The Psychological Record, 2010, 60, 273–286

INTERNET ADDICTION AND DELAY DISCOUNTING IN COLLEGE STUDENTS

Bryan K. Saville, Amanda Gisbert, Jason Kopp, and Carolyn Telesco

James Madison University

To examine the relation between Internet addiction and delay discounting, we gave 276 college students a survey designed to measure Internet addiction and a paper-based delay-discounting task. In our larger sample, we identified 14 students who met the criteria for Internet addiction; we also identified 14 matched controls who were similar to the Internet-addicted students in terms of gender, age, and grade point average. We then compared the extent to which these groups discounted delayed rewards. We found that Internet addicts discounted delayed rewards faster than non-Internet addicts. These results suggest that Internet addicts may be more impulsive than non-Internet addicts and that Internet addiction may share behavioral characteristics with other types of addiction.

Key words: Internet, addiction, delay discounting, college students

In recent years, the use of the Internet has skyrocketed. For example, whereas less than one half of Americans used the Internet in 2002, a recent Pew Internet and American Life Project study (Fellows, 2008) found that an estimated two thirds of Americans now consistently use the Internet to engage in various online activities such as checking e-mail, sending instant messages, blogging, playing online games, purchasing goods, storing data, and participating in online gambling. In addition, access to the Internet has become easier than ever. Fifty-five percent of Americans, for instance, have high-speed Internet access in their homes, and the percentage of college students who have access to high-speed Internet connections is presumably even higher (e.g., Davis, Smith, Rodrigue, & Pulvers, 1999). With such easy access to the Internet and its many reinforcing activities, some researchers have expressed concern over the possibility of the Internet acquiring the same addictive properties as alcohol, drugs, and gambling (e.g., Block, 2008; Young, 2004).

Although researchers have discussed computer and technology addictions for nearly two decades (Shotton, 1989, 1991), the study of Internet addiction is relatively new. As a result, there is still much debate regarding the potential addictive properties of the Internet and whether excessive Internet use constitutes an addiction at all (e.g., Fitzpatrick, 2008; Young, 2004). Some researchers have suggested that the term "addiction" should be

Correspondence concerning this article should be addressed to Bryan K. Saville, Department of Psychology, MSC 7704, James Madison University, Harrisonburg, VA 22807. E-mail: savillbk@jmu.edu

saved only for disorders that involve the ingestion of a drug (e.g., Rachlin, 1990). Others, though, have argued that activities such as gambling, sexual activity, overeating, watching television, and using the Internet can severely interfere with daily activities and thus be just as addictive as excessive drug use (e.g., Griffiths, 1990; Keepers, 1990; Lesieur & Blume, 1993). In fact, Young (2004) suggested that Internet addiction is largely similar to pathological gambling in that both seem to be addictive in nature but do not entail the ingestion of a drug. To this end, Young (2004) developed the Internet Addiction Test (IAT; see Table 1), an eight-item survey designed to identify Internet addicts. Young modeled the IAT after the DSM-IV criteria for pathological gambling and suggested that people are addicted to the Internet if they respond affirmatively to five or more test items. Because Internet addiction is similar in many respects to pathological gambling, there is debate regarding whether the next edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-V) should contain a diagnosis for Internet addiction (e.g., Block, 2008). Even in the face of such debate, though, there is growing agreement that excessive Internet use shares some key features with other behavior patterns that are regarded as addictive (Goldsmith & Shapira, 2006; Treuer, Fabian, & Furedi, 2001; Yellowlees & Marks, 2007).

Table 1
Questions on the Internet Addiction Test (IAT)

1. Do you feel preoccupied with the Internet (i.e., think about your previous online activity or anticipate your next online session)?
2. Do you feel the need to use the Internet with increasing amounts of time to achieve satisfaction?
3. Have you repeatedly made unsuccessful efforts to control, cut back, or stop Internet use?
4. Do you feel restless, moody, depressed, or irritable when attempting to cut down or stop Internet use?
5. Do you stay online longer than originally intended?
6. Have you jeopardized or risked the loss of a significant relationship, job, educational career, or opportunity because of the Internet?
7. Have you lied to family members, therapists, or others to conceal the extent of your Internet use?
8. Do you use the Internet as a way of escaping from problems or feelings of helplessness, guilt, anxiety, or depression?

One hallmark of addictive behavior is the tendency toward impulsivity, or the inability to delay gratification even when doing so may produce more positive long-term outcomes. For example, alcoholics may choose to drink and heroin users may choose to shoot up even though doing so may come at the expense of sobriety later on. Similarly, a smoker might choose to smoke a cigarette, knowing full well that cigarette use might increase his chances of getting emphysema or even lung cancer in the future. A pathological gambler might likewise choose to spend his money on gambling even though enduring financial distress may be the result. Casual observation suggests that a similar problem might be present with excessive Internet use. When individuals spend considerable amounts of time engaging in immediately gratifying Internet activities, they may have less time to invest in social

relationships, vocational advancement, and other activities that presumably yield larger but more delayed benefits.

Numerous studies have shown that addicts tend to be more impulsive than nonaddicts (see Acton, 2003; Bickel & Marsch, 2001; Iacono, Malone, & McGue, 2008; Monterosso & Ainslie, 2007; Olmstead, 2006; Verdejo-Garcia, Lawrence, & Clark, 2008). In much the same way that impulsivity seems characteristic of other types of addiction, a small number of studies suggest that impulsive behavior might also be characteristic of individuals who use the Internet to excess. For example, Cao, Su, Liu, and Gao (2007) found that young adults who met the criteria for Internet addiction had significantly higher scores on the Barratt Impulsiveness Scale-11 (BIS-11) than a group of matched controls. In another study, Kim, Namkoong, Ku, and Kim (2008) observed that Internet-addicted high school students tended to score lower on a measure of self-control and had a harder time inhibiting their responses on a GoStop impulsivity task than matched controls.

Although the preceding studies suggest that Internet addiction seems to entail impulsive tendencies, additional research is needed to elucidate the relation between Internet addiction and impulsivity. According to one well-known conceptual framework (Ainslie, 1975; Logue, 1988; Mischel & Ebbeson, 1970; Rachlin, 2000; Skinner, 1953), impulsivity occurs when an organism chooses a smaller, sooner reward over a larger, later reward; conversely, self-control occurs when an organism chooses the larger, later reward. Several researchers have suggested that delay discounting, or the subjective devaluation of a reward that occurs when its receipt is delayed in time, may be one mechanism that underlies impulsive behavior (see Bickel & Marsch, 2001; Critchfield & Kollins, 2001; Green & Myerson, 2004; Logue, 1988).

Numerous researchers have found that the following hyperbolic function, first proposed by Mazur (1987), typically fits the data well in studies on delay discounting: $V = A/(1 + kD)$. In this equation, V refers to the discounted, or subjective, value of a delayed reward; A refers to the actual value of a reward; D refers to the delay to a reward; and k is an empirically derived constant that indicates the rate at which a reward loses subjective value as a function of delay. Larger k values represent greater discounting, meaning that a delayed reward loses subjective value more quickly over time. The faster a delayed reward loses subjective value, the faster an individual will choose a smaller, sooner reward over a larger, later reward. As such, researchers have used these derived k values as an index of impulsivity.

For some time, researchers have effectively used delay-discounting tasks, a behavioral measure of impulsivity, to study different types of excessive and addictive behavior. For example, Madden, Petry, Badger, and Bickel (1997) studied delay discounting in opioid-dependent individuals and matched controls. They found that individuals addicted to opioids discounted delayed rewards significantly faster than nonaddicts. Vuchinich and Simpson (1998) found that college students who were heavy and problem drinkers discounted delayed rewards faster than light drinkers. Similarly, Bickel, Odum, and Madden (1999) compared current smokers, ex-smokers, and never-smokers and observed that current smokers tended to discount delayed rewards faster than ex-smokers and never-smokers. Together, these results suggest that heavy drug users may be more impulsive than nonusers.

Researchers have also studied other types of addiction using delay-discounting tasks. Dixon, Marley, and Jacobs (2003) studied delay

discounting in pathological gamblers and found them to be more impulsive than matched controls. Dixon, Jacobs, and Sanders (2006) subsequently observed that delay discounting by pathological gamblers was context dependent: Gamblers discounted delayed rewards faster in a casino than when they completed the same discounting task outside a casino. These studies suggest that pathological gamblers may be impulsive in much the same way as substance abusers.

Ultimately, if Internet addiction is similar to pathological gambling, as Young (2004) suggested, and because pathological gamblers seem to be more impulsive than nongamblers (Dixon et al., 2003), then Internet addicts should be more impulsive than non-Internet-addicted individuals. As mentioned earlier, some researchers (Cao et al., 2007; Kim et al., 2008) have already reported such a relation. To the best of our knowledge, though, no studies have examined Internet addiction using delay-discounting tasks. Because delay-discounting tasks seem to measure different aspects of impulsivity than other more traditional measures of impulsivity (e.g., the BIS-11; see, e.g., Mitchell, 1999; Vuchinich & Simpson, 1998), and because delay-discounting tasks have been used effectively to learn about other types of addiction (e.g., Dixon et al., 2003; Madden et al., 1997), studying Internet addiction via delay discounting may prove fruitful. The purpose of the present study, therefore, was to examine delay discounting in Internet-addicted and non-Internet-addicted college students.

Method

Two hundred seventy-six undergraduate students from several introductory psychology courses at James Madison University signed up for a study on decision making through the Department of Psychology participation pool. In exchange for their participation, students received partial course credit.

Groups of 6 students reported to a laboratory where each sat at a separate small table. Each student received a packet that contained the eight-item IAT, seven demographic questions (e.g., age, gender, grade point average), and a delay-discounting task (see below). The IAT contains items similar to those listed in the DSM-IV for pathological gambling and identifies respondents as Internet addicted when they answer yes to five or more of the eight survey questions (Young, 2004). Previous studies have shown the IAT to be a valid and reliable measure of Internet addiction (e.g., Widyanto & McMurran, 2004).

After completing the IAT and the demographic questions, and prior to completing the delay-discounting task, which made up the remainder of the packet, students read the following instructions printed at the bottom of the first page:

> On the next few pages, you will be asked to make a series of choices between two hypothetical amounts of money. One amount could be obtained immediately; the other amount would be available after a certain period of time. For example, you might be asked to choose between:
>
> $70 now or $200 in 2 weeks

> There are no right or wrong answers. We are simply interested in the option you prefer, so please make your choices as honestly and accurately as possible. Do not rush through this survey, randomly choose your answers, or flip back and forth between sheets.

The delay-discounting task, based on Rachlin, Raineri, and Cross's (1991) original methodology, required students to make a series of choices between hypothetical monetary rewards. Specifically, on each page of the delay-discounting task, students made 20 choices between smaller, immediate rewards and larger, delayed rewards. The smaller rewards, which were listed in ascending order in the left column on each page, consisted of the following dollar amounts available immediately: 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 140, 150, 160, 170, 180, 190, 198, and 199; the larger rewards, which were in the right column, consisted of $200 available after some delay. There were five delay values—1 week, 1 month, 6 months, 1 year, and 3 years—each of which was on a separate page of the survey. In total, students made 100 choices between a smaller, immediate reward and a larger, delayed reward (e.g., $100 now or $200 in 1 month).

Data collection continued until 15 students (13 women, 2 men) had answered yes to five or more questions on the IAT. Then, every student in our sample who answered yes to no more than one question on the IAT (n = 84) was identified. This criterion for non-Internet addicts was chosen because we specifically wanted to compare Internet-addicted students with students who reported the fewest problems related to Internet use. Holt, Green, and Myerson (2003) used similar criteria when studying delay discounting in problem gamblers, a group that, as mentioned previously, is similar in many respects to Internet addicts (Young, 2004). Using a three-step process, we then identified 15 matched-control students, chosen from our subsample of 84 non-Internet addicts, who were most similar to the Internet-addicted students on the variables of gender, age, and grade point average. Specifically, for each Internet addict, we first identified every non-Internet-addicted student who was of the same gender. From those students who remained, we then identified the ones who were of similar age to the Internet-addicted student; because there was variability in the students' ages, which at times made perfect matching difficult, we allowed the members of two pairs to differ in age by 1 year. Finally, of those non-Internet addicts who remained after matching on the variables of gender and age, we chose the student who most closely matched the Internet addict on grade point average; once again, because there was considerable variability in this measure, we allowed members of a pair to differ on grade point average by up to .20 points. The non-Internet-addicted students who were not paired with an Internet addict each time around were returned to the subsample for reconsideration.

Once Internet addicts were matched with non-Internet addicts, we analyzed how each student responded on the delay-discounting task. In delay-discounting research, it is fairly common to find a subset of respondents whose choices cannot be analyzed using conventional analyses because the data suggest lack of attention during the task or because response patterns do not approximate the negatively decelerating curve that common discounting models assume. Johnson and Bickel (2008) provided a two-step algorithm for

identifying nonsystematic delay-discounting data. First, they suggested that any indifference point should not be greater than the preceding indifference point by more than 20% of the value of the larger, delayed reward; this criterion allows for some variability in a data set that is otherwise consistent with well-known hyperbolic decay models of delay discounting. Second, because a large body of research suggests that delay devalues a reward, the final indifference point should be smaller than the first indifference point by at least 10% of the magnitude of the larger, delayed reward. Because our discounting task included a maximum delayed reward of $200, this included data sets in which (a) each indifference point was no more than $40 greater than the preceding indifference point and (b) the final indifference point was $180 or less. Using these criteria, 1 Internet-addicted participant (and consequently her matched control) whose delay-discounting data were nonsystematic in nature was removed. This left 14 (12 women, 2 men) students in the Internet-addiction group and 14 students in the non-Internet-addiction group (see Table 2 for demographic data from each group). The following analyses are thus based on data from these 28 students and do not include data from the remaining 248 students who initially completed our surveys.

Table 2
Demographic Information for Internet-Addicted and Non-Internet-Addicted Students

	Internet addicted	Non-Internet addicted
N	14	14
Gender		
Men	2	2
Women	12	12
Average age	19.21 (0.98)	19.07 (1.07)
Grade point average	3.26 (0.43)	3.21 (0.35)
Score on IAT (number of yes responses)	5.64 (0.93)	0.86 (0.36)

Results

To determine the extent to which our groups were similar on the matched demographic measures, two dependent-samples *t* tests were conducted. (Because we matched participants on gender, there was no need to run statistical analyses on this variable.) There were no significant differences between groups with regard to their average age, $t[13] = 1.47$, $p = .17$, or grade point average, $t[13] = 1.09$, $p = .30$. We also conducted a dependent-samples *t* test to determine whether Internet addicts and non-Internet addicts differed statistically on their IAT scores. The mean IAT score for the 14 Internet-addicted students was 5.64 ($SD = 0.93$), whereas the mean Internet addiction score for the 14 non-Internet-addicted students was 0.86 ($SD = 0.36$), a difference that was statistically significant, $t(13) = 17.04$, $p < .001$. Thus, individuals in the Internet-addicted group were more likely than individuals in the non-Internet-addicted group to report that they had recently experienced problems related to Internet use.

To determine whether there were differences in the extent to which

Internet-addicted and non-Internet-addicted students discounted delayed rewards, indifference points (i.e., the point at which a larger, delayed reward is subjectively equivalent to a smaller, immediate reward) were calculated using the method described by Rachlin et al. (1991). Figure 1 shows the median indifference points as a function of reward delay for both groups. In each case, the hyperbolic function fit the group data well (Internet addicted $R^2 = 0.99$, non-Internet addicted $R^2 = 0.97$). The hyperbolic function was also fit to the data for individual participants. Again, this function fit the data for the majority of participants in each group (see Table 3). In the Internet-addicted and non-Internet-addicted groups, the median R^2 values were 0.92 and 0.93, respectively. In addition, 10 of 14 Internet addicts and 9 of 14 non-Internet addicts had R^2 values that were 0.90 or greater. A Wilcoxon signed-ranks test showed that there was not a significant difference in R^2 values between the groups, $Z = -0.03$, $p = .98$.

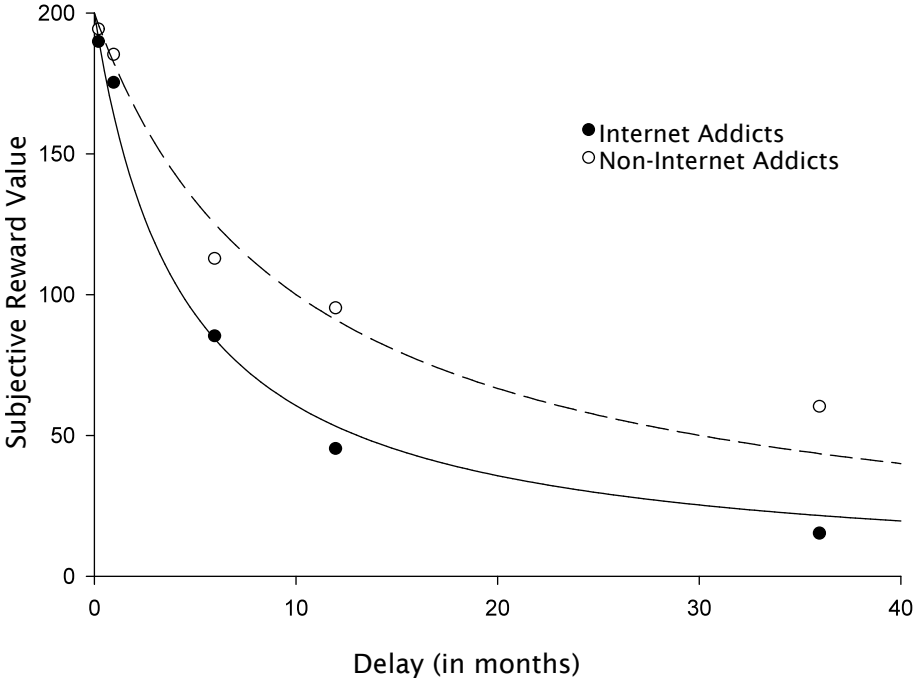

Figure 1. Subjective reward value as a function of delay for Internet addicts (closed circles) and non-Internet addicts (open circles). The data points represent group medians, and the curves represent the best-fitting hyperbolic functions.

Visual analysis of the indifference points in Figure 1 suggests that Internet addicts discounted delayed rewards faster than non-Internet addicts. To examine this possibility further, two methods of statistical analysis were used. First, the hyperbolic function was fit to the indifference points for each participant, resulting in a derived discounting parameter (k). Because the derived k values were not normally distributed for either group, a Wilcoxon signed-ranks test was used to compare the k values for Internet addicts and non-Internet addicts. In 12 of 14 cases, the derived k value for

Internet addicts was larger than the derived *k* value for non-Internet addicts, a difference that approached, but did not quite reach, traditional levels of significance, $Z = -1.73$, $p = .07$.

Table 3
The Derived k *Value, Percent Variance Accounted for by Equation 1* (R^2)*, and Area Under the Curve (AUC) for Students in the Internet-Addicted (IA) and Non-Internet-Addicted (NIA) Groups.*

	k	R^2	AUC
Internet addicted (IA)			
IA1	0.29	0.91	.08
IA2	0.28	0.92	.08
A3	0.49	0.96	.06
IA4	0.61	0.93	.20
IA5	0.34	0.42	.26
IA6	4.90	0.98	.04
IA7	1.13	0.96	.06
IA8	1.23	0.96	.04
IA9	0.66	0.92	.16
IA10	0.19	0.96	.26
IA11	0.05	0.87	.51
IA12	0.31	0.87	.18
IA13	0.11	0.94	.41
IA14	0.05	0.87	.55
Non-Internet addicted (NIA)			
NIA1	0.04	0.50	.63
NIA2	0.22	0.94	.26
NIA3	0.26	0.97	.24
NIA4	0.08	0.68	.51
NIA5	0.04	0.93	.60
NIA6	0.01	0.78	.86
NIA7	4.12	0.99	.04
NIA8	0.28	0.91	.16
NIA9	0.11	0.93	.41
NIA10	0.08	0.99	.40
NIA11	0.05	0.87	.53
NIA12	0.07	0.95	.46
NIA13	0.07	0.78	.48
NIA14	1.05	0.95	.11

Note. Participant IA1 was matched with participant NIA1, Participant IA2 was matched with Participant NIA2, Participant IA3 was matched with Participant NIA3, and so on.

Next, area under the discounting curve (AUC) was calculated for each individual (see Table 3). Myerson, Green, and Warusawitharana (2001) described several problems with using derived discounting parameters (k) for the purpose of comparing groups. Instead, they proposed AUC as an alternative approach to measuring the rates of discounting. AUC is a nontheoretical measure of discounting that calculates the actual area under the curve created by the indifference points at each delay. AUC values can range from 0.0 to 1.0, with smaller values indicating steeper discounting and larger values indicating less discounting. Because AUC values tend to be more normally distributed than k values, they can be analyzed using more powerful parametric statistics. Figure 2 shows the average AUC for the Internet-addicted and non-Internet-addicted groups. A dependent-samples t test showed that there was a significant difference between groups, $t(13) = -2.60$, $p = .02$. Specifically, the average AUC for the Internet-addicted group (.21) was smaller than the average AUC for the non-Internet-addicted group (.41). In other words, Internet addicts discounted delayed rewards faster than non-Internet addicts.

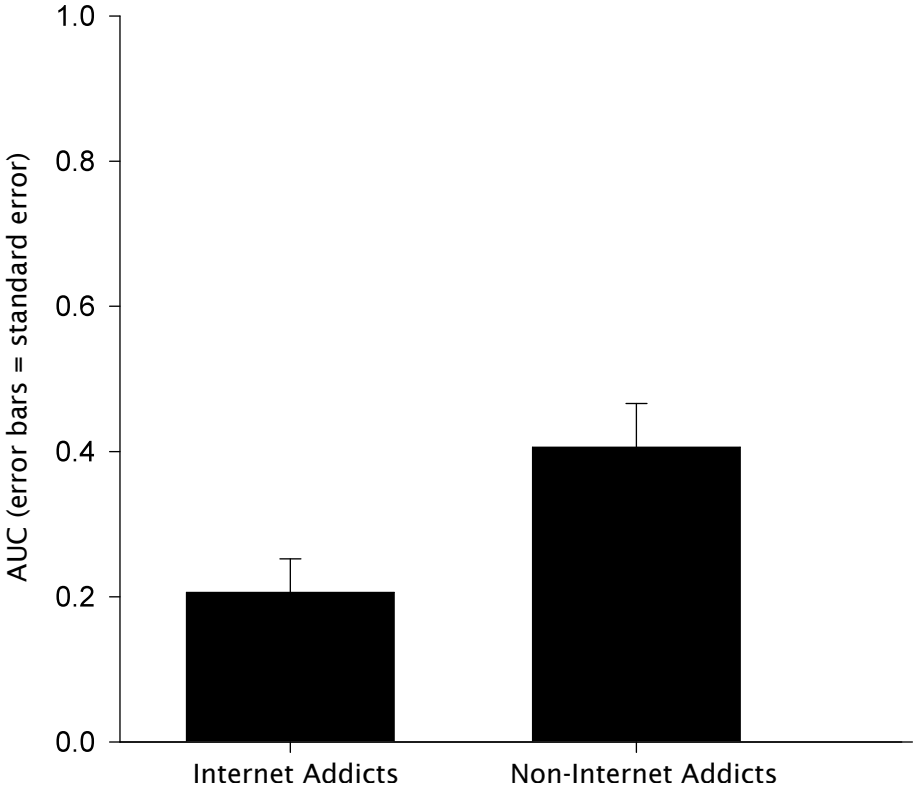

Figure 2. Mean area under the curve for Internet addicts and non-Internet addicts. The error bars represent one standard error of the mean.

Discussion

The purpose of the present study was to examine the relation between delay discounting and Internet addiction. College students completed the IAT, which measures Internet addiction (Young, 2004), and a paper-based delay-discounting task, which provides a behavioral measure of impulsivity. In sum, a group of 14 Internet-addicted students discounted delayed rewards faster, on average, than a group of 14 non-Internet-addicted controls.

The present study represents the first attempt to measure impulsivity in Internet-addicted individuals using a delay-discounting task. Our results are consistent with other studies that have examined the relation between impulsivity and Internet addiction. Cao et al. (2007), for example, found that young adults who were addicted to the Internet had higher scores on the BIS-11 than a group of non-Internet-addicted controls. Similarly, Kim et al. (2008) found that Internet-addicted high school students had lower scores on a self-control measure than matched controls; they also found that the Internet-addicted students had a harder time than non-Internet addicts inhibiting their responses on a behavioral GoStop task. Together, these results strengthen the argument that individuals who meet the criteria for Internet addiction may be more impulsive than non-Internet addicts. In addition, because the Internet addicts in the present study discounted delayed rewards faster than non-Internet addicts—just as other types of addicts tend to discount delayed rewards faster than nonaddicts (Dixon et al., 2003; Madden et al., 1997; Vuchinich & Simpson, 1998)—our results provide additional support for the assertion that excessive Internet use might constitute a valid type of addiction, on par with other types of addiction (Block, 2008; Young, 2004).

Although researchers have not previously used delay discounting to study Internet addiction, they have studied the relation between other types of addiction and impulsivity using delay-discounting tasks. In general, participants who meet the criteria for different types of addiction tend to discount delayed rewards faster than participants who are not addicted (e.g., Dixon et al., 2003; Madden et al., 1997; Vuchinich & Simpson, 1998). In much the same way, students in the present study who met the criteria for Internet addiction discounted delayed rewards faster than non-Internet-addicted students. Thus, it seems that one behavioral characteristic of addiction in general—regardless of whether or not the addiction involves the consumption of an addictive substance—might be the tendency to discount delayed rewards at a relatively fast rate. Together, these results also provide additional support for the notion that delay discounting may be one mechanism that underlies impulsive behavior.

Although we observed that Internet-addicted students discounted delayed rewards faster than non-Internet-addicted students, it is important to note that we did not screen our participants for the presence of co-occurring disorders or drug use. If, for example, Internet addicts are more likely than nonaddicts to use drugs of abuse (e.g., alcohol, heroin), gamble, or have sex addictions, then any tendency toward relatively rapid delay discounting may be a function of other addictions, in which the Internet is simply a medium for participating in certain other addictive activities (e.g., Shaw & Black, 2008; Widyanto & Griffiths, 2006). Future researchers may wish to examine this possibility more closely.

We also did not ask our participants how they were spending their time online. Consequently, we were unable to determine whether Internet addicts were gambling, blogging, chatting, or engaging in some other activity. In prior studies, researchers have found that individuals who gamble excessively tend to discount delayed rewards faster than those who do not (Dixon et al., 2003). Similarly, Lawyer (2008) found that some individuals who were "erotica" users discounted delayed rewards faster than individuals who did not use erotica. Thus, it is once again possible that the Internet addicts in this study may have discounted faster for reasons related to gambling or sexual activity more so than for general reasons related to excessive Internet use. Again, future researchers should examine how Internet-addicted individuals are spending their time online; doing so would help further elucidate those reasons why Internet addicts tend to discount delayed rewards faster than non-Internet addicts.

Finally, it is important to note that participants in this study were all college students, a population that may or may not be representative of the types of individuals who are most likely to become addicted to the Internet. Shaw and Black (2008) reviewed several studies on Internet addiction and found that the prevalence ranged from less than 1% in a sample of U.S. adults to nearly 40% in a sample of young Chinese adults; the median prevalence in these studies, however, fell between 3% and 5%. Although only a relatively small percentage of students (~5%) in the present study met the criteria for Internet addiction, the percentage is similar to most of the studies reviewed by Shaw and Black and very similar to those specific studies that examined Internet addiction in U.S. college students. In addition, most Internet addicts in the present study were women; in contrast, the majority of prior studies reviewed by Shaw and Black had more male Internet addicts. The discrepancy between our findings and those in previous research, however, may have been due to two factors: (a) Our participants came from a pool of psychology students, the majority of whom tend to be women; and (b) the college at which we collected our data has more female students than male students. Although some researchers have suggested that people who have easier access to the Internet are more likely to become addicted (e.g., Davis et al., 1999), additional research is nevertheless needed to determine what factors may cause individuals to become addicted to the Internet.

In sum, Internet-addicted college students in the present study were more impulsive, as measured by their responses on a delay-discounting task, than non-Internet-addicted college students. Additional research on the relation between impulsivity and Internet addiction may help identify the variables that lead to impulsive behavior in general, as well as the variables that lead to Internet addiction more specifically. In addition, the present results may be important for understanding the treatment of Internet addiction. Because Internet addiction seems to share characteristics with other types of impulse control disorders, treatments that have been effective in treating these disorders may also be useful in treating Internet addiction.

References

ACTON, G. S. (2003). Measurement of impulsivity in a hierarchical model of personality traits: Implications for substance use. *Substance Use & Misuse, 38,* 67–83.

AINSLIE, G. (1975). Specious reward: A behavioral theory of impulsiveness and impulse control. *Psychological Bulletin, 82,* 463–496.

BICKEL, W. K., & MARSCH, L. A. (2001). Toward a behavioral economic understanding of drug dependence: Delay discounting processes. *Addiction, 96,* 73–86.

BICKEL, W. K., ODUM, A. L., & MADDEN, G. J. (1999). Impulsivity and cigarette smoking: Delay discounting in current, never, and ex-smokers. *Psychopharmacology, 146,* 447–454.

BLOCK, J. J. (2008). Issues for DSM-V: Internet addiction. *American Journal of Psychiatry, 165,* 306–307.

CAO, F., SU, L., LIU, T., & GAO, X. (2007). The relationship between impulsivity and Internet addiction in a sample of Chinese adolescents. *European Psychiatry, 22,* 466–471.

CRITCHFIELD, T. S., & KOLLINS, S. H. (2001). Temporal discounting: Basic research and the analysis of socially important behavior. *Journal of Applied Behavior Analysis, 34,* 101–122.

DAVIS, S. F., SMITH, B., RODRIGUE, K., & PULVERS, K. (1999). An examination of Internet usage on two college campuses. *College Student Journal, 33,* 257–260.

DIXON, M. R., JACOBS, E. A., & SANDERS, S. (2006). Contextual control of delay discounting by pathological gamblers. *Journal of Applied Behavior Analysis, 39,* 413–422.

DIXON, M. R., MARLEY, J., & JACOBS, E. A. (2003). Delay discounting by pathological gamblers. *Journal of Applied Behavior Analysis, 36,* 449–458.

FELLOWS, D. (2008). Search engine use. Retrieved October 29, 2008, from http://www.pewinternet.org/pdfs/PIP_Search_Aug08.pdf

FITZPATRICK, J. J. (2008). Internet addiction: Recognition and interventions. *Archives of Psychiatric Nursing, 22,* 59–60.

GOLDSMITH, T. D., & SHAPIRA, N. A. (2006). Problematic Internet use. In E. Hollander & D. J. Stein (Eds.), *Clinical manual of impulse-control disorders* (pp. 291–308). Arlington, VA: American Psychiatric Publishing.

GREEN, L., & MYERSON, J. (2004). A discounting framework for choice with delayed and probabilistic rewards. *Psychological Bulletin, 130,* 769–792.

GRIFFITHS, M. (1990). The cognitive psychology of gambling. *Journal of Gambling Studies, 6,* 31–42.

HOLT, D. D., GREEN, L., & MYERSON, J. (2003). Is discounting impulsive? Evidence from temporal and probability discounting in gambling and non-gambling college students. *Behavioural Processes, 64,* 355–367.

IACONO, W. G., MALONE, S. M., & MCGUE, M. (2008). Behavioral disinhibition and the development of early-onset addiction: Common and specific influences. *Annual Review of Clinical Psychology, 4,* 325–348.

JOHNSON, M. W., & BICKEL, W. K. (2008). An algorithm for identifying nonsystematic delay-discounting data. *Experimental and Clinical Psychopharmacology, 16,* 264–274.

KEEPERS, G. A. (1990). Pathological preoccupation with video games. *Journal of the American Academy of Child and Adolescent Psychiatry, 29,* 49–50.

KIM, E. J., NAMKOONG, K., KU, T., & KIM, S. J. (2008). The relationship between online game addiction and aggression, self-control and narcissistic personality traits. *European Psychiatry, 23,* 212–218.

LAWYER, S. R. (2008). Probability and delay discounting of erotic stimuli. *Behavioural Processes, 79,* 36–42.

LESIEUR, H. R., & BLUME, S. B. (1993). Pathological gambling, eating disorders, and the psychoactive substance use disorders. *Comorbidity of Addictive and Psychiatric Disorders, 9,* 89–102.

LOGUE, A. W. (1988). Research on self-control: An integrating framework. *Behavioral and Brain Sciences, 11,* 665–679.

MADDEN, G. J., PETRY, N. M., BADGER, G. J., & BICKEL, W. K. (1997). Impulsive and self-control choices in opioid-dependent patients and non-drug-using control participants: Drug and monetary rewards. *Experimental and Clinical Psychopharmacology, 5,* 256–262.

MAZUR, J. E. (1987). An adjusting procedure for studying delayed reinforcement. In M. L. Commons, J. E. Mazur, J. A. Nevin, & H. Rachlin (Eds.), *Quantitative analyses of behavior: Vol. 5. The effect of delay and of intervening events on reinforcement value* (pp. 55–73). Hillsdale, NJ: Erlbaum.

MISCHEL, W., & EBBESON, E. B. (1970). Attention in delay of gratification. *Journal of Personality and Social Psychology, 16,* 239–337.

MITCHELL, S. H. (1999). Measures of impulsivity in cigarette smokers and non-smokers. *Psychopharmacology, 146,* 455–464.

MONTEROSSO, J., & AINSLIE, G. (2007). The behavioral economics of will in recovery from addiction. *Drug and Alcohol Dependence, 90* (Suppl.), 100–111.

MYERSON, J., GREEN, L., & WARUSAWITHARANA, M. (2001). Area under the curve as a measure of discounting. *Journal of the Experimental Analysis of Behavior, 76,* 235–243.

OLMSTEAD, M. C. (2006). Animal models of drug addiction: Where do we go from here? *The Quarterly Journal of Experimental Psychology, 59,* 625–653.

RACHLIN, H. (1990). Why do people gamble and keep gambling despite heavy losses? *Psychological Science, 1,* 294–297.

RACHLIN, H. (2000). *The science of self-control.* Cambridge, MA: Harvard University Press.

RACHLIN, H., RAINERI, A., & CROSS, D. (1991). Subjective probability and delay. *Journal of the Experimental Analysis of Behavior, 55,* 233–244.

SHAW, M., & BLACK, D. W. (2008). Internet addiction: Definition, assessment, epidemiology, and clinical management. *CNS Drugs, 22,* 353–365.

SHOTTON, M. (1989). *Computer addiction? A study of computer dependency.* Basingstoke, UK: Taylor & Francis.

SHOTTON, M. (1991). The costs and benefits of "computer addiction." *Behavior and Information Technology, 10,* 219–230.

SKINNER, B. F. (1953). *Science and human behavior.* New York: The Free Press.

TREUER, T., FABIAN, Z., & FUREDI, J. (2001). Internet addiction associated with features of impulse control disorder: Is it a real psychiatric disorder? *Journal of Affective Disorders, 66,* 283.

VERDEJO-GARCIA, A., LAWRENCE, A. J., & CLARK, L. (2008). Impulsivity as a vulnerability marker for substance-use disorders: Review of findings from high-risk research, problem gamblers, and genetic association studies. *Neuroscience and Biobehavioral Reviews, 32,* 777–810.

VUCHINICH, R. E., & SIMPSON, C. A. (1998). Hyperbolic temporal discounting in social drinkers and problem drinkers. *Experimental and Clinical Psychopharmacology, 6,* 292–305.

WIDYANTO, L., & GRIFFITHS, M. (2006). Internet addiction: A critical review. *International Journal of Mental Health Addiction, 4,* 31–51.

WIDYANTO, L., & MCMURRAN, M. (2004). The psychometric properties of the Internet Addiction Test. *CyberPsychology and Behavior, 7,* 443–450.

YELLOWLEES, P. M., & MARKS, S. (2007). Problematic Internet use or Internet addiction? *Computers in Human Behavior, 23,* 1447–1453.

YOUNG, K. S. (2004). Internet addiction: A new clinical phenomenon and its consequences. *American Behavioral Scientist, 48,* 402–415.