

The Effect of Interactive Electronics Use on Psychological Well Being and Interpersonal Relationship Quality in Adults

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Summary

A significant body of research focuses on the adverse effects of the overuse of electronics on young children and adolescents. The objective of the current study was to examine in adults, the relationship between the usage level of interactive electronic devices (computers, smartphones, and digital tablets) and (i) level of depression, anxiety, stress, and loneliness; and (ii) quality of interpersonal relationships. Three measures of the level of interactive electronics usage were considered: Internet addiction Test (IAT) score, hours per day of work related use, and hours per day of non-work related use. In this study, 265 adult participants took an online survey that was used to determine values for psychological and interpersonal relationship scores, along with values for the three measures of the level of interactive electronics usage. The study results support the hypothesis that for the participant population, a higher IAT score is significantly correlated with a higher level of depression, anxiety, stress, and loneliness, as well as with diminished relationship quality. By contrast, psychological well-being and relationship quality did not show a significant correlation with hours per day of either work related or non-work related use of interactive electronics. The study discussion addresses the implications of interactive electronics as a public health concern and suggests possible directions for further analyses.

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Introduction

There is a significant body of recent research on the potential adverse psychological effects on children and adolescents of excessive use of modern electronic devices, including computers, smartphones, and digital tablets with the common feature that they combine elements of audio, video, and computation, collectively

referred to in this study as interactive electronic devices (IED). Teenagers use the Internet and social media, among other things, to communicate with each other, to make social connections, to do school work, and generally to learn [1]. The American Academy of Pediatrics reports that over 75% of teens own cell phones and use these devices primarily to keep in touch with their peers. Of these teens, 88% use their phones to text their friends and over 71% use more than one social media site to stay socially connected [2].

While there are many apparent benefits of IED usage, research has demonstrated that a potential downside exists. For example, increased interactive electronics usage by 6th graders is linked to poorer face-to-face social skills, as compared to peers who use less electronics [3]. In addition, adolescents who spend a great deal of time on social networking sites and feel unaccepted by their peers on these sites tend to experience anxiety and depression (referred to as "Facebook Depression"), and may begin to withdraw from social contact [4]. Reported results provide evidence of a link between Facebook use and diminished psychological well-being [5]. Neurobiological mechanisms of Internet addiction have also been explored, including functional imaging studies with MRI and PET. Nuclear imaging findings indicate that Internet addiction is associated with brain dopaminergic systems [6]. Dopamine is a neurotransmitter that functions in the brain to influence movement, learning, attention, and emotion. Elevated peripheral blood dopamine levels have been found to be positively associated with adolescent Internet addiction. [7].

Like children and adolescents, adults display negative effects possible stemming from the overuse of interactive electronics. Adults are awake 16 to 18 hours a day on average, and it is estimated that 11 of those hours are spent utilizing interactive electronics [8]. Adults use Internet and social media for both work related purposes and non-work related personal use. Non-work related personal use includes: playing games, viewing videos, research, video-chatting, listening to music, texting, reading news, shopping, dating, reading for pleasure, and social networking. This list is important and expanding because as technology advances and evolves, the list

Gender	N	%
Women	137	71
Men	53	28
Other	2	1
Relationship Status	N	%
Married	115	60
Widowed	3	1.5
Divorced	15	7.8
Separated	2	1
Domestic partner	7	3.6
Single (living with someone else)	19	9.9
Single (never married)	31	16
Level of Education	N	%
Less than high school	0	0
High school	6	3.1
Some college	12	6.3
Associate degree	10	5.2
Bachelor's degree	72	37.5
Graduate degree	92	47.9
Employment Status	N	%
Working full time	113	59.2
Working part time	54	28.3
Not employed	14	7.3
Retired	10	5.2

Table 1: Demographic information about participants in this study.

	Mean	SD	Range
Depression	1.87	0.42	1.2-3.3
Anxiety	2.68	0.50	1.5-4.0
Stress	2.23	0.68	1.0-4.5
Loneliness	2.07	0.71	1.0-4.5
Relationship Quality	4.06	0.77	1.33-5.0
Internet Addiction (overall score)	16.40	11.25	1.0-54.0

Table 2: Means and standard deviations of key study variables, including Internet addiction, psychological well-being, and relationship quality for all participants

of non-work related uses of the Internet will also expand. The ability to perform and complete personal tasks on electronic devices on a day-to-day level has significantly improved the efficiency of accomplishing personal needs. Excessive smartphone use by adults, however, has been linked to lower work productivity, decreased physical fitness, poorer social and communication skills, greater problems maintaining close relationships, and reductions in real-life social interactions with others [9, 10]. Adults who are considered to be addicted to online gaming have poorer quality interpersonal relationships and more aggressive behaviors [11-14]. Research suggests that couples who overuse electronic devices will be less responsive to each other's emotional needs and hence will be more likely to report poorer relationship quality [15, 16]. Finally, experimental studies have shown that the mere presence of a cell phone while partners are talking diminishes the sense of closeness, trust, and empathy in the other partner [17].

Overuse of IED by adults has been linked to sleep disturbances, higher levels of stress, and poorer mental health (e.g., depression) [18, 19]. A new term, "Digital Dementia," [20] refers to the breakdown of cognitive abilities due to overuse of digital technology. Individuals who rely heavily on technology may suffer deterioration in cerebral function, such as short-term memory loss and cognitive dysfunction similar to what is seen in people who have suffered a head injury or psychiatric illness. Moreover, researchers in China have found a decrease in the frontal lobe brain function of individuals with Internet addiction [21]. The cause and effect relationship between Internet addiction disorder and frontal lobe dysfunction is unclear. The frontal lobe is involved in impulse control, social behavior, and judgement. Underlying frontal lobe disease may put individuals at risk for addictive disorders. Alternatively, excessive Internet use may contribute to frontal lobe disease.

In this study, Internet usage was expanded to include a list of non-work related activities involving the use of interactive electronics. The specific devices that we classified as interactive electronics included: computers, smartphones, and digital tablets. Because the uses of these devices are varied, often recreational, and generally fully engaging, there is at least the potential for interactive electronic usage to become addictive.

The study objective was to investigate the relationship between the level of use by adults of interactive electronics and (1) clinically defined measures of psychological well-being and (2) the quality of their close personal relationships. Specifically, this study assessed the relationship between the usage level of interactive electronics (as defined above) in non-work related activities and (1) perceived levels of depression, anxiety, overall stress, and loneliness; and (2) perceived

quality of relationship with spouse, children, friends, and coworkers.

Two hypotheses were studied. The first hypothesis was that increased use by adults of IED, as measured by total hours used per day on average, is linked to diminished psychological well-being and diminished relationship quality. The second hypothesis was that increased use by adults of interactive electronic devices as measured by the Internet addiction Test (IAT) score is linked to diminished psychological well-being and diminished relationship quality.

Results

The results indicate that for the population of study participants, correlation IAT score has a statistically significant correlation ($p < .001$) with each psychological well-being score and with relationship quality. By contrast, there is no statistical evidence of correlation between hours per day spent using interactive electronics (whether work related or non-work related) and either psychological well-being or interpersonal relationship quality. **Table 4** shows the calculated sample correlation between interactive electronics usage and both psychological well-being and interpersonal relationship quality. Also shown are the associated p-values based on the Student t-test.

To further study the relationship between IAT score and both psychological well-being and interpersonal relationship quality, a quadratic regression was performed. The results (not shown) indicate that there is no evidence of a nonlinear component of the relationship between IAT score and either psychological well-being or interpersonal relationship quality. In particular, there is no indication of a threshold effect. Specifically it is not the case that IAT score has to exceed a critical value before psychological well-being and relationship quality are adversely affected.

The next question considered was whether the indicated relationship between IAT score and both psychological well-being and relationship quality are gender dependent. Linear regression analysis was applied separately to the subpopulation of female study participants ($n = 116$) and male study participants ($n = 52$). As indicated, there was a significant correlation between IAT score and each psychological/social score for the sub-population of women (**Table 5**). For men, significant correlation was observed between IAT score and depression score, stress score, loneliness score, and relationship quality score. The absence for men of significant correlation between IAT score and anxiety score may be a result of the relatively small number of male study participants.

Bivariate linear regression analysis was performed with both subject age and IAT score as predictive

Function	% citing use
Video chats	97.5
Getting information (e.g. weather, navigation)	96.0
Phone calls	88.7
Reading news	83.2
Online shopping	72.6
Texting or IM	72.4
Watching videos	57.2
Reading for pleasure	48.8
Playing games	34.0
Listening to music	29.7
Social networking	27.6
Taking care of tasks (e.g. paying bills)	25.7
Online dating	5.0

Table 3: Patterns of interactive electronics use

Correlation Values	IAT score (n=168)	Work hrs (n=191)	Non-work hrs (n=193)
Depression	0.43 ($p < .001$)	0.00	0.15
Anxiety	0.38 ($p < .001$)	0.09	0.12
Stress	0.33 ($p < .001$)	0.07	0.08
Loneliness	0.35 ($p < .001$)	0.14	0.12
Relationship Quality	0.38 ($p < .001$)	0.01	0.12

Table 4: Sample correlation values between Internet Addiction Test (IAT) scores, interactive electronics usage (number of hours per day using electronics for work-related functions and non-work related functions), and psychological/social well-being

variables. The results in Table 6 indicate that IAT score and subject age in combination has no more explanatory power with respect to psychological/social well-being score than IAT score alone.

Methods

Participants and data collection procedures

A convenience sample of adults 18 years or older were recruited by email to participate from August through November 2015. The starting point for the

	Women (n=116)	Men (n=52)
Depression	0.45 (p < .001)	0.45 (p < .001)
Anxiety	0.47 (p < .001)	0.24 (p = .08)
Stress	0.38 (p < .001)	0.33 (p = .02)
Loneliness	0.31 (p < .001)	0.51 (p < .001)
Relationship Quality	0.35 (p < .001)	0.50 (p < .001)

Table 5: Sample correlation values by subject gender between Internet Addiction Test (IAT) scores and psychological/social well-being

	IAT Score (n=168)	IAT Score and Subject Age (n=159)
Depression	0.43	0.45
Anxiety	0.38	0.38
Stress	0.33	0.34
Loneliness	0.35	0.36
Relationship Quality	0.38	0.38

Table 6: Sample multiple correlation values between Internet Addiction Test (IAT) scores and subject age jointly and psychological/social well-being

sampling procedure was an email contact list from the author and her adult acquaintances, including teachers and family members. The direct contacts on this list were emailed and encouraged to invite their contacts to participate in the study. This recruitment method resulted in a population of study participants with varied ages and cultural backgrounds.

A link on the email directed the participants to the study survey website. Upon clicking on the study link, participants were taken to a separate webpage to participate in the survey. Participants first read and completed a consent form explaining the nature of the study and those who chose to participate completed the questionnaire online through SurveyMonkey. The survey included measures of risk (described in 3.2) for depression, anxiety, perceived stress, loneliness, and the perceived quality of relationships with important others. The survey also included questions to determine the types and levels of use of interactive electronics. The online survey program allowed subjects to complete surveys anonymously and confidentially without collecting IP addresses or other identifying information. Informed consent was obtained for each participant. Completion of the survey was completely voluntary. Participants could choose to answer any question or skip

questions that they did not feel comfortable answering. At the end of the survey, participants were provided a debriefing form explaining the purpose of the study, with references to learn more about the effects of using IED on well-being as well as the contact information of the study investigators. Because of an issue with SurveyMonkey, several participants were not asked to complete some of the later questions in the survey, thereby lowering the total number of participants in some of the analyses.

Measures used to form numerical scores

Daily usage of IED. Participants were asked questions about the total number of hours on average they use interactive electronic devices for both non-work related activities and work related activities. Participants were asked about their motivations for electronics use, including enjoyment, interest, boredom, relaxation, escape from stress, connection with others, and curiosity about others' lives. This list of motivations for using technology was generated by the author, based on personal experience. Sample items included "because it's fun" and "to kill time when I'm bored."

Internet Addiction. The 21-item Internet Addiction Test [22] measured Internet use in terms of mild, moderate, and severe levels of addiction. In the context of the IAT the level of "addiction" is defined by a score on a numerical scale as follows. Level of severity was determined by the total scale score, with 0 to 30 points indicating "no Internet addiction", 31 to 49 points indicating "mild Internet addiction", 50 to 79 points indicating "moderate Internet addiction", and 80 to 100 points indicating "severe Internet addiction." The Internet Addiction scale score was calculated by summing the scores of the relevant items. The total scale score as well as the level of severity were used as indices to represent Internet addiction. Sample items included "How often do you find that you stay online longer than you intended?" and "How often do you check your email before something else that you need to do?" The option was available to not answer a question if the item was not applicable to the participant.

The following items were each rated on a five-point Likert-type scale. All Likert scale scores have the direct best = 1 to worst = 5. Total scores are formed by taking the arithmetic average of the individual Likert scores.

Depression. The 10-item Center for Epidemiological Studies-Depression Scale short version [21] asked participants to rate how they have felt during the past month. Sample items included "I felt everything I did was an effort" and "I enjoyed life."

Anxiety. The 6-item State-Trait Anxiety Scale short version [25, 26] was used to assess how anxious the participant has felt in the past month. Sample items included "I felt tense" and "I felt upset."

Stress. The 4-item Perceived Stress Scale [27] was used to determine the extent to which participants experienced stressful thoughts and feelings over the past month. Sample items included “In the last month, how often have you felt that you were unable to control the important things in your life?” and “In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?”

Loneliness. The 8-item UCLA loneliness scale short version [28] was used to determine the extent to which participants felt lonely. Sample items included “How often did you feel that you lacked companionship?” and “How often did you feel that there was no one that you could turn to?”

Relatedness. The 3-item relatedness subscale of the Need Satisfaction Scale [29] was used to assess relationship connections with important others over the past month. Items included “I have felt loved and cared about”, “I have often felt a lot of distance in my relationships” (scored in reverse order), and “I felt a lot of closeness with others.”

Descriptive statistics and preliminary analyses

Two hundred sixty-five adults fully or partially completed the survey out of approximately 400 adults who were sent the survey by email. Complete demographics of the sample are found in **Table 1**. Of the people who disclosed their gender, 71% identified as women ($n = 137$), 28% identified as men ($n = 53$), and 1% ($n = 2$) reported that they use a label other than male or female. Participants ranged in age from 18 to 75, with a mean age of 43.7 years (standard deviation (SD) = 13.7 years). Of the participants who disclosed their relationship status, 60% reported that they are married ($n = 115$), 16% reported they are single ($n = 31$), 9.9% reported they are single but living with someone ($n = 19$), 3.6% are in a domestic partnership ($n = 7$), 8.8% reported that they are separated or divorced ($n = 17$), and 1.5% are widowed ($n = 3$). Most participants attained a graduate degree or higher ($n = 92$; 47.9%), 37.5% have attained a bachelor's degree ($n = 72$), 5.2% have completed an associates' degree ($n = 10$), 6.3% have completed some college ($n = 12$), and 3.1% have completed high school as their highest level of education ($n = 6$). Finally, of the participants who reported employment status, 59.2% of participants work full time ($n = 113$), 28.3% work part-time ($n = 54$), 7.3% are not currently employed ($n = 14$), and 5.2% are retired ($n = 10$; see **Table 1**).

Means and standard deviations of participants' risk for depression, anxiety, stress, loneliness, quality of relationships with important others, and interactive electronics use are found in Table 2. Most participants reported relatively low levels of depression, anxiety, stress, and loneliness, as well as relatively high levels of

relationship quality overall (**Table 2**).

Most participants also reported relatively low levels of Internet addiction. In fact, none of the participants would be considered highly addicted to Internet use (**Table 2**). On an average weekday, 44% of participants reported that they use IED for work related activities for 5 hours or more each day. Moreover, the majority of participants (64%) reported that they spend less than 2.5 hours per day on interactive electronic devices for non-work related purposes.

To understand more about how individuals use IED, we asked further questions about patterns of use. First, we asked whether subjects use their computer, tablet or smartphone for various purposes, including phone calls or video chats, texting or IM (Instant Messaging), social networking, playing games, listening to music, watching videos, getting information (e.g., weather, navigation), reading the news, reading for pleasure, taking care of tasks (e.g., paying bills), online shopping, and online dating. Results are shown in Table 3.

We further asked participants questions regarding the extent to which they use different forms of social media, including Facebook, Instagram, Snapchat, LinkedIn, Twitter, Pinterest, or other sites. Participants reported the greatest usage of Facebook ($n = 144$), followed by LinkedIn ($n = 68$), Instagram or Snapchat ($n = 63$), Pinterest ($n = 51$), Twitter ($n = 29$), and other ($n = 19$). On average, subjects reported use of Facebook for 2.73 hours (SD = 1.60 hours), use of other sites 2.17 hours (SD = 1.55), use of Instagram or Snapchat for 1.96 hours (1.52), Pinterest for 1.54 hours (SD = 1.04), Twitter for 1.32 hours (SD = 0.78), and LinkedIn for 1.21 hours (SD = .58 hours).

Finally, we asked participants to rate motivations for use of IED, including enjoyment, interest, boredom, relaxation, escape from stress, connecting to others, and curiosity about others (e.g., viewing others' social media pages). Participants reported that they use social media mostly to connect with others (mean = 3.40, SD = 1.26), followed by interest (mean = 2.97, SD = 1.20), curiosity about others (mean = 2.93, SD = 1.28), boredom (mean = 2.92, SD = 1.43), fun (mean = 2.76, SD = 1.17), relaxation (mean = 2.25, SD = 1.22), and to escape from stress (M = 2.22, SD = 1.26).

Analysis methods.

The strength and direction of the relationship between two study variates X and Y were measured using linear regression analysis. This approach has multiple advantages. The Pearson correlation between X and Y is zero if and only if the slope of the regression line is zero. Thus, the Student t-test for zero slope can be used to test the statistical significance of the sample correlation between X and Y. Regressing Y jointly on

X and X² (quadratic regression) provides a means for testing the linearity of the relationship between X and Y. Finally, additional explanatory variables can be introduced into the model to test their effect on the relationship between X and Y.

In the context of the present study, the variate X is either average number of hours/day of interactive electronic use or IAT score. Y is a psychological well-being score or a quality of relationship score.

Discussion

In this study, we used multiple types of regression analyses to study the relationship between the use of IED and both psychological well-being and quality of interpersonal relationships. Three measures of IED usage were considered: IAT score, hours per day of work usage, and hours per day of non-work usage. Of these, only IAT score showed statistically significant correlation with psychological well-being and quality of interpersonal relationships as measured by standardized Likert scale scores (**Table 4**). A possible explanation for the greater explanatory power of IAT score is that it attempts to capture the degree to which the usage of IED is compulsive and displaces other important activities and social interactions.

The link between IAT score and both psychological well-being and quality of interpersonal relationships was observed both in the subpopulation of female subjects and in the subpopulation of male subjects (**Table 5**).

Multivariate linear regression analysis was used to investigate whether regressing on subject age in combination with IAT score added significantly to the explanatory power of the regression model. The results of the analysis were negative (not shown in tables).

An important implication of the study is that for the subject adult population the link between IAT score and both psychological well-being and relationship quality was present (i) for both men and women, (ii) across all adult ages, and (iii) across all Internet addiction classifications (**Tables 5-6**). Further quantifying and understanding this link is therefore of considerable concern.

Study limitations included both the relatively small sample size and the sampling procedure. Although the age of the study participants varied widely, a disproportionate fraction of the participant ages fell in the interval 40 to 49 years. The ratio of female participants to male participants was 5:2. The predominantly relatively low IAT scores indicate that a majority of the participants were high functioning both in terms of their well-being and the quality of relationships. These sampling issues can be addressed in future studies by drawing from a larger and more diverse population.

The specified list of IED in our study included only

smartphones, computers and tablets. Other types of electronic usage, such as TV based video games, were not considered. This issue can be addressed in future studies by including a more comprehensive list of IED in activity time totals.

One cannot infer causation from the study results because many factors not considered (or controlled for) in the regression and correlation analysis can contribute to psychological well-being and quality of relationships. The study did not control for factors other than excessive use of IED that might adversely affect psychological well being and relationship quality. Such factors include physical health, financial state, family history and inherited predisposition. Specifically, the study did not consider the possibility that for some individuals excessive IED use is more the consequence than the cause of psychological and relationship problems. A multivariate regression model considering the range of factors affecting psychological well-being and personal relationships would serve as the basis for an investigation of cause and effect relationships.

Conclusions

Internet addiction has become a public health issue. Our results add to the growing body of work that suggests that usage of IED generally, not just IAT score, are linked to psychological well-being and interpersonal relationship quality. Given the proliferation of IED use in everyday life, greater awareness and focused intervention is required to reduce the potential negative impact of IED use.

In the absence of a validated metric of general IED use, IAT score was used in this study as a proxy. It is recommended that a counterpart to IAT score be developed that takes into account all IED usage.

Finally, the study results support the requirement for further study of the link between IED usage and both psychological well-being and relationship quality with a larger and more diverse subject population.

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