The characteristics of decision making, potential to take risks, and personality of college students with Internet addiction

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A B S T R A C T

This study aimed to identify risk factors involved in Internet addiction. A total of 216 college students (132 males and 84 females) were given the following: (a) the diagnostic interview for Internet addiction, (b) the Iowa gambling test for decision-making deficits, (c) the Balloon Analog Risk Test (BART) to assess risk-taking tendencies, and (d) the Tridimensional Personality Questionnaire (TPQ) for personality characteristics. The results revealed the following: (a) 49% of males and 17% of females were addicted, (b) the addicted students tended to select more advantageous cards in the last 40 cards of the Iowa test, indicating better decision making, (c) no difference was found for the BART, indicating that addicted subjects were not more likely to engage in risk-taking behaviors and (d) TPQ scores showed lower reward dependence (RD) and higher novelty seeking (NS) for the addicts. Their higher performance on the Iowa gambling test differentiates the Internet addiction group from the substance use and pathologic gambling groups that have been shown to be deficient in decision making on the Iowa test. Thus, students that fit these characteristics should be closely monitored to prevent Internet addiction.

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1. Introduction

Internet addiction, defined as a maladaptive use of the Internet, is estimated to occur in 8–13% of college students (Chou et al., 2005). It has become a serious mental health issue worldwide because addicts are impaired in various behavioral aspects including social interactions and academic performance (Scherer, 1997; Young, 1998; Morahan-Martin and Schumacher, 2000). Developing effective methods for intervention with and treatment of Internet addiction will require first establishing a clear understanding of the mechanisms underlying this condition. Today, the Internet is freely available in university campuses for the promotion of academic activities. However, it has also become one of the most popular recreational activities. An inevitable conflict has developed between the academic and social benefits and the negative consequences of uncontrolled use. Understanding how college students resolve or fail to resolve this conflict might shed light on the mechanism of Internet addiction. In the present study, the decision-making characteristics of college students with Internet addiction were evaluated in an attempt to delineate the mechanism of Internet addiction.

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The nature of Internet addiction is controversial. It has been classified as a behavioral addiction (Holden, 2001) or an impulse control disorder (Sadock and Sadock, 2007). The diagnostic criteria developed by Ko et al. (2005) indicate that the core symptoms of Internet addiction overlap with the criteria for substance dependence and pathologic gambling (Ko et al., 2005). One of the core symptoms for all three disorders is the persistence of the behavior despite recurrent psychological or physical problems caused by it. Why do Internet addicts repeat behaviors that result in negative consequences? The Iowa gambling task was developed to test the somatic marker hypothesis (Bechara et al., 2002), which postulates that reasoning is influenced by crude biasing signals arising from the neural machinery underlying emotion. As a test of decision making under ambiguity and risk (Brand et al., 2007b), the subjects make a series of choices between options with larger short-term gains that are offset by greater risks of heavy losses and those with smaller short-term gains and a lower risk of loss that results in long-term maximization of the monetary payoff. Because the potential outcomes of the various choices are initially unknown to subjects, they must learn the rule implicitly by using emotional feedback about their selections. Patients with lesions of the ventromedial frontal lobe or the amygdala have been found to perform poorly on the Iowa gambling task (Bechara et al., 2000; Brand et al., 2007a). Patients with the former lesion could
generate the somatic state but were unable to appropriately respond based on this marker. Patients with lesions of the latter type could not generate the somatic state to guide the decision (Bechara et al., 1999).

The Iowa gambling task is postulated to consist of two phases. In the early or initial phase (approximately the first 40 trials), subjects learn to make choices, but without any explicit knowledge about the rules of the task to guide their decisions. At this stage, the decisions are largely guided by implicit information (Brand et al., 2007b). In the second phase (after the first 40 trials, but varying from person to person), subjects acquire some conceptual knowledge about the task and the decision becomes more strongly influenced by explicit knowledge. Thus, subjects decide under ambiguity in the early phase and under risk in the later phase (Brand et al., 2007b). Decisions in this task are thought to be based on intuition, rather than reasoning, and may be dissociated from working memory (Turnbull et al., 2005). Thus, by using the Iowa gambling task, we can assess not only the function of emotion-based learning, but also the process of decision-making under ambiguity and risk.

Poor performance on the Iowa gambling task in patients with substance use disorder has been reported (Bechara and Damasio, 2002). This indicates that (a) substance abusers are insensitive (or myopic) to the future (Bechara et al., 2002); (b) they fail to modify behavior in response to feedback about negative payoffs; and (c) they are hypersensitive to wins and hypo-attentive to losses (Garavan and Stout, 2005). Pathological gamblers have also been reported to be deficient in decision making based on the Iowa gambling task (Goudriaan et al., 2005), indicating the same problems with decision making as in substance abusers. These deficits, which indicate a decision-making process based only on immediate highs and winning without attention to potential loss, might explain why they choose to continue abusing substances or gambling despite knowledge of negative results caused by these behaviors.

Persons with Internet addiction continue heavy Internet engagement even when faced with obvious negative outcomes. This is much like the impairment of decision making in substance abusers and pathological gamblers. However, whether impairment of implicit emotional learning in the Iowa gambling task is associated with Internet addiction has not been evaluated. The Iowa gambling task should be a suitable test for investigating the characteristics of decision making under ambiguity and risk among Internet addicts.

The loss of control of Internet use might also be related to other characteristics such as a risk-taking personality. Novelty seeking (NS) reflects activity in appetitive motivational systems, greater attention to reward cues, and increased emotional reactivity to reward (Finn, 2002). Risk taking and NS indicate the potential to seek new experiences, higher levels of rewarding stimulation, and persistent engagement in risky behaviors without considering future outcomes or consequences (Kelley et al., 2004). Accordingly, NS and the potential to take risk have been found to be associated with substance use disorder (Lukasiwicz et al., 2008; Bornovalva et al., 2005; Lejuez et al., 2005) and pathological gambling (Forbush et al., 2008). We also found that adolescents with Internet addiction had higher NS (Ko et al., 2006). In addition, adolescents with Internet addiction have been reported to have higher scores on the Barratt Impulsiveness Scale and more failure responses in the GoStop Impulsivity Paradigm (Cao et al., 2007). However, the potential to take risks has not been assessed directly in Internet addiction. The Balloon Analog Risk Task (BART) has been used to assess the potential to engage in risky behaviors (Lejuez et al., 2002) and to relate such tendencies to self-reported engagement in real world risk-taking behaviors (Lejuez et al., 2003). This instrument could, therefore, be utilized to determine whether college students with Internet addiction had a higher potential to engage in risk taking.

Thus, the aim of this study was to evaluate the characteristics of decision making, the potential to take risks, and personality characteristics using the Iowa gambling task, the BART, and the Tridimensional Personality Questionnaire (TPQ). The relationship between these three independent variables and Internet addiction was also assessed. Since addicts choose to continue uncontrolled Internet use despite understanding the negative consequences, we hypothesized that they would perform poorly in the Iowa gambling task. It was also predicted that they would show a greater tendency towards risk taking. Finally, they should show higher NS and lower reward dependence (RD) as previously reported in adolescent samples (Ko et al., 2006).

2. Methods

2.1. Participants

A total of 216 college students (132 male and 84 female) participated in this study. Subjects were recruited using an advertisement posted specifically for high (<20 h/week, 139 subjects) and low (<2 h/day, 77 subjects) levels of Internet use. Their mean age in years was 21.45 ± 2.05 (range, 18–27), and their average duration of education was 14.6 ± 1.4 years (range, 13–18). All participants completed the assessments after informed consent was obtained. The study was approved by the Institutional Review Board (IRB) of Kaohsiung Medical University Hospital.

2.2. Assessment instruments

2.2.1. Diagnostic criteria of Internet addiction for college students (DCIA-C)

The criteria proposed by Ko et al. (2009) were used to define Internet addiction. “Criterion A” is met when at least six of the following nine symptoms occur: preoccupation, uncontrolled impulse, more use than intended, tolerance, withdrawal, impairment of control, excessive time and effort devoted to the Internet, and impaired decision making. “Criterion B” describes functional impairment secondary to Internet use. "Criterion C" lists the exclusion criteria.

2.2.2. Tridimensional Personality Questionnaire (TPQ)

The Chinese version of the TPQ (Glominger, 1987) contains 100 self-administered true-false questions designed to measure NS, harm avoidance (HA), and reward dependence (RD). The 1-month test–retest reliability was 0.58 to 0.77. It has acceptable construct validity (Chen et al., 2002).

2.2.3. Iowa gambling task

A computerized version was developed by Delphi according to the original design (Bechara et al., 2000). The task involved drawing one card per trial from one of four decks (labeled as A, B, C, and D). Each deck contained 40 cards in a fixed sequence which was unknown to participants at the start of the task. Next, participants were asked to select cards from the four decks to gain as much money as possible. The task ended when the 100th card was drawn, although subjects did not know this in advance. The immediate monetary gain for each draw from deck A or B was 1000 new Taiwan dollars (NTD) and the gain from deck C or D was 500 NTD. The money was deposited in an account. However, when some selected cards were drawn, money was deducted from the account (1500–3500 NTD in deck A, 12,500 NTD in deck B, 250–750 NTD in deck C, and 2500 NTD in deck D). In total, decks C and D were more favorable. First, the net score was derived by (C + D) − (A + B) for every 20 cards of 5 blocks to demonstrate the implicit emotional learning. Then, the scores for the first 40 cards and for the last 40 cards were utilized to demonstrate the results of decision under ambiguity and risk, respectively.

2.2.4. Balloon Analog Risk Task (BART)

Lejuez et al. (2002) developed this task. All participants were asked to pump a balloon on the computer screen with the goal of making the balloon as large as possible without causing it to pop. A reward of 10 NTD was given to the temporary bank for each

### Table 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Internet addiction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (%)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>53(46.6)</td>
</tr>
<tr>
<td>Female</td>
<td>21(26.6)</td>
</tr>
<tr>
<td>Participating group</td>
<td></td>
</tr>
<tr>
<td>Self reported higher Internet user</td>
<td>70(58.3)</td>
</tr>
<tr>
<td>Self reported lower Internet user</td>
<td>4(5.8)</td>
</tr>
<tr>
<td>Online activity</td>
<td></td>
</tr>
<tr>
<td>Online gaming</td>
<td>42(71.2)</td>
</tr>
<tr>
<td>Online chatting</td>
<td>18(28.8)</td>
</tr>
<tr>
<td>Others</td>
<td>14(28.0)</td>
</tr>
</tbody>
</table>

\*P < 0.001; **P < 0.01.
Table 2

Comparison of the Iowa score in 1st to 5th block, first 40 cards and last 40 cards, BART results, and the Tri-dimensional Personality Questionnaire results between Internet addiction and control groups.

<table>
<thead>
<tr>
<th>Variable (mission value)</th>
<th>Internet addiction (N = 74) mean ± S.D.</th>
<th>Nil (N = 114) mean ± S.D.</th>
<th>df</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iowa gambling task*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st block</td>
<td>−3.32 ± 5.56</td>
<td>−3.23 ± 4.66</td>
<td>186</td>
<td>−0.13</td>
</tr>
<tr>
<td>2nd block</td>
<td>−1.54 ± 6.42</td>
<td>0.86 ± 6.34</td>
<td>186</td>
<td>−2.52</td>
</tr>
<tr>
<td>3rd block</td>
<td>1.43 ± 8.89</td>
<td>−1.25 ± 7.14</td>
<td>186</td>
<td>2.28</td>
</tr>
<tr>
<td>4th block</td>
<td>1.38 ± 8.40</td>
<td>−0.16 ± 8.09</td>
<td>186</td>
<td>1.25</td>
</tr>
<tr>
<td>5th block</td>
<td>3.08 ± 9.86</td>
<td>0.04 ± 8.61</td>
<td>186</td>
<td>2.24</td>
</tr>
<tr>
<td>Iowa first 40 cards</td>
<td>−4.86 ± 7.89</td>
<td>−2.37 ± 7.89</td>
<td>186</td>
<td>2.12</td>
</tr>
<tr>
<td>Iowa last 40 cards</td>
<td>4.46 ± 12.09</td>
<td>−0.12 ± 10.85</td>
<td>186</td>
<td>2.61</td>
</tr>
<tr>
<td>BART†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total pumps of non-exploding balloon</td>
<td>200.80 ± 41.95</td>
<td>191.92 ± 40.65</td>
<td>186</td>
<td>1.44</td>
</tr>
<tr>
<td>Number of non-exploding balloon</td>
<td>19.97 ± 4.50</td>
<td>19.93 ± 4.70</td>
<td>186</td>
<td>0.06</td>
</tr>
<tr>
<td>Total trail of expansion</td>
<td>12.03 ± 4.50</td>
<td>12.07 ± 4.70</td>
<td>186</td>
<td>−0.06</td>
</tr>
<tr>
<td>Total score</td>
<td>2007.97 ± 419.54</td>
<td>1919.21 ± 406.46</td>
<td>186</td>
<td>1.44</td>
</tr>
<tr>
<td>BART score</td>
<td>10.72 ± 3.63</td>
<td>10.53 ± 4.03</td>
<td>186</td>
<td>0.33</td>
</tr>
<tr>
<td>Tri-dimensional Personality Questionnaire</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noveltly seeking</td>
<td>19.01 ± 4.45</td>
<td>17.46 ± 4.72</td>
<td>186</td>
<td>2.25</td>
</tr>
<tr>
<td>Harm avoidance</td>
<td>17.32 ± 8.22</td>
<td>16.45 ± 7.42</td>
<td>186</td>
<td>0.76</td>
</tr>
<tr>
<td>Reward dependence</td>
<td>17.51 ± 3.61</td>
<td>18.54 ± 3.32</td>
<td>186</td>
<td>−1.99</td>
</tr>
</tbody>
</table>

* P < 0.05; ** P < 0.01.
† BART: Balloon Analog Risk Task.
‡ The average number of pumps excluding balloons that popped = Total pumps of non-exploding balloon / Number of non-exploding balloons.

3. Results

Eight participants were excluded due to alcohol use disorder. Twenty participants (12 in the non-addiction group, and 8 in the Internet addiction group) were excluded because they did not complete all assessments. Data from these subjects were not analyzed further. This left 74 and 114 participants in the Internet addiction and non-addiction groups, respectively. There were four participants with self-reported low Internet use that were diagnosed with Internet addiction based on their Internet use behavior and resulting functional impairment. Chi-square analysis revealed that (a) college students with Internet addiction were more likely to be male and were more likely to be involved in online gaming (see Table 1 for chi-square value). A t-test (see Table 2) revealed that participants with Internet gaming addiction were more likely to select cards from the disadvantageous decks (A&B) in the first 40 draws in the Iowa gambling task (t186 = 2.12, P = 0.035). This effect was not significant, however, when the Bonferroni correction was used. They were also more likely to choose the advantageous decks (C&D) in the last 40 draws (t186 = 2.12, P = 0.01). The MANOVA revealed that the main effect of blocks was significant (F(4,183) = 15.03, P < 0.001, η2 = 0.25) which indicates that all participants shifted to the advantageous decks over the course of the 5 blocks. The interaction between Internet addiction and block was also significant (F(4,183) = 4.64, P = 0.001, η2 = 0.09) which demonstrates that the Internet addicts had better implicit emotional learning in the Iowa gambling task than the control group (Fig. 1).

For BART evaluation, the difference between two groups was not significant. TPQ scores showed that the Internet addiction group had lower scores on RD and higher scores on NS. Further forward stepwise logistic regression revealed that NS was the first variable entering this regression model followed by choice on the last 40 cards and choice on the first 40 cards (Table 3). This indicates that NS was the factor most strongly associated with Internet addiction.

4. Discussion

This was the first study to evaluate the characteristics of decision making in college students with Internet addiction. The data demonstrate that (a) addicted subjects had better implicit emotional learning on the Iowa gambling task than the non-addiction group; (b) they chose more high-reward decks (A&B) under ambiguity and chose more advantageous decks (C&D) under risk; (c) they did not show more risk-taking potential; and (d) they had higher NS and lower RD based on the TPQ; (e) NS was the factor most strongly associated with Internet addiction. These results differ from those for substance dependence in /

Table 3

Forward multivariate stepwise logistic regression analysis for association between significant variables in Table 2 (results of Iowa and Tri-dimensional personality) and Internet addiction controlling for gender and age.

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>Wald</th>
<th>OR</th>
<th>95%CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>0.98</td>
<td>8.40</td>
<td>2.67</td>
<td>1.37--5.19</td>
</tr>
<tr>
<td>Age</td>
<td>4.04</td>
<td>0.27</td>
<td>0.96</td>
<td>0.81--1.13</td>
</tr>
<tr>
<td>Iowa first 40 cards</td>
<td>0.04</td>
<td>3.78</td>
<td>0.96</td>
<td>0.52--1.08</td>
</tr>
<tr>
<td>Iowa last 40 cards</td>
<td>0.04</td>
<td>6.76</td>
<td>1.04</td>
<td>1.01--1.07</td>
</tr>
<tr>
<td>Novelty seeking</td>
<td>0.09</td>
<td>6.40</td>
<td>1.10</td>
<td>1.02--1.18</td>
</tr>
</tbody>
</table>

* The Iowa score was calculated by the card numbers with ((C + D) − (A + B)) in the Iowa gambling task.

Activities were analyzed by chi-square analysis. T-tests were used to test for differences between the Internet addiction group and the non-addiction group for age and for scores on the TPQ, the Iowa gambling task, and the BART. In addition, a repeated-measures MANOVA with block (1-5) as a within-subjects factor and group (Internet addiction and non-addiction) as a between-subjects factor was carried out on the frequency of advantageous choices ((C + D) − (A + B)). Lastly, a forward multivariate stepwise logistic regression was used to analyze the association between the above independent variables and Internet addiction while controlling for gender and age. All statistical analyses were performed using the SPSS 10.0 computer program. Statistical significance was P < 0.05 for all tests.
that subjects with substance use disorders have been reported to have poor performance on the Iowa gambling task (Bechara et al., 2002), a tendency towards risk-taking behavior (Lejuez et al., 2005), and lower HA (Galen et al., 1997) than control groups.

According to the somatic markers hypothesis, decisions are influenced by crude biasing signals arising from the neural mechanisms that underlie emotion. Somatic markers can reflect the brain's representation of the action expected to occur in the body or emotional response (Damasio, 1996). In the Iowa gambling task, subjects should succeed in the task based on emotion-based learning via somatic marker signals in the early stages. In other words, they need to choose according to their “feel” for the deck which develops based on the emotional responses generated from previous choices. In this study, Internet addicts chose more disadvantageous decks at first and more advantageous decks in the later stages. This may suggest that they had an intact implicit emotional learning response to the task. Previous reports involving the Iowa gambling task in substance abusers had suggested myopia for the future or insensitivity to punishment were characteristic of their decision process (Bechara et al., 2002). The present data demonstrate that Internet addicts do not have these deficits for this task.

It is not clear why Internet addicts perform better than control subjects on the Iowa gambling task. It could have predicted that superior decision-making ability, as reflected in performance on the Iowa gambling task, would protect people from becoming addicted to the Internet. It has been reported that university-educated people had poorer performance on the Iowa gambling task than the less well educated (Evans et al., 2004). It is possible that the tertiary education requires students to rely on explicitly documented sources of evidence to reason and to make decisions. Thus, college students may rely more on explicit information than the emotion-based information reflected in the somatic marker (Evans et al., 2004). Since the Iowa gambling task was designed to test for the ability to make decisions based on emotional implicit learning, the college students could have been ignoring the somatic marker, resulting in poorer performance on the task. In our study, the subjects were college students; thus, the control subjects may not perform well due to over-reliance on analytical rules of the game, thus resulting in the addiction group's performing significantly better. On the other hand, although relying on emotion-based information could help participants make better decisions in the Iowa gambling task, this behavior does not necessarily result in better outcomes in the real world. The present data suggest the possibility that the decision-making of Internet addicts could be effectively biased by emotional information which contributes to their better performance in the Iowa gambling task. The heavy Internet use is usually linked to positive emotional experiences (for example, success in gaming), which might result in not only a positive implicit emotional bias but also long-term negative consequences when the person loses control. Then, the positive somatic marker for Internet use will become important. This might lead to persistent Internet use. Further, Internet addicts also had intact responses to negative somatic markers in the Iowa gambling task. However, the negative consequences of heavy Internet use do not occur immediately. Thus, the delayed negative emotional experience could be linked to Internet activity only by explicit reasoning, not by somatic markers (implicit emotional learning). Moreover, success in online gaming is usually dependent upon the ability to generate effective somatic markers based on immediate gain and loss. Repeated training could make them act automatically, rapidly, and successfully in gaming based on somatic markers. Thus, relying more on somatic markers, but not on reasoning, might make them neglect the negative consequences and make the decision to continue heavy Internet use. This might also explain their choices in the early part of the task when: they chose more high-reward cards before the negative somatic markers had been established. However, this hypothesis should be investigated by further studies to test whether the delayed long-term consequences could establish somatic markers and whether this decision characteristic results in heavy Internet use.

According to the neurobiological viewpoint, it has been suggested that affective responses acquired and expressed by the amygdala are short-lived and habituate very quickly (Bühel et al., 1998). Thus, somatic markers could be established according to the immediate response. However, negative consequences that happen several weeks later might not establish strong negative somatic markers as effectively as immediate responses. In addition, hyperactivity in the amygdala, the so-called impulsive system, can weaken control from the reflective system (ventromedial prefrontal cortex) (Bechara, 2005). This can lead to the sensitization and attention bias towards immediate reward (Bechara, 2005) as important mechanisms of addiction. Thus, based on the better performance in the Iowa gambling task for Internet addicts, we suggest that they suffer from a condition opposite from that of subjects with lesions of the amygdala. That is, their behavior appears to reflect a hypersensitive amygdala for both reward and aversion. This might result in a decision-making process that over-relies on somatic markers. Since the negative consequences of Internet addiction are too delayed to establish effective somatic markers, the Internet addicts would make the choice to continue heavy Internet use based on their somatic markers established by a hypersensitive amygdala. This idea should be further explored in functional brain-imaging studies.

The evaluation with the BART demonstrates that the college students with online gaming addiction did not have a higher tendency towards risk-taking. Additionally, they also chose the advantageous decks under risk in the Iowa gambling task. Thus, college students with Internet addiction may not show a higher potential to take risks. This result also corresponds to our previous reports that adolescent Internet addicts had higher scores on HA (Ko et al., 2006).

Our study also demonstrated that Internet-addicted college students had lower RD and higher NS, consistent with previous reports in adolescents (Ko et al., 2006, 2007). NS reflects the brain's "incentive" or behavior activation system, and is associated with the dopaminergic system (Bardo et al., 1996). People with high NS readily engage in new interests and activities, but tend to neglect details and are quickly distracted or bored (Cloninger, 1987). Internet activities, especially online games, provide a highly varied virtual environment which satisfies the NS needs of college students. College students with high NS might engage in Internet activities with higher motivation and arousal responses. So, high NS may predispose an individual to heavy Internet use, similar to its effect on substance use, as previously reported (Cloninger et al., 1995).

The character of RD is a heritable tendency to respond intensely to signals of reward (particularly verbal signals of social approval, and sentiment), and to maintain or resist extinction of rewarded behavior (Cloninger, 1987). Internet behavior could be persistently rewarded by feelings of being in control, the synchronous interactive quality, the immediate achievement, and the freedom of self-representation (Leung, 2004). On the other hand, these pleasures are often unpredictable and difficult to satisfy in the real world. Since the college students with lower RD had difficulty persisting with an activity without a predictable reward, they are more willing to continue persistent effort online than in the real world.

There are several limitations to this study. First, college students with Internet addiction comorbid with alcohol or illicit substance use disorder were excluded from the study. This limits the ability to generalize the results to persons with comorbid conditions. Second, our addiction criteria relied on self-reported information from college students. Supplementary information from family members and other acquaintances might improve diagnosis. Third, no assessment for executive functioning was conducted in this study. Further study to compare decision-making characteristics with control of executive function would provide more information. Fourth, the cross-sectional research design of the present study cannot...
demonstrate a causal relationship between neurocognitive function and Internet addiction.

5. Conclusions

The present study revealed that college students with Internet addiction had a better performance on the Iowa gambling task. This result indicates that Internet addiction is not identical to substance use disorder or pathological gambling from a neurocognitive standpoint. Thus, this result suggests that the loss of control over Internet use might be associated with overreliance on implicit emotional learning, which establishes positive somatic markers for heavy Internet use. This result also indicates that college students with high NS and low RD should be closely monitored for Internet addiction.

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