Constantly connected – The effects of smart-devices on mental health

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Abstract

A number of studies have demonstrated the mental health implications of excessive Internet-browsing, gaming, texting, emailing, social networking, and phone calling. However, no study to date has investigated the impact of being able to conduct all of these activities on one device. A smart-device (i.e., smart-phone or tablet) allows these activities to be conducted anytime and anywhere, with unknown mental health repercussions. This study investigated the association between smart-device use, smart-device involvement and mental health. Two-hundred and seventy-four participants completed an online survey comprising demographic questions, questions concerning smart-device use, the Mobile Phone Involvement Questionnaire, the Internet Addiction Test and the Depression, Anxiety and Stress Scales. Higher smart-device involvement was significantly associated with higher levels of depression and stress but not anxiety. However, smart-device use was not significantly associated with depression, anxiety or stress. These findings suggest that it is the nature of the relationship a person has with their smart-device that is predictive of depression and stress, rather than the extent of use.

Keywords: Smart-devices, smart-phones, mental health, depression, stress, addiction

1.0 Introduction

According to Ofcom, adult smart-device (i.e., smart-phones and tablets; e.g., iPhone and iPad) users have very strong relationships with their devices, with 37% considering themselves to be highly addicted (2011). Sixty-three percent of entrepreneurs reported that it would be tougher to go for a day without their smart-devices than a week without their "significant other" (Lesonsky 2011).

Previous research has looked into the effects of addictive and problematic use of various activities that can be accomplished on a smart-device. Excessive use of the calling and texting features of mobile phones have been linked to depression, anxiety and stress (Jenaro, Flores et al. 2007, Yen, Tang et al. 2009, Thomee, Dellve et al. 2010, Walsh, White et al. 2010, Lu, Watanabe et al. 2011, Strassberg, McKinnon et al. 2013). Lu et al. (2011) suggested that individuals who send a large number of texts can develop "text message dependency", becoming increasingly worried about why they have not instantly received a reply to their message, increased feelings of isolation or neglect and ultimately increased anxiety. Thomee, Harenstam & Hagberg (2011) have linked excessive mobile phone use with sleep disturbance and muscular skeletal problems due to texting, factors which they suggest are contributing to the feelings of depression, anxiety and stress. The majority of their participants reported that they felt they were expected to be available around the clock, which increased feelings of stress. Considering the finding that on average, smart-phone owners call and text more than traditional mobile phone owners (Ofcom Report 2011), the effects on their mental wellbeing could be even more severe.

High Internet use, something that is common on smart-devices (Ofcom Report 2011), has been consistently linked with depression and anxiety (Young 1998, Jenaro, Flores et al. 2007, Ko, Yen et al. 2009, Lam and Peng 2010, Morrison and Gore 2010,

Lu, Watanabe et al. 2011, Cash, Rae et al. 2012, Tonioni, D'Alessandris et al. 2012). Ko et al. (2009) reported that depression and anxiety are predictive of Internet addiction at a two-year follow up, suggesting they could be important factors in the casual pathway of pathological Internet use. Another study (Lam and Peng 2010) suggested that it is the Internet addiction that is predictive of depression. Despite the lack of a clear causal relationship, the Internet allows an individual to develop a "virtual self" which allows them to escape from the real world (Lu, Watanabe et al. 2011). In the past, computers were relatively immovable objects meaning that eventually the user would be forced to discontinue their current Internet session. With the development of smart-devices, users have the ability to be constantly connected to the Internet, with health repercussions which are as of yet, unknown.

There are other functions that can be achieved using a smart-device that, on their own, have been linked to mental well-being issues. Excessive gaming and Internet gaming have been linked with depressed mood, low self-control and loss of self-esteem (Yang and Tung 2007, Kwon, Chung et al. 2011, van Rooij, Schoenmakers et al. 2011, King and Delfabbro 2013). Social networking is a commonly used function on smart-devices, especially among the teenage population (Ofcom Report 2011). Experts have described social networking websites as "addiction prone technologies" (Turel and Serenko 2012, Tarafdar, Gupta et al. 2013), with the potential for strong habit formation leading to pathological and maladaptive psychological dependency. Overall, this research has shown that gaming, social networking, Internet browsing, emailing, phone calling and texting, when done in excess, are linked to stress, anxiety and depression.

Smart-device use and smart-device involvement are not necessarily synonymous. Whereas an individual's smart-device use can be measured in terms of, for example, the of amount of calls made or number of emails sent, smart-device involvement includes aspects that are largely out of the users conscious awareness and is therefore harder to measure. Walsh et al. (2010) described a user's mobile phone involvement as having two distinct components, cognitive and behavioural. The cognitive component involves thinking about the phone, the desire to check if something has happened and the anxiety, depression and social isolation that can occur if the user is not able to access their phone. The behavioural component relates to the constant checking of the phone and the maintaining of close physical proximity. For example, someone who has high mobile phone involvement would be very aware of the location of their phone, be anxious that they have not received replies to messages or worried that they are not up to date on the news. Their behavioural reaction to this anxiety would be to compulsively check their device for any messages or updates. People who display these behaviours may not necessarily record high use, as quickly checking the device may not be time consuming. However, these people are still heavily preoccupied with their phones and may be distracted from other tasks. Although smart-device use and involvement are likely to be highly related, someone who has high smart-device use but uses their device to serve a practical purpose might not record high involvement.

Neal, Wood and Quinn (2006) found that when a specific course of action has been consistently rewarded, respective goal-seeking behaviours are automatically triggered with expectations of subsequent rewards. These automatically triggered behaviours can lead to the formation of habits and in extreme cases addiction. Smart-devices can provide salient rewards quickly to facilitate this habit formation. They

help people avoid boredom and cope with a lack of stimuli in everyday situations as well as make them aware of interesting events and social networks (Oulasvirta, Rattenbury et al. 2012). The rewards afforded by smart-devices could lead to checking habits and contribute to the extent of involvement the individual has with their smart-device as well as overall use.

It is important to develop an understanding of why individuals might immerse themselves in these smart-device practices and develop high usage patterns and high involvement. Suler (2004) referred to the online disinhibition effect, the act of feeling more confident online, which some individuals experience when communicating via online or not using face-to-face methods. In this context, smart-devices provide opportunities for users to undertake this form of communication more often, whether that communication is social networking, sending SMS messages or calling. Tokunaga and Rains (2010) reported that, compared to well-adjusted youths, youths who report symptoms of anxiety actually prefer communicating with others online than in person and seek emotional support from others online when feeling lonely. People with higher levels of depression, social anxiety, shyness and loneliness may use these types of communication as a means of social compensation (Valkenburg and Peter 2007), utilising the less anxiety-provoking, non-personal means of communication. Individuals experiencing increased social success when communicating via their smart-devices, rather than in person, could feel rewarded, therefore increasing the future likelihood that they will form a habit of communicating via their smart-device and become overly involved in the process. One concern of this type of communication is that it often leads to the development of artificial and weak online relationships. Furthermore, the perceived benefits of online communication may prevent some users from seeking alternative "offline" strategies

which facilitate the development of social connection and emotional stability (Morahan-Martin and Schumacher 2003, Caplan, Williams et al. 2009).

There is extensive evidence demonstrating the impact of excessive calling, texting, Internet use, gaming, social networking and emailing on mental health. However, to date, no study has investigated the mental health impact afforded by being able to complete all of these functions on one portable smart-device. Whether high use or high involvement has positive or negative effects, smart-devices appear to encourage high use and involvement (Ofcom Report 2011) and therefore the consequences need to be investigated. The aim of this study is to examine the association between smart-device use, smart-device involvement and mental health. It is hypothesized that (1) higher smart-device use will predict poorer mental health; and (2) higher smart-device involvement will predict poorer mental health.

2.0 Method

2.1 Materials

2.1.1 Demographics and extent of smart-device use. Participants completed an online survey comprised of demographic questions (age, gender and occupation), and questions concerning participants' smart-device use (call, text, email and application use). Call use scores were calculated by averaging responses to four questions concerning frequency of use, each measured on 5-point Likert scales. Text and email use scores were both calculated by averaging responses to four questions concerning frequency of use, each measured on 6-point Likert scales. Application use scores were calculated by averaging responses to 18 questions concerning frequency and length of use for six different purposes (information-seeking, awareness-seeking, organisational, social networking, gaming and media), each measured on 7-point

Likert scales. Scores ranged from 1 to 5 for call use, from 1 to 6 for text and email use and from 1 to 7 for application use. In all instances, higher scores related to higher use. Finally, a smart-device use score was calculated by totalling the call, text, email and application use scores; scores therefore ranged from 4 to 24.

Participants also completed the following:

2.1.2 Mobile Phone Involvement Questionnaire (MPIQ). The MPIQ is an 8-item self-report questionnaire relating to cognitive and behavioural associations to mobile phones (smart-devices in the context of this study) (Walsh, White et al. 2010). The MPIQ includes items measuring withdrawal, cognitive and behaviour salience, euphoria, loss of control, relapse and reinstatement, conflict with other activities and interpersonal conflict. Responses were provided using 7-point Likert scales ranging from 1 (strongly disagree) to 7 (strongly agree), where higher scores represented higher levels of involvement. A smart-device involvement score was then calculated by averaging participants' responses to the eight items ($\alpha = .83$).

2.1.3 Internet Addiction Test (IAT). The IAT is a 20-item self-report scale designed by Young (1998) based on the DSM IV diagnostic criteria for the concepts and behaviours exhibited by pathological gamblers. Items on the IAT reflect the typical behaviours of addiction in relation to the Internet. Responses were provided using 5-point Likert scales ranging from 1 (strongly disagree) to 5 (strongly agree), where higher scores represented higher levels of addiction. An Internet addition score was then calculated by totalling participants' responses to the 20 items; scores therefore ranged from 20 to 100 ($\alpha = .90$). This calculation enabled the Internet addiction score to be compared to the predetermined categories of severity of addiction to the Internet, which separate normal, moderate and severe levels of Internet addiction(Young 1998).

2.1.4 Depression, Anxiety and Stress Scales (DASS-21). The DASS-21 is a 21-item self-report scale that consists of seven depression items, seven anxiety items and seven stress items (Lovibond and Lovibond 1995). Responses were provided using a 4-point Likert scale ranging from 0 (did not apply to me at all) to 3 (applied to me very much/most of the time). Responses to each subscale were totalled and multiplied by two to produce separate depression, anxiety and stress scores ranging from 0 to 42 ($\alpha = .85$ for the depression scale, $\alpha = .77$ for the anxiety scale and $\alpha = .82$ for the stress scale). This calculation enabled the depression, anxiety and stress scores to be compared to the predetermined categories of the DASS, which separate normal, mild, moderate, severe and extremely severe levels of depression, anxiety and stress.

2.2 Procedure

The survey was made available online using the Qualtrics research software. A link to the survey was distributed via numerous University and professional mailing lists and social network sites. Following the informed consent process, participants completed the survey. At the end of the survey, a debrief form informed participants about the nature of the study and provided the contact details of the researchers and external support agencies. No reward or incentive was offered for participation.

2.3 Participants

The initial sample comprised 374 people, but 56 were excluded from the study because they did not complete the survey, representing a completion rate of 85.0%. A further 44 people were excluded from the study because their mobile phone was not a smart-device. The final sample comprised 274 people (25.2% men and 74.8% women) with an average age of 27.24 years ($SD = 12.09$, ranging from 16 to 59). The

majority of participants were students (186, 67.9%), or employed in professional (56, 20.4%) or managerial (22, 8.0%) positions. The remaining participants were employed in skilled non-manual positions, unemployed or retired (10, 3.7%).

3.0 Results

The smart-device use score was 8.99 (*SD* = 2.33, ranging from 4.44 to 17.81). The smart-device involvement score was 3.82 (*SD* = 1.16, ranging from 1.13 to 6.88). Finally, the mean Internet addiction score was 43.12 (*SD* = 11.76, ranging from 21 to 87). The predetermined categories of severity of addiction to the Internet (Young, 1998) indicate that a score of 20 to 49 represents normal (i.e., not addicted to the Internet), while 50 to 79 represents moderate addiction, and a score of 80 to 100 represents severe addiction. It is apparent therefore that the average participant experienced a 'normal' level of Internet addiction, although notably at the higher end of 'normal'. When Pearson correlations were performed for smart-device use, smart device involvement and Internet addiction, significant positive correlations were found between smart-device use and smart-device involvement, $r = .28$, $p < .001$, and between smart-device involvement and Internet addiction, $r = .35$, $p < .001$. However, smart-device use was not associated with Internet addiction.

3.1 Depression

The mean depression score was 6.12 (*SD* = 6.51, ranging from 0 to 30) indicating that the average participant experienced a 'normal' level of depression. The predetermined categories indicate that a score of 0 to 9 represents a normal level of depression while a score of 28+ represents an extremely severe level of depression (Lovibond & Lovibond, 1995). Pearson correlations and a t-test analysis were

performed to determine whether participants' smart-device use, smart-device involvement, Internet addiction, gender and/or age were associated with levels of depression.

Smart-device use was not associated with levels of depression, although there was a significant negative correlation for call use, $r = -.13$, $p = .033$. In addition, there was a significant positive correlation for smart-device involvement, $r = .24$, $p < .001$; a significant positive correlation for Internet addiction, $r = .37$, $p < .001$; and a significant negative correlation for age, $r = -.20$, $p = .001$. Gender did not significantly influence levels of depression.

Multiple hierarchical regression (MHR) was then used to assess the ability of smart-device use and smart-device involvement to predict levels of depression, having controlled for the influence of Internet addiction and age. Gender did not influence levels of depression and therefore was not controlled for (see Table 1).

Table 1

Regressions of smart-device use, smart-device involvement, Internet addiction and age as predictors of depression

	B	SE B	β
Step 1			
Constant	-.25	1.81	
Internet addiction	.19	.03	.34***
Age	-.07	.03	-.12*
Step 2			
Constant	.20	2.37	
Internet addiction	.16	.03	.29***
Age	-.05	.03	-.10
Smart-device use	.29	.17	-.10
Smart-device involvement	.82	.35	.15*

Note. R^2 = .151 for Step 1, R^2 change = .020 for Step 2 (p = .042). * p < .05., *** p < .001.

Internet addiction and age were entered at Step 1, and explained 15.1% of the variance in levels of depression, $F(2, 271) = 24.05$, $p < .001$. In Step 2, smart-device use and smart-device involvement were entered, with the model as a whole now explaining 17.0% of the variance, $F(4, 269) = 13.82$, $p < .001$. Entering smart-device use and smart-device involvement into the model explained an additional 1.9% of the variance in levels of depression after controlling for Internet addiction and age. This change was significant, R^2 change = .020, F change (2, 269) = 3.20, p = .042. In the final model only Internet addiction and smart-device involvement significantly contributed to the seen variance in levels of depression; smart-device use did not.

3.2 Anxiety

The mean anxiety score was 4.75 (*SD* = 5.78, ranging from 0 to 34) indicating that the average participant experienced a 'normal' level of anxiety. The predetermined categories indicate that a score of 0 to 7 represents a normal level of anxiety while a score of 20+ represents an extremely severe level of anxiety (Lovibond & Lovibond, 1995). Pearson correlations and a t-test analysis were performed to determine whether participants' smart-device use, smart-device involvement, Internet addiction, gender and/or age were associated with their levels of anxiety.

Smart-device use was not associated with levels of anxiety, although there was a positive correlation with text use, $r = .19$, $p = .001$. There were also significant positive correlations for smart-device involvement, $r = .24$, $p < .001$, and Internet addiction, $r = .31$, $p < .001$ as well as a significant negative correlation for age, $r = -.26$, $p < .001$. Gender did not significantly influence levels of anxiety.

MHR was then used to assess the ability of smart-device use and smart-device involvement to predict anxiety, having controlled for the influence of Internet addiction and age (see Table 2).

Table 2

Regressions of smart-device use, smart-device involvement, Internet addiction and age as predictors of anxiety

	B	SE B	β
Step 1			
Constant	1.88	1.63	
Internet addiction	.13	.03	.26***
Age	-.10	.03	-.20**
Step 2			
Constant	-.49	2.13	
Internet addiction	.11	.03	.22***
Age	-.09	.03	-.18**
Total smart-device use	.07	.15	-.03
Smart-device involvement	.61	.32	.12

Note. R^2 = .133 for Step 1, R^2 change = .016 for Step 2 (p = .084). **p< .01. *** p < .001.

Internet addiction and age were entered at Step 1, and explained 13.3% of the variance in levels of anxiety, $F(2, 271) = 20.87$, $p < .001$. In Step 2, smart-device use and smart-device involvement were entered, with the model as a whole now explaining 14.9% of the variance, $F(4, 269) = 11.80$, $p < .001$. Entering smart-device use and smart-device involvement into the model explained an additional 1.6% of the variance in levels of anxiety after controlling for Internet addiction and age. This change was non-significant, R^2 change = .016, F change (2, 269) = 2.50, p = .084.

3.3 Stress

Finally, the mean stress score was 10.16 (*SD* = 7.49, ranging from 0 to 38) indicating that the average participant experienced a 'normal' level of stress. The predetermined categories indicate that a score of 0 to 14 represents a normal level of stress while a score of 34+ represents an extremely severe level of stress (Lovibond & Lovibond, 1995). Pearson correlations and a t-test were performed to determine whether participants' smart-device use, smart-device involvement, Internet addiction scores, gender and/or age were associated with their levels of stress.

Smart-device use was not associated with levels of stress, $r = .110$, $p = .050$; nor were call, text email or application use. However, there were significant positive correlations for smart-device involvement and Internet addiction, , $r = .27$, $p < .001$, and $r = .25$, $p < .001$ respectively. Finally, gender significantly influenced levels of stress, with women being more stressed than their male counterparts, $t(272) = 2.34$, $p = .020$. Age was not significantly associated with levels of stress.

MHR was then used to assess the ability of smart-device use and smart-device involvement to predict stress, having controlled for the influence of Internet addiction and gender (see Table 3).

Table 3

Regressions of smart-device use, smart-device involvement, Internet addiction, gender and age as predictors of stress

	B	SE B	β
Step 1			
Constant	-2.64	2.56	
Internet addiction	.17	.04	.27***
Gender	3.03	1.00	.18**
Step 2			
Constant	-7.95	3.37	
Internet addiction	.14	.04	.22**
Gender	3.22	1.02	.19**
Total smart-device use	.23	.20	.07
Smart-device involvement	1.16	.42	.18**

Note. R^2 = .093 for Step 1, R^2 change = .042 for Step 2 (p = .002). ** p < .01, *** p < .001.

Internet addiction and gender were entered at Step 1, and explained 9.3% of the variance in levels of stress, $F(2, 271) = 13.96$, $p < .001$. In Step 2, smart-device use and smart-device involvement were entered, with the model as a whole now explaining 13.5% of the variance, $F(4, 269) = 10.50$, $p < .001$. Entering smart-device use and smart-device involvement into the model explained an additional 4.2% of the variance in levels of stress after controlling for Internet addiction and gender. This change was significant, R^2 change = .042, F change (2, 269) = 6.48, p = .002. In the

final model, Internet addiction, gender and smart-device involvement significantly contributed to the seen variance in levels of stress; smart-device use did not.

4.0 Discussion

Smart-devices have increased dramatically in popularity over the past five years but much remains to be understood about the impact these devices have on mental health. This study investigated the influence of smart-devices on users' mental health, specifically smart-device use and smart-device involvement. This study is the first to examine the association between smart-devices and mental health, specifically depression, anxiety and stress. Despite evidence from the previous literature suggesting that gaming, Internet browsing, social networking, calling and texting, when performed in excess individually (i.e., not on a smart-device) are linked to depression, anxiety and stress, smart-device use (i.e., total use of all of these functions) did not predict levels of depression, anxiety or stress. Therefore, hypothesis 1, which stated that higher smart-device use would predict poorer mental health was not supported. Smart-device involvement (i.e., the cognitive aspects underlying smart-device use) predicted levels of depression and stress, but not anxiety. Consequently hypothesis 2, which stated that higher smart-device involvement would predict poorer mental health, was partially supported.

It has become clear from the present research that for smart-devices, use is different from involvement and it presents different risks to wellbeing. Turel (2011) stated that conducting an activity at the expense of other necessary activities is a pre-requisite for addiction. Turel and Serenko (2010) suggest that addictive or problematic usage patterns may lead to a range of negative consequences including depression, mood alteration, loneliness, social isolation and stress. The MPIQ, used as

a measure of smart-device involvement in the present research, is based on the addiction literature (Walsh, White et al. 2010) and was found to be associated with depression and stress. This finding is in line with the general addiction literature. The rewards afforded by smart-devices could lead to checking habits and compulsive use (Oulasvirta, Rattenbury et al. 2011), types of use that may not be picked up by general use questionnaires due to the largely unconscious and short duration of the activity but are captured by the measure of involvement.

More longitudinal research is required to understand the order of causality for the relationship between smart-device involvement, depression and stress..For depression and stress, it is likely that individuals more prone to stress or in more stressful situations seek their smart-devices as a means of managing their stressful lives. Previous research has found that being constantly connected is no longer seen as work obsession and that individuals are keeping connected as a way of maintaining a sense of calm and control in their work lives during their personal time (Karlson, Meyers et al. 2009). However, the more an individual comes to depend on their smart-device as a way of keeping on top of depression and stress, the more cognitively and behaviourally involved they will become. It is also likely that being highly involved further increases depression and stress, as previous research has found that the greatest contribution to depression, stress and sleep disturbances is the perceived expectation that individuals should be available around the clock (Thomee, Dellve et al. 2010, Thomee, Harenstam et al. 2011).

The results for text use with regard to anxiety appear to fit in with Valkenburg and Peter's (2007) theory of social compensation. Text messaging allows for the majority of the advantages that online communication affords for individuals seeking or engaging in online disinhibition such as invisibility, minimal or no eye-contact and

asynchronicity in communication, meaning there is less requirement to deal with people's reactions in real time (Suler 2004, Lapidot-Lefler and Barak 2011). In the present study it was found that sending more text messages on a smart-device significantly predicted higher levels of anxiety whereas number of calls did not. It could be argued that texting is less personal and provides less anxiety provoking opportunities than calling and is thus a more attractive means of communication for the socially anxious. By utilising this function and perhaps gaining more social success from texting than they would by calling, individuals may develop habits that increase their involvement. As Lu et al. (2011) suggested, the development of habits could form a cycle whereby anxious people who are socially rewarded by using their smart-devices become more anxious as they worry about receiving replies to interactions via their smart-devices – thus increasing their involvement with their devices.

The finding that smart-device involvement is linked to depression and stress has important policy and public health implications. People need to be made aware of the potential mental health related consequences of over involvement with technology/smart-devices and possible early warning signs that they are developing habits, which have been linked to addiction. An application for all new smart-devices designed to educate users about the implications of over involvement could go some way to reducing the development of habitual and compulsive use. If a cyber-education programme is to be devised, it needs to be targeted and implemented to a very young audience. Twenty percent of children aged 6 to 11 years own a mobile phone of some description and 47% of the top 100 applications on iTunes are aimed at children, an interesting trend considering children are not the primary market for smart-devices (Gutnick, Bernstein et al. 2011).

Naturally, the present study is not without its limitations. Firstly depression, anxiety and stress are co-morbid symptoms and an increase in one is likely to lead to an increase in another. Although previous research has demonstrated that the DASS measures three distinct mental health variables, it is probable that feelings of depression will lead to feelings of stress and visa versa. Another limitation of the present research is the requirement for retrospective reports of activity and the possibility for individuals to over or under estimate. For example, it has been found that people tend to underestimate the amount of time they use their mobile phones compared to their actual call records (Cohen and Lemish 2003). This limitation could potentially provide accuracy issues for the present research, which relied on retrospective accounts of individual use. However, Cohen and Lemish found that people were more accurate at recalling the number of times per day that they used their mobile phones and thus it is likely that the questions relating to frequency in this research, which required number of times per day, were more accurate than a general estimation of length of use. Despite there being a number of established and validated measures relating to mobile phone use and addiction, at the time of writing there are no measures specifically related to smart-devices. It is important therefore that measures are developed to evaluate smart-device use. Although people were excluded from the study their mobile phone was not a smart-device, there is the possibility that using the MPIQ to measure smart-device involvement could have reduced its validity. Finally the vast majority of the participants were recruited from the UK, and therefore further replication with other countries would be desirable to ensure the generalizability of the results.

5.0 Conclusion

Overall, this study investigated the association between smart-device use, smart-device involvement and mental health. It was found that smart-device involvement, but not use, was predictive of depression and stress, suggesting that it is the nature of use rather than the extent of use that matters. Whilst the development of mobile technology has numerous benefits, it is vital to understand the costs of becoming overly involved with a technology that is increasing in popularity and allows for use anytime and anywhere. It is important that research continues to advance knowledge in this area and develops ways in which people can benefit from the huge advances in mobile technology without suffering any negative effects.

Reference list

Caplan, S., D. Williams and N. Yee (2009). "Problematic Internet use and psychosocial well-being among MMO players." Computers in Human Behavior **25**(6): 1312-1319.

Cash, H., C. D. Rae, A. H. Steel and A. Winkler (2012). "Internet addiction: A brief summary of research and practice." Current Psychiatry Reviews **8**(4): 292.

Cohen, A. A. and D. Lemish (2003). "Real time and recall measures of mobile phone use: Some methodological concerns and empirical applications." New media & society **5**(2): 167.

Gutnick, A. L., L. Bernstein and M. H. Levine (2011). Always connected: The new digital media habits of young children. New York, The Joan Ganz Cooney Center at Sesame Workshop.

Jenaro, C., N. Flores, M. Gomez-Vela, F. Gonzalez-Gil and C. Caballo (2007). "Problematic internet and cell-phone use: Psychological, behavioral, and health correlates." Addiction Research & Theory **15**(3): 309-320.

Karlson, A., B. Meyers, A. Jacobs, P. Johns and S. Kane (2009). "Working Overtime: Patterns of Smartphone and PC Usage in the Day of an Information Worker." Pervasive Computing: 398-405.

King, D. L. and P. H. Delfabbro (2013). "Issues for DSM-5: Video-gaming disorder?" Australian and New Zealand Journal of Psychiatry **47**(1): 20-22.

Ko, C. H., J. Y. Yen, C. S. Chen, Y. C. Yeh and C. F. Yen (2009). "Predictive values of psychiatric symptoms for internet addiction in adolescents: a 2-year prospective study." Archives of Pediatrics and Adolescent Medicine **163**(10): 937.

Kwon, J.-H., C.-S. Chung and J. Lee (2011). "The effects of escape from self and interpersonal relationship on the pathological use of Internet games." Community Mental Health Journal **47**(1): 113-121.

Lam, L. T. and Z.-W. Peng (2010). "Effect of Pathological Use of the Internet on Adolescent Mental Health: A Prospective Study." Archives of Pediatrics and Adolescents Medicine **164**(10): 901-906.

Lapidot-Lefler, N. and A. Barak (2011). "Effects of anonymity, invisibility, and lack of eye-contact on toxic online disinhibition." Computers in Human Behavior **1**: 102-115.

Lesonsky, R. (2011). "Survey says: The call is coming from the bathroom." Retrieved 13th Nov, 2011, from http://smallbusiness.aol.com/2011/04/07/survey-says-the-call-is-coming-from-inside-the-bathroom/.

Lovibond, P. F. and S. H. Lovibond (1995). "The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories." Behaviour Research and Therapy **33**(3): 335-343.

Lu, X., J. Watanabe, Q. Liu, M. Uji, M. Shono and T. Kitamura (2011). "Internet and mobile phone text-messaging dependency: Factor structure and correlation with dysphoric mood among Japanese adults." Computers in Human Behavior **27**(5): 1702-1709.

Morahan-Martin, J. and P. Schumacher (2003). "Loneliness and social uses of the Internet." Computers in Human Behavior **19**(6): 659-671.

Morrison, C. M. and H. Gore (2010). "The relationship between excessive internet use and depression: A questionnaire-based study of 1,319 young people and adults." Psychopathology **43**(2): 121-126.

Neal, D. T., W. Wood and J. M. Quinn (2006). "Habits - A repeat performance." Current Directions in Psychological Science **15**(4): 198.

Ofcom Report. (2011). "A nation addicted to smartphones." Retrieved 4th Aug, 2011, from http://consumers.ofcom.org.uk/2011/08/a-nation-addicted-to-smartphones/?utm_source=Twitter&utm_medium=Tweet&utm_campaign=CMR2011cons.

Oulasvirta, A., T. Rattenbury, L. Ma and E. Raita (2011). "Habits make smartphone use more pervasive." Personal and Ubiquitous Computing: 1-10.

Oulasvirta, A., T. Rattenbury, L. Ma and E. Raita (2012). "Habits make smartphone use more pervasive." Personal and Ubiquitous Computing **16**(1): 105-114.

Strassberg, D. S., R. K. McKinnon, M. A. Sustaita and J. Rullo (2013). "Sexting by high school students: An exploratory and descriptive study." Archives of sexual behavior **42**(1): 15-21.

Suler, J. (2004). "The online disinhibition effect." CyberPsychology & Behavior **7**(3): 321-326.

Tarafdar, M., A. Gupta and O. Turel (2013). "The dark side of information technology use." Information Systems Journal **23**: 269-275.

Thomee, S., L. Dellve, A. Harenstam and M. Hagberg (2010). "Perceived connections between information and communication technology use and mental symptoms among young adults - a qualitative study." Bmc Public Health **10**(1): 66.

Thomee, S., A. Harenstam and M. Hagberg (2011). "Mobile phone use and stress, sleep disturbances, and symptoms of depression among young adults - a prospective cohort study." Bmc Public Health **11**.

Tokunaga, R. S. and S. A. Rains (2010). "An evaluation of two characterizations of the relationships between problematic Internet use, time spent using the Internet, and psychosocial problems." Human Communication Research **36**(4): 512-545.

Tonioni, F., L. D'Alessandris, C. Lai, D. Martinelli, S. Corvino, M. Vasale, F. Fanella, P. Aceto and P. Bria (2012). "Internet addiction: hours spent online, behaviors and psychological symptoms." General Hospital Psychiatry **34**(1): 80-87.

Turel, O. and A. Serenko (2010). "Is mobile email addiction overlooked?" Communications of the ACM **53**(5): 41-43.

Turel, O. and A. Serenko (2012). "The benefits and dangers of enjoyment with social networking websites." European Journal of Information Systems **21**(5): 512-528.

Valkenburg, P. M. and J. Peter (2007). "Preadolescents' and adolescents' online communication and their closeness to friends." Developmental Psychology **43**(2): 267.

van Rooij, A. J., T. M. Schoenmakers, A. A. Vermulst, R. J. van den Eijnden and D. van de Mheen (2011). "Online video game addiction: Identification of addicted adolescent gamers." Addiction **106**(1): 205-212.

Walsh, S. P., K. M. White and R. M. Young (2010). "Needing to connect: The effect of self and others on young people's involvement with their mobile phones." Australian Journal of Psychology **62**(4): 194-203.

Yang, S. C. and C. J. Tung (2007). "Comparison of Internet addicts and non-addicts in Taiwanese high school." Computers in Human Behavior **23**(1): 79-96.

Yen, C. F., T. C. Tang, J. Y. Yen, H. C. Lin, C. F. Huang, S. C. Liu and C. H. Ko (2009). "Symptoms of problematic cellular phone use, functional impairment and its association with depression among adolescents in Southern Taiwan." Journal of Adolescence **32**(4): 863-873.

Young, K. S. (1998). "Internet addiction: The emergence of a new clinical disorder." CyberPsychology & Behavior **1**(3): 237-244.