

Technology-related transformations of imaginary body boundaries: Psychopathology of the everyday excessive Internet and mobile phone use

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Background. In line with the approach of Larkin et al. (2006), we consider technological dependence in the context of the interaction between personality, environment, and culture.

Objective. The aim of this study is to discover technology-related changes in psychological needs and boundaries that could mediate the relationship between psychopathological symptoms and indicators of excessive use of info-communication technologies (ICT). The application of the Body Function Regulation Model to the use of ICT suggests that technology-related changes in the system of an individual's needs and psychological boundaries mediate the relationship between a sense of poor psychological well-being and the risk of technology dependence.

Design. The study of a normative sample (N=275) using two technologies—mobile phones and the Internet—was performed.

Results and Discussion. We demonstrated that the relationship between the general level of psychopathological symptoms and excessive use of technology (subjective dependence and inability to refrain from use of mobile phones and the Internet) is indeed mediated by the perception of their indispensability for extension of psychological boundaries, and (for the Internet) its use in image-making.

Keywords: Body function regulation model, psychological consequences of technologies, psychopathological complaints, the revised version of the Technology-Related Psychological Consequences Questionnaire, excessive use of technologies

Introduction

The terms “excessive use” and “problematic use” (Bianchi & Phillips, 2005) of technologies, as well as “technological addiction” (Griffiths, 2000, 2005), refer to an individual spending so much time using some form of info-communication tech-

nology that he/she neglects other life spheres, or adopts a potentially dangerous use of the technology (like cyberbullying or calling when driving).

While scientists are still arguing about whether to consider technological addiction a mental disorder, and what the criteria for its definition should be (Kuss & Lopez-Fernandez, 2016), most researchers agree that this is a practical problem with rather higher incidence. The components used to define technological addiction are typically taken from the criteria used to define substance use or gambling (e.g., salience, mood modification, tolerance, withdrawal symptoms, conflict, and relapse—Griffiths, 2005), and include subjective appraisals of dependency and the negative impact on personal life spheres.

Excessive use of both the Internet and mobile phones were found to be a widespread problem, especially among adolescents and youth. For instance, in Britain, 10% of students report extensive use of mobile phones (Lopez-Fernandez et al., 2014); in China, 11.7% of student Internet users meet the criteria for Internet addiction (Li et al., 2014). Comparisons of 31 nations revealed a 6.0% (Cheng & Li, 2014) mean prevalence rate for Internet addiction, with the highest rate in the Middle East (10.9%) and the lowest rate in Northern and Western Europe (2.6%). According to a study of the Russian population, 11% of adolescents report three or more symptoms of excessive Internet use (Soldatova & Rasskazova, 2013). Internet addiction is related to high stress, sleep disturbances (Younes et al., 2016, Cannan et al., 2013), and lower subjective and objective quality of life (Cheng & Li, 2014).

There is a growing body of data showing that problematic or excessive use of info-communicational technologies is related to a higher level of psychopathological complaints and different psychological factors. Internet addiction was found to be related to anxiety, depression, and low self-esteem (Younes et al., 2016), extrinsic locus of control (Andreou & Svoli, 2013), and a wide range of psychopathological symptoms (Kuss & Lopez-Fernandez, 2016), including even psychotic-like experiences (Mittal et al., 2013). Moreover, technological addiction is accompanied by a preference for specific kinds of perception of one's self and others, and coping strategies. Adolescents with problematic use of mobile phones tend to perceive themselves as experts in this technology, and see their peers as using their phones extensively as well (Lopez-Fernandez et al., 2014).

Experiential avoidance as a self-regulatory strategy, which involves trying to control or escape from negative stimuli such as thoughts, feelings, or sensations that generate strong distress (Garcia-Oliva & Piqueras, 2016), was found to be an important factor involved in addictive use of the Internet, mobile phones, and video games in adolescents. The relationship between Internet addiction and psychosocial maladjustment was found to be mediated by coping inflexibility and coping avoidance (Cheng et al., 2015). A sense of lack of perceived control, especially if accompanied by a perception of a low level of familial emotional support, predicts the ability of the Internet to negatively affect a person's life (Pace et al., 2014).

However, due to the cross-sectional design of most studies, it is unclear whether psychological changes are the reason for, or an outcome of, the extensive use of technology. Although the relationship between psychopathology and technological addiction was traditionally interpreted as an indicator of vulnerability, some re-

searchers insisted that understanding of technological addictions demands consideration of the whole system of “personality–environment–culture” (Larkin et al., 2006) and the context of excessive use (Griffiths, 2010). According to an Interaction of Person-Affect-Cognition-Execution (I-PACE) model of specific Internet-use disorders (Brand et al., 2016), while personality factors could predispose an individual to different Internet-use disorders, cognitive and affective processes further mediate addiction formation. Thus, both reasons for and effects of addiction depend not only on the individual’s personality and symptoms; rather, while the personality creates specific conditions for dependence, the dependence’s development is a result of different factors. In line with this idea, there is data showing that psychopathological symptoms are different in those Internet addicts who have social dysfunction, compared with those who have not: the former have higher levels of interpersonal sensitivity, hostility, and paranoia; lower levels of social responsibility, anxiety, self-control, and family social support; and they were more likely to employ negative coping strategies (Chen et al., 2015).

The purpose of this study is to uncover technology-related psychological changes that could mediate relationship between psychopathological symptoms and indicators of excessive use of info-communication technologies. In line with the approach of Larkin et al. (2006), we consider technological dependence in the context of the interaction between personality, environment, and culture, applying the Body Function Regulation Model (Tkhostov, 2002) to the use of ICT.

Perception of information technologies as indispensable and invisible: The psychological model of body function regulation

The Body Function Regulation Model (Tkhostov, 2002) was suggested as a framework for explaining functional and behavioral disorders from a socio-cultural perspective. It suggests that the perception of objects as “mine” and part of “me” is based on a feeling of their controllability. Loss of controllability (due to too high social demands for functioning, damage, or external influence) leads to the externalization of functions that are felt to be “not mine any more.” Attempts to consciously regulate them are typically unhelpful and might provoke the perpetuation of the problem. The application of this approach to ICT allows us to consider technologies not only as human extensions (MacLuhan, 1964) opening up new opportunities (Reingold, 2002), but also as psychological transformations (Emelin et al., 2012). As a result, technologies become indispensable to the person, and invisible, creating an illusion of controllability and the subjective necessity to use them, even if it is not obligatory.

Indeed there is data (Walsh & White, 2007) demonstrating that technology use is closely related to subjective appraisals of its controllability and the development of a technology-related identity (self-identity, similarity to a prototype, the emotional appraisal of the prototype). According to L. Tian et al. (2009), any technology which makes access to information quick and easy, reduces the feeling of uncertainty and increases the feeling of safety. In analyzing psychological changes in users of mobile phones, L. Srivastava (2005) suggests that they are perceived as “always necessary,” making them subjectively indispensable, and their loss personally traumatic.

The application of the Body Function Regulation Model to technologies (Emelin et al., 2012) identifies different changes in psychological boundaries: the feeling of controllability (boundary extension); vulnerability to others who can always achieve (boundary violation); and preference for the technologies over activities that are not moderated by technologies. In this study we used two indicators of excessive use of two technologies (mobile phones and the Internet): subjective dependence, and the inability to refrain from using them.

The study puts forward several hypotheses:

1. Psychopathological complaints are related to indicators of excessive use of mobile phones and the Internet in the normative sample.
2. This relationship is mediated by an extension of psychological boundaries and perceived changes in needs due to the technologies.
3. The mediation effects do not depend on the frequency of technology use.

Method

In accordance with the study's objectives, we sought a broad adult sample (not only youth). To obtain this sample, second-year students of the psychology faculty were asked to advertise this research project in their communities. Inclusion criteria were: 1) an age range of 17–70 years old; 2) access to and experience of use of the Internet and mobile phones (even if they don't use them now); and 3) the absence of diagnosed mental illness. The volunteer subjects then filled out questionnaires. While it is typical in Russia for women and younger people to be more open to participating in psychological studies, recruitment continued until at least 100 males were included. Two hundred and seventy-four people living in Moscow and the Moscow region (100 males, 174 females, mean age 25.8 ± 11.8) participated in the study. Of these, 95 (34.7%) had higher education; others had completed basic education, and were either students (72 participants, 26.3%) or worked (107 participants, 39.1%). Seventy-five (27.3%) were married or lived with a partner, 187 (68.3%) were not married, and 12 (4.4%) were divorced. Sixty-three (23.0%) had children.

The study was of the cross-sectional design. Participants supplied the following information:

1. **The revised version of Technology-Related Psychological Consequences Questionnaire.**¹ This is a screening instrument (Emelin et al., 2014) based on the body function regulation approach (Tkhostov, 2002), and applies to both technologies (the Internet and communication by mobile phones). There are nine scales within each technology, which are divided into three blocks: indicators of excessive use, psychological boundary transformation, and needs transformation. Each scale is tested by three items appraised on the 4-item Likert scale. The block of indicators of excessive use includes two scales: the inability to refrain from use (e.g., "I can't imagine my life without mobile phone") and subjective dependence (e.g.,

¹ The revised version of Technology-Related Psychological Consequences Questionnaire and further details on its structure and items are available from the corresponding author.

“I spend more time on the Internet than I would like to”). The block of transformation of boundary extension includes four scales: 1) boundary extension (e.g., “If the person with whom I used to talk in the Internet isn’t online for a long time, I worry”); 2) boundary violation (e.g., “I’m concerned that my personal information may be available to anyone in the Internet”); 3) easiness-related preference for the technology (e.g., “The Internet can substitute for lots of hobbies and real-life activities”); and 4) opportunity-related preference for technologies (e.g., “It’s important that the mobile phone makes it easy for me to distract myself from unpleasant discussion or events”).

Technology-related needs each have three scales: 1) functionality (“I like the fact that with the Internet I can at any time send a message to any people I need to contact wherever I am or they are”); 2) convenience (“All I need in a computer is for it to be reliable and easy to use”); and 3) image-making (“I prefer to buy an expensive but stylish mobile phone”). In this study we didn’t use the boundary violation scale, due to ambiguity in its interpretation (Emelin et al., 2014): it reflects both the degree of violation and sensitivity to the impact of the technologies.

2. **Frequency of use** of the Internet and mobile phone was assessed by the response to one statement on a 4-point Likert scale: “Typically I use ... (the Internet or mobile phone) never or almost never / rarely / sometimes / often”.
3. **Symptom Checklist-90-Revised** (Derogatis & Spitzer, 2000) includes a list of 90 psychopathological symptoms measuring Somatization, Obsessive-Compulsiveness, Interpersonal Sensitivity, Depression, Anxiety, Hostility, Phobic Anxiety, Paranoid Ideation, and Psychoticism. There are three secondary global indexes: the Global Severity Index (measuring overall psychological distress); the Positive Symptom Distress Index (measuring the intensity of symptoms); and the Positive Symptom Total (measuring the number of self-reported symptoms). In line with data showing that there are general psychopathological complaints which increase with different psychiatric conditions (e.g., demoralization, Tellegen et al., 2008), the scores across the nine scales were highly consistent (Cronbach’s alpha .95). Thus we constructed a mean score of psychopathological complaints across all the scales of SCL-90R, thus measuring a general level of vulnerability to psychopathology.

Taking into account the imbalance in gender and age in the sample, we tested for their effects on all the dependent variables. Gender was unrelated to both the inability to refrain from, and subjective dependence on, the use of mobile phones and the Internet. Age was unrelated to the inability to refrain from mobile phone use ($r = -.07$), but as expected, negatively correlated to subjective dependence, as well as to the inability to refrain from Internet use ($r = -.29$ to $-.18$). Nevertheless, to be sure that the results were not distorted by the effects of age and gender, all the analyses were repeated with the inclusion of both factors as covariates. As shown below, the general pattern of results remained the same. In the discussion section, we further address the possible limitations due to this imbalance.

Results

Indicators of excessive use of technologies and psychopathological complaints

There were medium positive correlations between subjective dependence and the inability to refrain from use of the technologies ($r = .25$, $p < .01$ for mobile phones and $r = .41$ for the Internet) and across technologies ($r = .30$ – $.36$, $p < .01$)¹. Both indicators of excessive technologies use were related to more frequent use ($r = .24$ – $.39$ for mobile phones and $r = .27$ for Internet)².

Table 1. Correlations between psychopathological complaints (SCL-90-R), subjective dependence and the inability to refrain from mobile phone and Internet use. (Partial correlations after adjusting for age and gender are in the parentheses).

SCL-90-R Scales and Indexes	Inability to refrain from mobile phone use	Subjective dependence on mobile phone use	Inability to refrain from Internet use	Subjective dependence on the mobile phone and Internet
Somatization	.10 (.13*)	.23** (.24**)	.02(.01)	.19** (.18**)
Obsessive-Compulsiveness	.19** (.19**)	.29** (.26**)	.19** (.14*)	.38** (.32**)
Interpersonal Sensitivity	.19** (.18**)	.22** (.18**)	.20** (.16**)	.35** (.31**)
Depression	.16** (.15*)	.21** (.18**)	.15* (.10)	.36** (.30**)
Anxiety	.20** (.20**)	.23** (.21**)	.13* (.09)	.31** (.27**)
Hostility	.14* (.14*)	.21** (.18**)	.12 (.07)	.24** (.17**)
Phobic Anxiety	.09 (.06)	.20** (.17**)	.16** (.12)	.25** (.21**)
Paranoid Ideation	.21** (.22**)	.25** (.22**)	.16** (.13*)	.30** (.26**)
Psychoticism	.19** (.20**)	.28** (.25**)	.15* (.10)	.32** (.27**)
Global Severity Index	.19** (.20**)	.28** (.25**)	.16** (.11)	.36** (.31**)
Positive Symptom Total	.15* (.16*)	.29** (.27**)	.15* (.11)	.36** (.33**)
Positive Symptom Distress Index	.20** (.20**)	.20** (.16**)	.15* (.11)	.28** (.21**)
Mean level of psychopathological complains	.20** (.20**)	.28** (.25**)	.17** (.12*)	.36** (.31**)

* — $p < .05$, ** — $p < .01$.

¹ Partial correlations after adjusting for age and gender are $r = .24$, $r = .36$ and $r = .30$ – $.33$, consequently.

² Partial correlations after adjusting for age and gender are $r = .21$ – $.37$ and $r = .18$ – $.21$, consequently.

In line with theories of technological addictions, both subjective dependence and the inability to refrain from use were weakly positively correlated with different psychopathological complaints (Table 1): especially complaints of obsessive-compulsive symptoms, anxiety, paranoid ideation, and psychoticism. With the exclusion of the inability to refrain from Internet use, the weakest correlations disappear after adjusting for age and gender; for the other three dependent variables, the correlational pattern remains relatively stable even when age and gender are taken into account.

Indicators of excessive use of technologies and psychological boundary and needs transformation

Boundary extension and technology-based image-making were the strongest predictors of excessive use for both mobile phones and the Internet (Table 2). Easiness-related preference for technology correlated mainly with Internet use while opportunity-related preference correlated with mobile phone use. The general pattern of the results remained after adjusting for age and gender.

Table 2. Correlations between indicators of psychological boundary and needs transformation, subjective dependence and the inability to refrain from mobile phone and Internet use. (Partial correlations after adjusting for age and gender are in the parentheses).

Indicators of psychological boundary and needs transformation	Inability to refrain from mobile phone use	Subjective dependence on mobile phones	Inability to refrain from Internet use	Subjective dependence on mobile phones and Internet
Boundaries extension	.43** (.42**)	.21** (.21**)	.47** (.45**)	.47** (.45**)
Easiness-related preference of technology	.10 (.07)	.15* (.12*)	.32** (.31**)	.30** (.30**)
Opportunity-related preference of technology	.40** (.42**)	.47** (.46**)	.20** (.20**)	.11 (.11)
Functionality	.34** (.35**)	-.02 (.00)	.18** (.15*)	.19** (.14*)
Convenience	.23** (.22**)	.02 (-.04)	.21** (.20**)	.16** (.14*)
Image making	.46** (.48**)	.37** (.35**)	.41** (.38**)	.46** (.42**)

* — $p < .05$, ** — $p < .01$.

Psychological boundaries and needs transformation as mediators of the relationship between psychopathological complaints and indicators of excessive use of technologies

To test the hypothesis that psychological transformations mediate the relationship between psychopathological complaints and indicators of excessive use of technologies, we conducted a number of mediation analyses separately for mo-

Table 3. Psychological boundary and needs transformation as mediators of the relationship between psychopathological complaints and indicators of excessive use of mobile phone and Internet. (Effects after control for age and gender are in parentheses).

Mediator	β Complaints – Mediator	β Mediator – DV	Direct effect β Complaints – DV [95% CI]	Indirect effect β Complaints – DV [95% bootstrapped 10,000 CI]
<i>Dependent variable: Inability to refrain — Mobile phones</i>				
Boundaries extension	.51** (.51**)	.41** (.38**)	.14 [–.06 – .34] (.14 [–.06 – .34])	.21 [.12 – .32] (.19 [.11 – .30])
Opportunity-related preference of technology	.44** (.46**)	.37** (.38**)	.19 [–.01 – .39] (.16 [–.04 – .36])	.16 [.08 – .28] (.18 [.09 – .29])
<i>Dependent variable: Subjective dependence - Mobile phones</i>				
Boundaries extension	.51** (.51**)	.14* (.15*)	.43** [.21 – .64] (.36** [.15 – .58])	.07 [.01 – .15] (.07 [.02 – .16])
Opportunity-related preference of technology	.44** (.46**)	.43** (.41**)	.31** [.12 – .50] (.25* [.05 – .44])	.19 [.11 – .30] (.19 [.11 – .30])
<i>Dependent variable: Inability to refrain - Internet</i>				
Boundaries extension	.69** (.69**)	.48** (.46**)	–.03 [–.23 – .17] (–.10 [–.31 – .11])	.33 [.21 – .48] (.32 [.20 – .47])
Easiness-related preference of technology	.37** (.39**)	.30** (.30**)	.19 [–.01 – .40] (.11 [–.10 – .31])	.11 [.05 – .19] (.11 [.05 – .20])
Image making	.42** (.42**)	.39** (.35**)	.14 [–.06 – .34] (.07 [–.13 – .28])	.16 [.08 – .28] (.15 [.07 – .25])
<i>Dependent variable: Subjective dependence - Internet</i>				
Boundaries extension	.69** (.69**)	.39** (.37**)	.37** [.17 – .57] (.29** [.08 – .50])	.27 [.17 – .40] (.25 [.15 – .38])
Easiness-related preference of technology	.37** (.39**)	.24** (.24**)	.55** [.36 – .75] (.45** [.25 – .66])	.09 [.03 – .17] (.09 [.04 – .18])
Image making	.42** (.42**)	.40** (.34**)	.48** [.29 – .66] (.40** [.21 – .60])	.17 [.09 – .27] (.14 [.08 – .24])

* — $p < .05$, ** — $p < .01$.

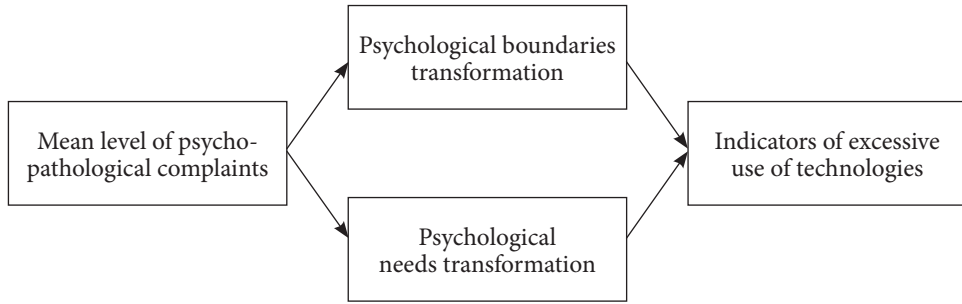


Figure 1. Schema of mediation analysis

bile phones and the Internet, and for both indicators (Chaplin, 2007). The dependent variables were the subjective dependence on technology, and the inability to refrain from its use, and the independent variable was the mean level of psychopathological complaints (Fig. 1). Three scales of the psychological boundary transformation block, and three scales of psychological needs transformation block, were tested as possible mediators. Preacher and Hayes' macro for SPSS was used to measure indirect bootstrapped effects¹. Unstandardized indirect effects were computed for 10,000 bootstrapped samples, and the 95% confidence intervals were obtained (Table 3).

For both subjective dependence and the inability to refrain from mobile phone use, the effect of the psychopathological complaints was mediated by boundaries extension and the opportunity-related preference for technology. No direct effect of psychopathological complaints on the inability to refrain from mobile phone use was found, allowing us to hypothesize that vulnerability to mobile phone-related psychological transformations in people with higher psychopathological complaints is a key factor in their inability to refrain from mobile phone use.

Furthermore, both the effects of psychopathological complaints on subjective dependence, and the inability to refrain from Internet use are mediated by boundary extension, easiness-related preference for the Internet, and image-making online. As in the case of mobile phones, we found no significant direct effects of psychopathological complaints on the inability to refrain from Internet use.

The same mediation patterns remained after we added the frequency of use variable in the first step of regression analysis. Moreover, as can be clearly seen in the table, adjusting for age and gender leads to minor changes in the results.

Discussion

According to our data, higher psychopathological complaints are indeed related to higher subjective dependence, and the inability to refrain from the use of the technologies (both mobile phones and the Internet). However, these effects are mediated by technology-related changes in psychological boundaries and needs. Specifically, people with higher psychopathological complaints tend to feel that they can control and achieve more than others by using mobile phones and the Internet,

¹ URL: <http://processmacro.org/download.html>

and this feeling, if developed, contributes to the risk of subjective dependence and the inability to refrain from use of the technologies. Moreover, these people more frequently consider mobile phones as indispensable due to the opportunities they open up, while the Internet is seen as indispensable due to its easiness. These feelings are consequently related to indicators of excessive use of mobile phones and the Internet.

In general, these results are in accordance with vulnerability-stress-coping model that has been suggested for mental illnesses (especially schizophrenia, see Zubin & Spring 1977), in that external stimuli (e.g., technology use) can amplify initial personal vulnerabilities. Moreover, the data indicate that psychological complaints should be considered a risk factor creating vulnerability to technology-related changes, but not to their excessive use per se (Larkin et al., 2006). An interesting question for future research is why psychopathological symptoms are related to a higher vulnerability to psychological transformations when using technologies.

Technology-related transformation in needs seem to be unrelated to the “psychopathological complaints–indicators of excessive use” relationship. The only exception refers to image-making: people with higher psychopathological complaints more often believe that Internet improves their image, and this belief predicts both subjective dependence and the inability to refrain from its use. L. Srivastava (2005) suggests the construct of “personalization” of mobile phones that make them subjectively indispensable, and their loss personally traumatic. She describes (e.g., Srivastava, 2005) changes in psychological needs when technologies obtain some additional meanings for the person (e.g., “to have an expensive mobile phone” means “to look decent”).

Compared to mobile phone use, which uses “real-life” communication to make a person’s image, the image-making function of the Internet occurs “through” the Internet. We can hypothesize that the preference for online image-making is sometimes due to problematic image-making offline, or due to the choice of an online image that is socially undesirable and could lead to poorer adjustment. Supporting this hypothesis is the fact that youth preference for online self-presentation is associated with a less stable sense of self (Fullwood et al., 2016), although longitudinally it could lead to better self-esteem (Yang & Brown, 2016). It could be that (both in youth and adults) by becoming the main sphere where person is able to create and share his preferred meaning with others, the Internet becomes a highly unique place, thus increasing the person’s vulnerability to Internet addiction.

In accordance with the psychological model of body function regulation in this study, we aimed to reveal relationships that are common for males and females and for different ages (e.g., not only youth). Although adjusting for age and gender didn’t change the whole pattern of results, it should be noted that our sampling strategy (resulting in prevalence of females and younger people) could potentially lead to poor representation of older people (55+). This group demands further study on special samples. We still believe that the results could be extended to people of both genders and to both youth and adults in their 30s to 50s, because these groups are represented in a volume that justifies their statistical control. Certainly —as in most

psychological research —it is still possible that people who agreed to participate in the study differ from those who refused.

In general, our data support the idea that experiences of controllability and indispensability could make an important contribution to explaining technology use and technology-related adaptation.

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