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Computer Playfulness, Personal Innovativeness, and Problematic Technology Use: A New Measure and Some Initial Evidence

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COMPUTER PLAYFULNESS, PERSONAL INNOVATIVENESS, AND PROBLEMATIC TECHNOLOGY USE: A NEW MEASURE AND SOME INITIAL EVIDENCE

Enjouement, innovativité personnelle et utilisation problématique des technologies: une nouvelle mesure et de premiers résultats

Research-in-Progress

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Abstract

Considerable research in the technology adoption and use literature has focused on two user traits, i.e., computer playfulness and personal innovativeness with IT, and how they lead to various positive adoption and usage outcomes. However, little work to date has empirically investigated the possibility that these traits may also lead to undesirable usage outcomes. Building on recent psychology research on problematic technology use, this study fills this gap in the literature by testing these relationships with two samples.

Data from 267 undergraduate students indicated that these user traits are indeed associated with problematic use, manifested as pathological dependency on technology (dependency) and procrastination and avoidance of social and occupational responsibilities (distraction). Preliminary results from a sample of 184 working adults are consistent with findings from the student sample. Implications of these findings are discussed.

Keywords: Computer playfulness, personal innovativeness, problematic technology use, Internet addiction, technology adoption, technology use

Résumé

Cette étude complète les recherches précédentes montrant l'effet favorable de deux traits des utilisateurs de technologie : l'enjouement et l'innovativité personnelle en informatique. Les résultats d'un échantillon de 184 adultes actifs indiquent que ces deux traits peuvent devenir problématiques lorsque l'utilisation de la technologie se manifeste par la dépendance pathologique, la procrastination et le manque de responsabilités.

Introduction

Much IT research on technology user trait has been conducted in the context of technology adoption and use, where personal innovativeness with IT (Agarwal and Prasad 1998) and computer playfulness (Martochhio and Webster 1992) are probably the two traits that have received the most attention. Research to date has investigated how these two traits lead to various positive adoption and usage outcomes, such as behavioral intentions to use technology

(Agarwal and Karahanna 2000; Webster and Ahuja 2006), improved learning in software training (Martochhio and Webster 1992), and increased satisfaction and decision performance (Hess, Fuller and Mathew 2006). Little IS research to date has empirically investigated the possibility that these traits may also lead to undesirable usage behaviors and user outcomes.

In contrast, recent research in psychology on the same technologies (e.g., personal computer, the World Wide Web) has linked various user traits with varying types and degrees of problematic psychological states and behaviors exhibited by technology users (e.g., Chou, Condron and Belland 2005; Davis 2001; Shotton 1989; Yellowlees and Marks 2007; Young 1996). More recent work has conceptualized the *problematic technology use* construct (Davis 2001; Davis, Flett and Besser 2002).

This exploratory study integrates these two disparate streams of research and seeks to fill the gap in the IS literature by investigating whether the two frequently investigated user traits in the IT literature, personal innovativeness and computer playfulness, are also associated with problematic use. Results of this research will be useful for IT user management and help us achieve a more complete understanding of both favorable and unfavorable consequences of technology usage for users. This knowledge may also have policy implications for management as well as the IT department as technology providers. This in-progress research employs a two-sample design to test these relationships with both undergraduate students and working adults.

The rest of the paper is organized as follows. We first introduce the IS literature on personal innovativeness and computer playfulness, discuss the recent psychology research on problematic technology use, and then develop hypotheses. Next, we present our findings from the student sample and the employee data collected so far. The paper concludes with a discussion of contributions and implications for research and practice.

Personal innovativeness and computer playfulness

Most trait research in IS has been conducted in the context of technology adoption and use, where the primary focus has been on two IT-specific traits: personal innovativeness and computer playfulness.

Personal innovativeness with IT is a trait that reflects an intrinsic willingness to try out new technologies (Agarwal and Prasad 1998). *Computer playfulness*, as a trait, refers to the degree of cognitive spontaneity in microcomputer interactions (Webster and Martochhio 1992, p. 204). As discussed in the Introduction, these two technology user traits have been linked with a variety of user attitudes, beliefs and intentions related to technology adoption and use (e.g., Agarwal and Prasad 1998; Hess, Fuller and Mathew 2006; Leonard-Barton and Deschamps 1988; Lewis, Agarwal and Sambamurthy 2003; Limayem and Khalifa 2000; Srite, Galvin, Ahuja and Karahanna 2007; Thatcher and Perrewé 2002; Venkatesh 2000; Webster and Ahuja 2006; Webster and Martochhio 1992; Yi, Fiedler and Park 2006).

Another frequently studied individual characteristic is computer self-efficacy (e.g., Compeau and Higgins 1995), which refers to an individual's *perception* (or *belief*) of his/her own ability to perform the behavior (Bandura 1977). Because self-efficacy is perceptual in nature and is not a stable trait, it is not examined in this study.

In light of the favorable outcomes resulting from these user traits, some authors have suggested the possibility of their potentially negative consequences as well (e.g., longer time to task completion, Sandelands 1988, Starbuck and Webster 1991; and non-productive play, Webster and Martochhio 1992). However, little empirical IS research has explored such possibilities. In the next paragraphs, we introduce the psychological research on problematic technology use and see how their findings may inform our understanding in this phenomenon.

Problematic Technology Use

During the past two decades, psychology research has documented varying types and degrees of dysfunctional use of technologies, such as video games (e.g., Keepers 1990), amusement machines (e.g., Griffiths 1992), personal computers (e.g., Shotton 1989), and the Internet (e.g., Young 1996). Problematic use can be manifested in various ways, including intense preoccupation with technology use (Chou 2001; Treuer, Fabian and Furedi 2001), poor impulse control (Beard and Wolf 2001; Treuer et al. 2001), excessive amounts of usage time, compulsive use, increased anxiety if use is restricted, decreased social interaction with ‘‘real’’ people, and increased post-usage loneliness, depression and guilt (Chou et al. 2005; Kraut et al. 1998; Nalwa and Anand 2003; Whang, Lee and

Chang 2003). A variety of psychological and occupational consequences, such as neglect of academic, work, and domestic responsibilities and disruption of social relationships, have been documented (e.g., Brenner 1997; Davis et al. 2002; Kraut et al. 1998; Shotten 1989; Young 1996; Widyanto and McMurran 2004).

Psychologists have characterized the more severe cases of problematic technology use as computer dependency, computer addiction (e.g., Shotten 1989), Internet addiction (e.g., Young 1996), Internet dependency (e.g., Scherer 1997), and problematic Internet use (e.g., Davis 2001, Davis et al. 2002).

Despite the continued debate regarding how the phenomenon of excessive technology use should be labeled and the extent of the phenomenon, there is a general agreement in the psychology literature over the nature of the phenomenon itself, and a preliminary measurement instrument has been developed (Chou et al. 2005; Davis et al. 2002).

In the context of Internet use, Davis (2001) conceptualized *problematic technology use* as behaviors and cognitions associated with technology use that result in negative personal and professional consequences for the user. The construct has the following four dimensions (Davis et al. 2002):

- Diminished Impulse Control (i.e., compulsive technology use)
- Loneliness/Depression (i.e., negative affective consequences of not using technology)
- Social Comfort (i.e., perceived social comfort during technology usage)
- Distraction (i.e., procrastination and avoidance from social and occupational responsibilities through technology use)

It has been noted that problematic use may result when some psychological factor causes an individual to be vulnerable to dependence on technology use (Davis 2001). Research so far has studied a number of such factors, from broad traits such as the Big Five personality factors (Landers and Lousbury 2006) to narrow traits such as work ethics (Landers and Lousbury 2006) and need for cognition (Amichai-Hamburger et al. 2007). However, with the exception of one study which associated playfulness with excessive play of online games (Chou and Ting 2003), IS-specific traits, such as personal innovativeness and computer playfulness, have not been investigated. We explore these relationships in this study:

H1: Computer playfulness is positively related to problematic technology use.

H2: Personal innovativeness is positively related to problematic technology use.

To investigate these relationships, we employed a two-sample design, where we first validated the preliminary measure of problematic Internet use (Davis et al. 2002) and test the hypotheses with a student sample, and then investigated these relationships with data from a sample of working adults to establish generalizability. In keeping with Agarwal and Karahanna (2000), the target technology chosen in this study was the World Wide Web. Results from these two samples are discussed in turn.

Study 1: Student sample

Instrument refinement

Davis et al. (2002) proposed a four-factor, 36-item measurement instrument for the problematic Internet use construct and presented the following factor correlations (Table 1).

Table 1: Factor correlation matrix from Davis et al. (2002)

		LD	DIC	SC	DIS
1	Loneliness/Depression	1			
2	Diminished Impulse Control	**.71**	1		
3	Social Comfort	**.70**	**.76**	1	
4	Distraction	.59	.66	.58	1

In view of the high inter-correlations amongst the first three factors (ranging from .70 to .76), there clearly exists significant overlaps amongst the three latent constructs, and thus a lack of discriminant validity, because as factor correlations approach 0.71 (thus, less than 50% of variance is shared), discriminant validity becomes problematic (MacKenzie, Podsakoff and Jarvis 2005). In fact, these three factors likely tap the same underlying latent construct. Therefore, this instrument needed to be further refined to demonstrate satisfactory psychometric properties.

To refine this measure, we first administered the original 36-item instrument to a small sample of 25 undergraduate students. Inter-item correlations of the first three factors in this sample all exceeded 0.75. Thus, they were combined into one dimension which we call Dependency, and the fourth dimension, Distraction, was retained. Items were eliminated to reduce redundancy based on the correlation matrix, resulting in a parsimonious 10-item instrument in two scales in Table 2.

Table 2. The refined measurement instrument for problematic Internet use

Dependency	DIC02	When I am on the Internet, I often feel a kind of "rush" or emotional high.
	DIC04	People complain that I use the Internet too much.
	DIC06	When I am not online, I often think about the Internet.
	LD02	I am less lonely when I am online.
	LD05	I feel helpless when I don't have access to the Internet.
	SC01	I am most comfortable online.
	SC11	The Internet is more "real" than real life.
Distraction	DIS03	I find that I go online more when I have something else I am supposed to do.
	DIS06	I often use the Internet to avoid doing unpleasant things.
	DIS07	Using the Internet is a way to forget about the things I must do but don't really want to do.

The refined PIU scales were then distributed to 288 students in a junior-level undergraduate business class at a public university, who were invited to participate for extra course credit. A total of 267 students returned useable responses, forming the sample for confirmatory factor analysis (CFA).

Goodness-of-fit tests of alternative models. LISREL 8.80 was used to evaluate the goodness-of-fit of the three alternative models (Models 1-3 in Figure 1a – 1c) in relation to the hypothesized two-factor PIU model (Model 4 in Figure 1d).

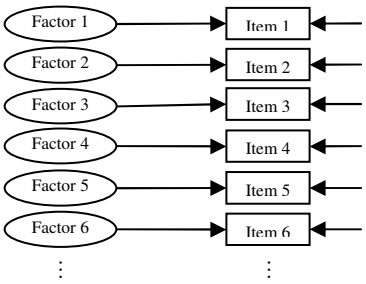

Figure 1 a. Model 1: Null

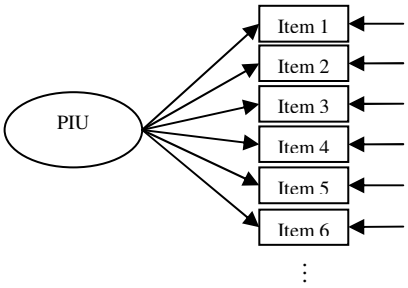

Figure 1b. Model 2: One first-order

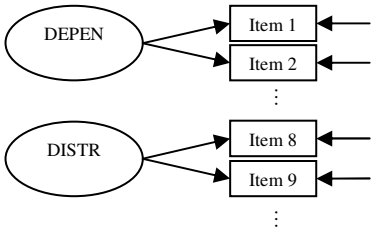

Figure 1c. Model 3: Uncorrelated two factors

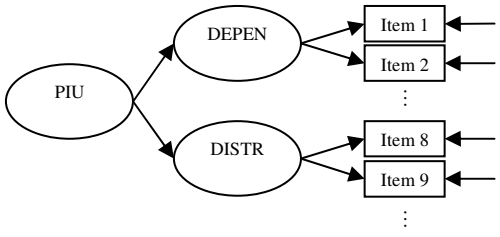

Figure 1d. Model 4: Second-order Model

As shown in Table 3, only the hypothesized model (Model 4 in Figure 1d) demonstrated satisfactory fit, with its fit indices more favorable than all thresholds. Figure 2 shows the estimates of all parameters in this model. Based on the above test of alternative models, it was concluded that the hypothesized two-factor model best represents the PIU construct.

Table 3. Goodness-of-fit Tests of Alternative Models (*n* = 267)

Criteria	Threshold	Model 1 Null	Model 2 One first-order factor	Model 3 Two uncorrelated first-order factors	Model 4 Second-order Model
χ^2		1624.43	178.94	134.60	78.03
d.f.		35	35	35	33
χ^2/d.f.	(< 2.50)	46.41	5.11	3.85	2.36
RMSEA	(< 0.08)	0.41	0.12	0.10	0.07
CFI	(> 0.90)	0.47	0.92	0.93	0.97
NFI	(> 0.90)	0.46	0.90	0.91	0.95
GFI	(> 0.90)	0.45	0.88	0.91	0.94
AGFI	(> 0.80)	0.14	0.81	0.86	0.91

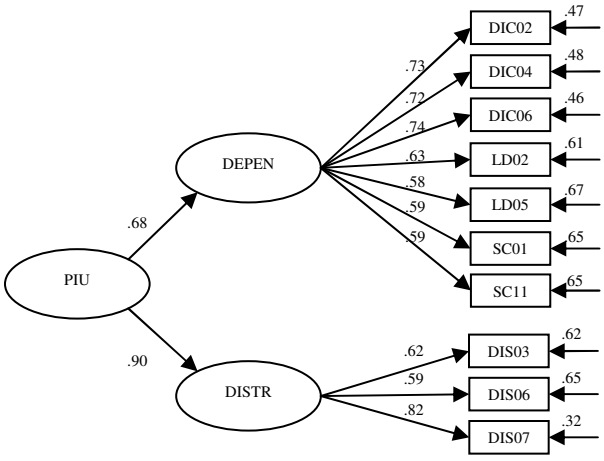

Figure 2. Parameter Estimates (Model 4, *n* = 267)

Convergent validity/unidimensionality was assessed through separate LISREL runs for the two PIU scales. Results in Table 4 indicate that though χ^2/d.f. and RMSEA values of the Dependency scale were higher than the recommended thresholds (in Table 3), all four fit indices (CFI, NFI, GFI, and AGFI) were more favorable than the thresholds. It was concluded that the general model fit was good, thus demonstrating convergent validity and unidimensionality.

Table 4. Unidimensionality/Convergent Validity (*n* = 267)

Factor	Number of indicators	χ^2	d.f.	χ^2/d.f.	RMSEA	CFI	NFI	GFI	AGFI
DEPEN	7	45.08	14	3.22	0.091	0.97	0.96	0.95	0.91
DISTR*	3	78.03	34	2.30	0.070	0.97	0.95	0.94	0.91

Note: * This model is saturated because of the number of indicators. Fit indices are thus not available. Fit indices presented here were calculated from a two-factor model including DEPEN and DISTR.

Discriminant validity was demonstrated in a pair of LISREL models, one with the two latent constructs allowed to freely covary (unconstrained model), and the other with their covariance constrained to one (constrained model). The unconstrained model ($\chi^2 = 78.03$) represents significantly better fit than the constrained model ($\chi^2 = 120.93$) in the χ^2 test ($\Delta\chi^2 = 42.90$, $p < 0.01$). In addition, the factor correlation between the two dimensions is 0.61, below the recommended upper limit of 0.71 (MacKenzie et al. 2005). Thus, the two PIU scales possess satisfactory discriminant validity.

Composite reliability (ρ_c) values are also satisfactory, with the Dependency scale at 0.840, the Distraction scale at 0.728, and the overall instrument at 0.867. Having shown satisfactory reliability, convergent validity/unidimensionality and discriminant validity from the refined PIU instrument, the two hypotheses were tested next.

Hypothesis testing

Descriptive statistics, scale reliability and correlation matrix are shown in Table 5. Separate hierarchical regression equations were estimated for the two user traits, with gender as a control variable. Because all participants were students in the same junior-level class and of approximately the same age, age was not controlled. Regression results in Table 6 show that,

a) Males are more likely to exhibit problematic use,
b) Playful users are more likely to exhibit problematic use (supporting H1), and
c) Personally innovative users are more like to exhibit problematic use (supporting H2).

Table 5. Descriptive statistics, correlation matrix and scale reliability (*n* = 267)

	Mean	Std. Dev.	Reliability	PIU	CP	PI
PIU	3.21	1.04	.84	1		
CP	4.02	.97	.82	.465	1	
PI	4.25	1.19	.83	.216	.529	1

Table 6. Hierarchical regression results for problematic Internet use (Student sample *n* = 267)

		b	*t*	*Sig.*	ΔR^2	*Total* R^2		*b*	*t*	*Sig.*	ΔR^2	*Total* R^2
1	Gender	.296	2.21	.028	.018	.018	Gender	.296	2.21	.028	.018	.018
2	Gender	.024	.18	.860			Gender	-.065	-.514	.607		
	PI	.252	5.01	.000	.087	.105	CP	.511	8.25	.000	.202	.220

Study 2: Employee sample (in progress)

An anonymous online survey was used to collect data from a diverse sample of working adults. Because it concerns problematic Internet use, collecting data through an employer-sanctioned survey is likely to have social desirability bias as employees may be reluctant to answer truthfully or be unwilling to participate. Therefore, we recruited participants through *StudyResponse*, a nonprofit online research facilitator at Syracuse University, which maintains a large pool of research participants (over 95,000 individuals as of August 2005). *StudyResponse* forwarded our email invitation with a link to the online survey to 1,000 working adults randomly selected from the participant pool. To encourage participation, the respondents were entered into a random drawing to receive gift certificates from an online merchant.

Measurement scales used in the online survey were the same as those in the student sample: Webster and Martochhio's (1992) 7-item playfulness scale, Agarwal and Prasad's (1998) 4-item measure for personal innovativeness, and the 10-item PIU instrument. All the above were measured by 7-point Likert-type scales from "Strongly Disagree" to "Strongly Agree."

Preliminary Results

Data collection is currently ongoing. We have so far received useable responses from 184 working adults, including 86 males (47%) and 98 females (53%). After sending out a reminder email to participants, we expect to receive another wave of responses, and hope to report full results at ICIS. The following preliminary results are reported in the meantime based on the 184 responses received so far.

Before testing the hypotheses, it was first made sure that the refined PIU instrument remains robust for the employee sample. CFA results in Table 7 show that though χ^2/d.f. and RMSEA values are slightly higher than the recommended thresholds, all fit indices (CFI, NFI, GFI, and AGFI) meet the thresholds. It was therefore concluded that the PIU instrument is robust across student and employee samples.

Table 7. Confirmatory factor analysis for the employee sample (*n* = 184)

Factor	χ^2	d.f.	χ^2/d.f.	RMSEA	CFI	NFI	GFI	AGFI
PIU	89.42	33	2.71	0.097	0.97	0.96	0.91	0.85

Descriptive statistics, scale reliability and correlation matrix are shown in Table 8. Separate hierarchical regression equations were estimated for the two hypotheses. Regression results in Table 9 are consistent with the findings from the student sample:

a) Internet users who are male and young are more likely to exhibit problematic use,
b) Playful technology users are more likely to exhibit problematic use (supporting H1), and
c) Personally innovative technology users are more like to exhibit problematic use (supporting H2).

Table 8. Descriptive statistics, correlation matrix and scale reliability (*n* = 184)

	Mean	Std. Dev.	Reliability	PIU	CP	PI
PIU	3.25	1.40	.91	1		
CP	4.68	1.30	.94	.296	1	
PI	4.25	1.60	.90	.382	.596	1

Table 9. Hierarchical regression results for problematic Internet use (*n* = 184)

		b	*t*	*Sig.*	ΔR^2	*Total* R^2		*b*	*t*	*Sig.*	ΔR^2	*Total* R^2
1	Gender	-.511	-2.60	.010			Gender	-.511	-2.60	.010		
	Age	-.192	-3.98	.000	.115	.115	Age	-.192	-3.98	.000	.115	.115
2	Gender	-.353	-1.89	.061			Gender	-.426	-2.25	.026		
	Age	-.170	-3.73	.000			Age	-.192	-4.14	.000		
	PI	2.94	5.00	.000	.108	.223	CP	.300	4.12	.000	.076	.191

SUMMARY AND CONTRIBUTIONS

Complementing prior work on favorable implications of personal innovativeness and computer playfulness, this research is among the first empirical IS studies to investigate the possibility that these traits can also lead to undesirable outcomes.

This study refined and validated a problematic technology use instrument in the context of Internet use, consisting of two dimensions: dependency and distraction. Using data from 267 undergraduate students, we found support for the hypotheses that personally innovative and playful technology users are more likely to exhibit problematic use. A follow-up study with a sample of working adults is currently ongoing. Preliminary results from 184 early respondents are consistent with the findings from the student sample that while these user traits can lead to many

positive outcomes as established in the prior IS literature, they are indeed also associated with problematic use. However, it should be noted that while some individuals may seek to procrastinate or avoid responsibilities through technology use, many others may use technology for relaxation or as a stress buster, which will not be unhealthy.

As IS researchers continue to assess benefits of these user traits, more attention should be given to their potentially negative consequences. Such knowledge is essential as we strive to achieve a thorough understanding of this phenomenon. We hope that our initial attempt at filling the gap in this literature stimulates more work in this area.

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