., 2014; Koch et al., 2018; Pashler et al., 2013; Rubinstein et al., 2001). Furthermore, this effect appears most prominent for performance on continuous or complex tasks such as studying (Strobach and Schubert, 2017). The detrimental effects of divided attention have been attributed to cognition's limited attentional and processing capacity (Koch et al., 2018; Levine et al., 2012). Consequently, performance may be limited by an individual's innate inability to thoroughly engage in one task when distracted by another.

Smartphone multitasking has been demonstrated to be a particularly distracting form of multitasking (Levine et al., 2012; Ophir et al., 2009). The portability and size of a smartphone makes it convenient for the user to access anywhere, at any time. In addition, the functionality of smartphones are ever increasing, allowing individuals to simultaneously have access to a growing variety of functions and applications (Levine et al., 2012). Moreover, smartphones may be particularly distracting for the student population due to the increased positive affect associated with its use (David et al., 2015). As explained by the advanced motivated cognition model, student motivation for using a smartphone may be a strategy of aversive and appetitive systems (Lang, 2006). Whilst the appetitive system aims to increase positive affect through behaviour, negative affect is avoided by the aversive system (Lang, 2006). Studying may be considered a reasonably unpleasant or dull activity by some students and consequently lead to the activation of the aversive system (David et al., 2015). Smartphones can provide a pleasant distraction for students that results in the avoidance of the negative stimulus of study. Concurrently, a student may find positive affect by engaging in appetitive activities on their smartphone such as texting a friend or browsing social media (David et al., 2015; Junco, 2012). It is the overall functionality, convenience and activity appeal that may give the smartphone attractive and addictive qualities that result in high usage rates for students.

1.2. Problematic smartphone use and study behaviour

Research has demonstrated that there is a significant link between high rates of smartphone use and problematic smartphone use, particularly amongst young people (Ben-Yehuda et al., 2016). As smartphone addiction is not a clinical diagnosis, researchers have adopted a variety of terms to refer to this type of behaviour including "nomophobia" denoting no-mobile-phone-phobia (King et al., 2014), FoMo (fear of missing out) (Elhai et al., 2016), smartphone use disorder (Lachmann et al., 2018) analogous to the inclusion of Internet Gaming Disorder in the Diagnostic and Statistical Manual of Mental Disorders (APA, 2013), and smartphone addiction proneness (Kwon et al., 2014). Smartphone addiction proneness is defined as susceptibility to problematic smartphone use that results in negative consequences or significant interference with other tasks (Kwon et al., 2013; Kwon et al., 2014; T. Y. Lee and Busiol, 2016). An all-inclusive term "problematic smartphone use" will be used in this article to signify high attachment and dependency and addictive tendencies towards one's smartphone.

There is no denying that mobile technology has changed people's lives and everyday behaviour dramatically. The newly coined terms generally depict a new found behaviour related to peoples' relationship and behaviour towards their smartphone. However, some of these behaviours, in the current technological zeitgeist, may not be atypical but might rather represent the new societal norm and their behavioural adaptation to mobile technology use (Billieux et al., 2015; Chotpitayasunondh and Douglas, 2016; Lin and Chiang, 2017; Montag and Walla, 2016). For example, according to Chotpitayasunondh and Douglas (2016) "phubbing" or ignoring others due to their smartphone use has become the latest behavioural norm when communicating. On the other hand, some smartphone habits including overuse, inattention, insecure attachment to and problematic smartphone use including driver distraction, constant phone checking, and sleeping with one's phone have raised questions about the possible pathological implications including cognitive deficits as well as anxiety and depression (Elhai et al., 2017; Elhai et al., 2018; Stevens and Egger, 2017).

The features of a smartphone may contribute to high use and the risk of problematic use of smartphones, as they are convenient and provide instant access to a diverse range of applications such as social media (C. Lee and Lee, 2017; Montag et al., 2015a). In addition, individuals are actively encouraged to regularly check their device through features that immediately alert users to updates and notifications (C. Lee and Lee, 2017). The effects of smartphones' attention seeking features and functions on everyday cognition have been found to result in inattention and hyperactivity (Kushlev et al., 2016), as may be observed for example in distracted walking and driving.

Evidence suggests that young adults are particularly at risk for developing problematic smartphone use habits (Alosaimi et al., 2016; Ben-Yehuda et al., 2016). There is a growing smartphone culture in which young people are relying more on digital sources in all aspects of life compared to older populations (T. Y. Lee and Busiol, 2016). Smartphone use amongst young people can often be a means to avoid negative emotions and create pleasure (Ben-Yehuda et al., 2016). It has been demonstrated that coping motives, mood regulation, perceived enjoyment, and conformity are all positively related to problematic smartphone use (T. Y. Lee and Busiol, 2016), while empathy and life satisfaction are negatively related to proneness to smartphone and internet use disorders (Lachmann et al., 2018). University can be a challenging and often stressful time for some students, making the temporary escape smartphones provide, very attractive. Students who exhibit problematic smartphone use may find it difficult to control usage during study (C. Lee and Lee, 2017). Their ability to self-regulate use is typically relatively low and may contribute to significant academic performance costs (Alosaimi et al., 2016; Hawi and Samaha, 2016, Lachman). The inverted u-function has been used to describe the association between problematic smartphone use and productivity. Specifically, findings have indicated that high academic achievement is unlikely to be attained by students who are highly prone to problematic smartphone use (Hawi and Samaha, 2016). Perhaps the inverted u-function may best describe the association between problematic smartphone use and productivity, whilst fragmentation of everyday life represents a problem for concentrated work (Duke and Montag, 2017).

Frequent smartphone use often appears to be distinguished by habitual, mindless behaviour, which is characterised by an individual's inability to self-regulate use (Horwood and Anglim, 2018) and innatention (Kushlev et al., 2016). For students, this inability can lead to increased usage time and frequent task switching between their device and study, which have both been identified as contributing to a decrease in overall grade achievement (Horwood and Anglim, 2018). Therefore, the consequences for high rates of smartphone use can be significant for students, particularly if an individual shows proneness to addictive tendencies towards their smartphone (Kwon et al., 2014).

A growing empirical line of research indicates that depression and anxiety are related to problematic smartphone use. A relationship between problematic smartphone use and depression levels have been found (Elhai et al., 2017). In addition, lower self-esteem was found to be significantly associated with greater problematic smartphone use.

Research also indicates that the physical location of one's smartphone may be a mediating factor between an individual's cognitive function and level of anxiety experienced when separated from their smartphone (Ward et al., 2017). Recent research has revealed that separation from one's smartphone leads to an increase in anxiety levels (Elhai et al., 2016, 2017, 2018; Hartanto and Yang, 2016; King et al., 2014), especially among high users (Cheever et al., 2014). High anxiety, in turn, was found to have a negative impact on working memory, inhibitory control (Hartanto and Yang, 2016) and be related to problematic smartphone use (Elhai et al., 2016, 2017, 2018). Smartphone separation has also been found to have a deleterious effect on social connectedness and cognitive performance (Elhai et al., 2016; Hartanto and Yang, 2016). In contrast, other studies have shown that smartphone separation has a positive effect on academic performance in classrooms (Lee et al., 2017) and on cognitive task performance (Ward et al., 2017) when compared to smartphones being present. A linear relationship between smartphone salience and cognitive performance has also been found, whereby the closer the phone to the vicinity of the person the higher the cognitive cost (Ward et al., 2017). An earlier study showed that even the mere presence of a mobile phone, other people's and one's own, have a significant negative effect on attention and cognitive performance particularly when completing more cognitively demanding tasks (Thornton et al., 2014).

1.3. Smartphone applications and effects on study behaviour

Smartphones provide users with access to a wide variety of applications and functions. Some applications such as social media, music, texting and instant messaging have been investigated more than others. Research has also revealed that these various applications have different effects on performance (David et al., 2015). Social media is one of the most commonly used smartphone applications and has consequently elicited a large amount of research into the implications of its use (Giunchiglia et al., 2018; Junco, 2012). Social media are application platforms that allow individuals to create and share content, view subject matter shared by others and exchange messages (Hassell and Sukalich, 2016).

The characteristics of social media may make it particularly distracting and addictive compared to other applications (Hassell and Sukalich, 2016). In the current technologically minded society, communicating through social media is the norm. Social media platforms including WhatsApp and Facebook currently seem to be the main drivers of smartphone use (Sha et al., 2019). Social media is extremely appealing as it connects one with family and friends (Hassell and Sukalich, 2016).

Social media is viewed as being particularly detrimental to student performance due to its appealing and emotive features (Giunchiglia et al., 2018). For example, Rozgonjuk et al. (2018) found that social media use during lectures was associated with problematic smartphone use and procrastination. Also, a recent study revealed a link between smartphone use disorder with WhatsApp Use Disorder and Facebook Use Disorder, and found that Smartphone Use Disorder may be predicted by FoMo (Sha et al., 2019). Another study found a positive relationship between the personality trait of extraversion and the use of WhatsApp, while conscientiousness and WhatsApp showed an inverse correlation (Montag et al., 2015b). Furthermore, low conscientiousness, and low self-regulation abilities/low will-power have been found to be more important than either neuroticism or anxiety in predicting problematic internet and smartphone use (Lachmann et al., 2017). The authors concluded that the personality trait of low self-directedness may be the core contributing factor driving overuse on both platforms. These findings were recently supported by a replication study using a larger (N = 773) multicultural cohort (Peterka-Bonetta et al., 2019). The results reaffirm the relationship between high smartphone and internet use disorders with both low conscientiousness and high neuroticism. Furthermore, positive correlations were also found between internet and smartphone use disorders and both impulsivity, and social anxiety (Peterka-Bonetta et al., 2019). Therefore, the problem may not be smartphone use per se but rather personality traits and choice of applications with social media functions playing a prominent role (Sha et al., 2019).

Texting and instant messaging have also emerged as one of the most common smartphone activities for students whilst studying. Similar to social media, these applications allow the user to instantly connect and engage with family and friends (David et al., 2015). Significant costs to academic performance have been demonstrated for students who use their smartphone to engage with both social media and instant messaging while studying (David et al., 2015; Giunchiglia et al., 2018; Hassell and Sukalich, 2016). These types of communication require active attention and responses (David et al., 2015). Smartphone notifications have also been found to contribute to people's inattention and symptoms of hyperactivity (Kushlev et al., 2016).

Interaction with social media and instant messaging whilst studying requires task-switching, resulting in divided attention and a switch in focus from the primary task of studying (David et al., 2015; Marone, Thakkar, Suliman, O'Neill and Doubleday, 2018). However, recent research suggests that the use of social media may not always have detrimental consequences for students (Imlawi et al., 2015; Milošević et al., 2015). When social media is utilised for specific academic purposes, a positive relationship is evident (Milošević et al., 2015). For example, it has been demonstrated that when instructors use course-relevant social networks as a communication tool, it can enhance motivation, engagement and course satisfaction (Imlawi et al., 2015). Thus, when social media applications are used as a tool for specific learning objectives, there may be potential benefits. However, when the purpose of its use is non-academic, academic performance costs are likely.

Listening to music is a frequent form of smartphone multitasking during studying (David et al., 2015; Hoffner and Lee, 2015). However, unlike social media and texting, it may have little or no negative consequences for student performance (Pool, Koolstra and van der Voort, 2003). Research has demonstrated that when music is provided as a distraction simultaneously with study, there appears to be no significant performance costs (Pool et al., 2003; Pool, van der Voort, Beentjes and Koolstra, 2000). It is likely that this absence of performance costs is due to music being a form of dual-task multitasking, which does not require active engagement (David et al., 2015). Consequently, music may often be ignored as background noise, despite generally being engaging and eliciting strong emotional affect (David et al., 2015; Pool et al., 2003). Furthermore, a recent study has revealed that listening to music prior, rather than during studying might be an effective way to improve one's cognitive performance (Küssner, 2017).

Mobile applications measuring and recording actual data used on a smartphone have been used in smartphone research. Software log data has shown that some individuals underestimate their average smartphone use by up to 40% (H. Lee, Ahn, Nguyen, Choi and Kim, 2017), while another study found that weekly usage was overestimated and number of calls and texts made were underestimated (Montag et al., 2015a). Recent evidence suggests that individuals may lack awareness of the true amount of time they spend on their device (H. Lee et al., 2017; Lin et al., 2015; Wilcockson et al., 2018). Thus, self-report data provides only an approximation of smartphone usage and the relationship with one's smartphone, whilst psychoinformatics or software log data can provide more accurate data (Montag et al., 2015b).

The current study aimed to assess and compare smartphone use during study in Korean and Australian university students. Koreans are currently number one for smartphone use in the world (Poushter et al., 2018). Their integration and consumption of technology is significantly advanced compared to Australia, thus, making a meaningful and interesting comparison. Furthermore, this study aimed to examine the relationship between smartphone use during study, problematic smartphone use and academic performance. Based on previous research, several hypotheses can be derived. Firstly, given that smartphone ownership is more prevalent in Korea, it was predicted that smartphone usage during study would be higher for Korean students compared to Australian students. Secondly, as there is a significant relationship between average daily smartphone use and problematic smartphone use, it was hypothesized that there would be a positive relationship between smartphone use and problematic smartphone use for both Korean and Australian students. Lastly, it was predicted that both smartphone use and problematic smartphone use would have a negative relationship with academic performance.

2. Methods

2.1. Participants and procedure

The participants consisted of Korean university students and Australian university students. Korean students were recruited via class attendance at Kyungnam University, South Korea. Participants completed a printout of the survey in class that had been translated from English to Korean and then back translated (Brislin, 1970). The survey contained questions regarding demographics (age and gender), current GPA (Grade Point Average) score, as well as a smartphone usage questionnaire (based on David et al., 2015), and a smartphone addiction scale (Kwon et al., 2013) (see Appendix). Australian students were recruited at Southern Cross University via email and completed an online English version using Survey Monkey.

The participants included 119 Korean university students (60 females; mean age = 20.64, *SD* = 1.71) and 270 Australian university students (210 females; mean age = 21.26, *SD* = 2.55). Both groups had an age range of 18 years–26 years. There was no significant difference in mean age between the two groups (t (388) = 1.58, p = .11). This research was approved by the Southern Cross University Human Research Ethics Committee (Approval number: ECN-17-244).

2.2. Materials

2.2.1. Smartphone usage questionnaire

The measure of smartphone use was adapted from David et al. (2015) (see Appendix A). It included an item measuring estimated daily smartphone usage, which was followed by 13 items measuring typical use of different smartphone applications and functions during study. Items included common smartphone multitasking activities such as social media and music (David et al., 2015). Two of these items were adapted to include applications relevant to Korean students. The item 'messaging and texting' was adapted to include the application Kakao Talk and 'social media' adapted to include Kakao Story. Participants rated how often they used each item on a 5-point Likert scale: 0 = never, 1 = a little of the time, 2 = some of the time, 3 = most of the time, and 4 = always.

2.2.2. Smartphone addiction scale

To assess level of addictive tendencies toward one's smartphone, a 10-item Smartphone Addiction Scale – (Short Version) developed by Kwon et al. (2013) was used (Appendix B). This scale was derived from a Korean population. The scale has been demonstrated to be a valid and reliable indicator of level of smartphone addiction proneness (Cronbach's alpha = 0 .97) and in the current study (Cronbach's alpha = 0.86). The scale is comprised of 10 items measuring six factors: cyberspace-oriented relationship, overuse, daily-life disturbance, withdrawal, positive anticipation and tolerance. Participants rated the extent to which they agreed with each item on a 6-point Likert scale where 1 = strongly disagree, 2 = disagree, 3 = weakly disagree, 4 = weakly agree, 5 = agree, and 6 = strongly agree. In addition, the sum of all items was used to calculate an overall problematic smartphone use score for each participant.

3. Results

In order to determine if Korean versus Australian students differed significantly in terms of time spent using their smartphone, using their smartphone while studying and level of problematic smartphone use, a series of analyses of variance (ANOVAs) were conducted. Gender was included in the analyses but no significant interaction effects were found between gender and culture for any of the dependent variables. Preliminary analyses showed no evidence of outliers and no violations of the assumptions of normality or homogeneity of variance.

Descriptive statistics and analyses of variance results for Australian and Korean smartphone usage are presented in Table 1. Estimated smartphone usage per day was significantly higher for Korean students (6.52 h) compared to Australian students (4.72 h), F (1, 387) = 20.89, $p <$ .001, η_p^2 = .051. As can be seen from Table 1, Koreans used their smartphones significantly more than Australians to make and receive phone calls, messaging and texting, playing games, watching videos, listening to music, shopping and booking tickets, using LinkedIn, and using Google for other purposes. However, Australian students used their smartphones significantly more than the Koreans for email and using Google for study purposes. No significant differences were found between Korean and Australian students for the frequency of use of social media or dating and relationship applications.

Table 2 presents the descriptive statistics and analyses of variance results for problematic smartphone use scores for Korean and Australian students. Results indicated overall problematic smartphone use scores to be significantly higher for Koreans compared to Australians, F (1, 378) = 9.16, p = .003, η_p^2 = .024. From Table 2, it can be seen that Korean

Table 1
Mean scores for overall and specific smartphone usage while studying in Koreans and Australians. Standard deviations are in parentheses.

Item	Koreans	Australians	*F* value	*p*	η_p^2
Estimated smartphone usage per day (hours)	6.52 (4.45)	4.72 (3.12)	20.89	<.001	.051
Make a phone call	1.95 (1.10)	1.17 (1.00)	43.54	<.001	.107
Receive a phone call	2.24 (0.98)	1.57 (1.02)	34.66	<.001	.087
Messaging and Texting, e.g., WhatsApp, Facebook Messenger, Kakao Talk	2.93 (0.96)	2.38 (1.06)	22.23	<.001	.058
Email	1.01 (1.01)	2.06 (1.14)	70.80	<.001	.163
Social media, e.g., Facebook, Snapchat, Instagram, Twitter, Pinterest, Kakao Story	2.36 (1.40)	2.35 (1.18)	.015	.901	.000
LinkedIn	0.76 (1.03)	0.21 (0.62)	40.07	<.001	.099
Playing Games	1.27 (1.24)	0.58 (0.94)	34.27	<.001	.086
Watching Videos	2.30 (1.12)	1.42 (1.13)	48.03	<.001	.117
Listening to Music	2.79 (1.20)	2.35 (1.31)	8.99	.003	.024
Shopping and Booking tickets, e.g. eBay, cinema tickets, travel	1.74 (1.28)	0.82 (0.99)	56.31	<.001	.134
Use Google for studying purposes	2.35 (0.98)	2.63 (1.12)	5.32	.022	.014
Use Google for other purposes, e.g. web browsing	2.27 (0.99)	1.88 (1.27)	8.26	.004	.022
Dating and Relationship apps	0.38 (0.88)	0.29 (0.74)	1.04	.308	.003

students scored significantly higher than the Australians on many items on the addiction proneness questionnaire such as missing planned work due to smartphone use, experiencing neck or back pain while using a smartphone, not being able to stand not having a smartphone, feeling impatient and fretful when not holding their smartphone, people telling them that they use their smartphone too much and refusal to give up smartphone use despite daily life being greatly affected. However, Australian students had a significantly higher score compared to Korean students for using their smartphone longer than intended. As Korean students already use their smartphones to a considerable extent already, there is a limit on how much more they could potentially use them. No significant differences were found between Korean and Australian students for having a hard time concentrating in class, while doing assignments, or while working due to smartphone use, having a smartphone in their mind even when they are not using it, and constantly checking their smartphone so as not to miss conversations between other people on Twitter or Facebook.

3.1. Relationship between smartphone use, problematic smartphone use and GPA scores

In order to examine the relationships between smartphone use whilst studying, problematic smartphone use scores and GPA scores, a series of bivariate correlations were conducted for Australian and Korean students separately. Preliminary analyses showed no violation of normality or evidence of heteroscedasticity.

For Korean students, a positive correlation was found between hours spent using their smartphone and problematic smartphone use scores, r = .39, n = 119, $p <$ .001. No significant correlations were found between problematic smartphone use scores and GPA, r = -.12, n = 119, p = .24 or

Table 2

Mean scores for problematic smartphone use or degree of attachment to Smartphone in Koreans and Australians. Standard deviations are in parentheses.

Items	Koreans	Australians	F value	p value	η_p^2
1. Missing planned work due to smartphone use	3.12 (1.37)	2.52 (1.49)	14.38	<.001	.037
2. Having a hard time concentrating in class, while doing assignments, or while working due to smartphone use	3.13 (1.32)	3.23 (1.56)	.37	.544	.001
3. Feeling pain in the wrists or at the back of the neck while using a smartphone	2.82 (1.62)	2.45 (1.41)	5.15	.024	.013
4. Won't be able to stand not having a smartphone	4.07 (1.49)	3.44 (1.66)	12.68	<.001	.032
5. Feeling impatient and fretful when I am not holding my smartphone	2.82 (1.36)	2.49 (1.41)	4.47	.035	.012
6. Having my smartphone in my mind even when I am not using it	2.61 (1.27)	2.36 (1.25)	3.22	.074	.008
7. I will never give up using my smartphone even when my daily life is already greatly affected by it.	3.21 (1.44)	2.59 (1.38)	15.97	<.001	.041
8. Constantly checking my smartphone so as not to miss conversations between other people on Twitter or Facebook	3.07 (1.44)	2.76 (1.49)	3.84	.051	.010
9. Using my smartphone longer than I had intended	4.06 (1.27)	4.36 (1.30)	4.47	.035	.012
10. The people around me tell me that I use my smartphone too much.	2.85 (1.52)	2.42 (1.45)	7.18	.008	.019
Total (Overall)	31.62 (9.69)	28.61 (9.32)	9.16	.003	.024

hours spent using their smartphone and GPA, $r = .04, n = 119, p = .71$. However, negative correlations were found between GPA and a number of specific applications including: social media, $r = -.24, n = 119, p < .05$, watching videos, $r = -.20, n = 119, p < .05$, and shopping and booking tickets, $r = -.21, n = 119, p < .05$.

For Australian students similar to Korean students, a positive correlation was found between hours spent using their smartphone and problematic smartphone use scores, $r = .32, n = 258, p < .001$. Notably, a negative correlation was found between hours spent using their smartphone and GPA, $r = -.30, n = 269, p = 001$. No significant correlations were found between problematic smartphone use scores and GPA, $r = -.10, n = 258, p = .26$. In addition, there were no significant correlations between specific smartphone applications used while studying and GPA.

4. Discussion

The purpose of this study was to investigate and compare smartphone use while studying and problematic smartphone use in Korean and Australian university students. Currently, South Korea is one of the largest consumers of technology with their smartphone ownership rating the highest globally (Poushter et al., 2018). Australia is lagging considerably behind in comparison but is ultimately headed in the same direction with growing technological advancement (Poushter et al., 2018). With the increasing presence of the smartphone, particularly amongst university students, it is essential to investigate the possible consequences of its use on study behavior. This study also examined the relationship between average daily smartphone use, problematic smartphone use and academic performance.

4.1. Smartphone use and study behavior

Firstly, both Korean and Australian students estimated using their smartphone for a considerable number of hours. However, it was found that Korean students spent significantly more time on their smartphone compared to Australian students. Notably, Korean students estimated an average of six and a half hours of daily use, nearly 2 h more than Australians. These results highlight the greater prevalence of smartphone use amongst the Korean students where the device is widely integrated into daily life (C. Lee and Lee, 2017). South Korea's internet infrastructure gives its population access to reliable and high-speed internet at a reasonably low cost (Laravea, 2018; C. Lee and Lee, 2017). In addition, individuals are frequently encouraged to use their portable smart device outside their home with access to free wireless internet at numerous public locations such as cafes, shopping centers and public transport (Laravea, 2018; C. Lee and Lee, 2017). Consequently, the significantly higher usage amongst Korean students could reflect a greater acceptance of interacting and engagement with one's smartphone in various daily contexts including during studying. Furthermore, these findings suggest Korean students may be more likely than Australian students to frequently switch their attention to their smartphone from the primary task of studying.

In line with previous research, messaging and texting, social media and music were the most commonly used applications while studying for both Korean and Australian students (David et al., 2015; Giunchiglia et al., 2018). However, there was an exception for Australian students who, on average, used Google for study purposes more frequently than the Koreans. These findings partially support previous research that suggests smartphone applications that hold personal relevance to be more distracting than other applications during study (David et al., 2015; Hassell and Sukalich, 2016). For example, the personally tailored content of social media platforms may be more tempting to use during study than other applications (Hassell and Sukalich, 2016). However, as indicated for the Australian students, individuals do not exclusively use their smartphone for non-academic purposes while studying. Notably, it was found that Australian students frequently use their smartphone as a tool to find information relevant to the primary task of studying. It is also to be noted that in Korea, local portal sites such as NAVER and DAUM are more often used than Google when searching for information, but this was not specifically included in the questionnaire. These findings highlight how the increasing reliance on smartphones is transforming study behavior and at the same time potentially having benefits as a study tool. Students may use smartphones not only to provide temporary relief through entertainment and online social interaction but also to assist them with academic tasks.

4.2. Problematic smartphone use and study behavior

As predicted, a positive relationship was found between overall smartphone use and problematic smartphone use for both Korean and Australian students. Notably, Korean students were found to score significantly higher for problematic smartphone use compared to Australian students. Considering the significantly higher rate of usage by Koreans compared to Australians, this difference is likely a reflection of a greater smartphone dependency amongst Koreans. The active encouragement and integration of smartphone use has led to a substantial reliance on smart technologies and the internet in many aspects of life for the Korean population (Kwon et al., 2013; C. Lee and Lee, 2017). Consequently, Korean students may experience a significant degree of attachment to their smartphones.

Moreover, the positive relationship between smartphone use and problematic smartphone use supports previous research that suggests controlling usage during study to be more difficult for students with addictive tendencies toward their smartphones (Alosaimi et al., 2016; T. Y. Lee and Busiol, 2016). Smartphone use may be particularly attractive to university students during study due to the relatively mundane nature

of the task (David et al., 2015). Accordingly, students may be motivated during study to engage in smartphone use in an attempt to increase positive affect whilst avoiding negative affect (David et al., 2015; Lang, 2006). That is, through the activities provided by a smartphone, students can avoid the negative discomforts of study whilst simultaneously creating pleasure (Ben-Yehuda et al., 2016; David et al., 2015). With their increasing functionality and convenient nature, smartphones may ultimately provide students with an easily accessible and entertaining procrastination tool (Rozgonjuk et al., 2018). However, the entertaining aspect of smartphones and the positive affect experienced by students is what may make the device particularly distracting and even addictive (David et al., 2015; T. Y. Lee and Busiol, 2016).

Previous research has demonstrated that for students, who exhibit signs of problematic smartphone use, there can be adverse consequences (Alosaimi et al., 2016; Hawi and Samaha, 2016). Specifically, it seems that the associated inability to self-regulate usage while studying can lead to significant academic performance costs (Hawi and Samaha, 2016; C. Lee and Lee, 2017).

4.3. Smartphone use and academic performance

Finally, a negative relationship was found between average smartphone use and GPA scores for the Australian students. Consistent with previous research, this finding indicates frequent smartphone use during study may contribute to a decrease in overall academic achievement (Horwood and Anglim, 2018). Further, it supports evidence that when attention is divided between multiple tasks, performance on at least one of the tasks is likely to decrease (Finley et al., 2014; Levine et al., 2012).

In contrast, Korean students' GPA was found to have no relationship with either overall smartphone use or problematic smartphone use. However, GPA was found to have a negative relationship with the specific use of social media, watching videos, shopping and booking tickets. In accordance with previous research, these findings suggest smartphone applications that require active attention and response are likely be the most disruptive in relation to a student's academic performance (David et al., 2015; Giunchiglia et al., 2018; Hassell and Sukalich, 2016).

In the current study, we did not find a relationship between problematic smartphone use and GPA for Australian students. This finding is somewhat at odds with the demonstrated relationship between overall smartphone use and GPA. This suggests that performance costs may occur for individuals who frequently use their smartphone during study, regardless of their level of attachment. Another plausible explanation for this finding is that frequent smartphone use could be better understood as a social norm rather than an addiction (Billieux et al., 2015; Lin and Chiang, 2017; Montag and Walla, 2016). With a growing smartphone culture, digital communication is becoming increasingly part of day-to-day social interactions (Hassell and Sukalich, 2016; T. Y. Lee and Busiol, 2016). Moreover, this culture is seemingly creating a growing reliance on smartphones in all aspects of life (T. Y. Lee and Busiol, 2016). This dependency is particularly evident amongst the young adult population who have grown up amidst modern technological advancements (T. Y. Lee and Busiol, 2016; Poushter et al., 2018). Consequently, whilst an increasing smartphone culture may have fostered extensive use for many, only some individuals may be vulnerable to a genuine addiction (Alosaimi et al., 2016; Horwood and Anglim, 2018).

4.4. Limitations and future directions

Firstly, it should be noted that the current study utilized a self-report measure to gain estimates of daily smartphone usage. However, recent evidence suggests individuals may have a significant lack of awareness of the true amount of time spent on their device (H. Lee et al., 2017; Lin et al., 2015; Wilcockson et al., 2018). Whilst it has been demonstrated that self-report data may provide an approximation of smartphone usage, software log data has shown that some individuals underestimate their average smartphone use by up to 40% (H. Lee et al., 2017). In order to remedy this concern, future research could utilize accurate phone log data to comprehensively investigate actual smartphone usage (Y. H. Lin et al., 2015; Montag et al., 2015a). Furthermore, the current study was limited by the relatively small size of participants. Thus, future studies would benefit from recruiting a larger cohort of students. It would also be particularly informative to investigate smartphone usage and study behavior in a younger cohort of high school students.

Lastly, it should be noted that this study did not account for individual characteristics of students such as distractibility, anxiety and personality factors. Recent research has indicated that some individuals may be more distractible and inattentive, and at higher risk of problematic smartphone use than others (Elhai et al., 2016; Horwood and Anglim, 2018; Ophir et al., 2009). Particularly, high anxiety and the recent construct of fear of missing out have both been linked to addictive tendencies and problematic smartphone use (Elhai et al., 2016, 2018; Horwood and Anglim, 2018). In contrast, problematic smartphone use appears less likely for individuals who are highly conscientious (Horwood and Anglim, 2018); satisfied with their life and empathetic towards others (Lachmann et al., 2018). Therefore, it would be beneficial for future research to assess the individual differences and characteristics of students when examining the relationships between average daily smartphone use, problematic smartphone use and academic performance. Lastly, it must be noted that aspects of this study are of a correlational nature and thus causality cannot be inferred.

5. Conclusion

Overall, the findings of this study provide insight into how smartphone use is becoming increasingly integrated with student study behavior. Notably, this was the first study to compare smartphone use and problematic smartphone use between Korean and Australian university students. Findings indicate that smartphone use and risk of problematic smartphone use are significantly greater for Korean students compared to Australian students. Furthermore, the prevalence of smartphone use and smartphone dependency amongst Koreans may indicate the future direction for Australian students with rising technological advancement and consumption. Moreover, individuals with high rates of smartphone use may be at higher risk of developing problematic smartphone use habits. Evidence suggests that students who frequently use their smartphone during study are more likely to experience academic performance costs. These findings have significant educational and societal implications. As smartphone technology advances, smartphone use will become an increasingly accepted and normal aspect of everyday behavior including during student study behavior. Modern society is becoming increasingly reliant on technology and with continuous advancements in smartphone technology, it is essential to parallel this growing trend with future research.

Declarations

Author contribution statement

Heather Winskel, Tae Hoon Kim, Lauren Kardash, Ivanka Belic: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

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The authors declare no conflict of interest.

Additional information

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