Risky Decision Making in Smoking and Nonsmoking College Students: Examination of Iowa Gambling Task Performance by Deck Type Selections

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The Iowa Gambling Task (IGT) is used to assess risky decision making in clinical and nonclinical populations. Recent studies have begun to assess performance on the IGT not by number of advantageous and disadvantageous selections, but rather by the pattern of performance on each of the four individual decks (A, B, C, and D). The present study sought to further examine deck selection patterns among smoking and nonsmoking college students, as mixed results have been found on the IGT in nicotine and as a function of substance saturation level. Participants were 136 undergraduates (48 male; mean age 19.24 years), of whom 70 were nonsmokers. Thirty-one smokers abstained from smoking overnight. Performance on the IGT was broken into two blocks (Trials 1–40, Trials 41–100) for each of the four decks. Abstinent smokers selected more from Deck A on Block 2 than the ad libitum smokers. No group or block differences were found for Decks B or C. Selections from Deck D increased as the task progressed, regardless of smoking status. Ad libitum smokers preferred Deck B to Deck A on Block 2. The results provide some evidence that nicotine saturation level affects IGT deck selections among smokers.

Key words: Iowa Gambling Task (IGT), nicotine, risky decision making

The Iowa Gambling Task (IGT) was developed to assess decision making in adults with frontal-lobe damage who were not impaired on formal executive function measures but who exhibited real-world decision-making deficits (Bechara, Damasio, Damasio, & Anderson, 1994). Individuals are told to maximize profit by selecting 100 cards, one at a time, from one of four decks. On each draw, selections from Decks A and B yield an average profit of $100, whereas selections from Decks C and D yield a smaller average profit of $50. However, after 10 selections from Decks A and B, individuals have incurred a net loss of $250, while 10 selections from Decks C and D results in a net gain of $250. Based on these long-term outcomes, Decks A and B have traditionally been termed “disadvantageous” and Decks C and D “advantageous” (Bechara et al., 1994).

Based on these classifications of advantageous and disadvantageous choices, risky decision making—continued selection from the disadvantageous decks even after the risks associated with them become apparent—has been seen in many clinical and nonclinical populations, including substance dependence, pathological gambling, schizophrenia, attention-deficit hyperactivity disorder, and frontal-lobe injury (see Buelow & Suhr, 2009, for a review). Risky decision making on the IGT is often conceptualized as a failure to learn to
choose advantageously, or as an overreliance on short-term gains at the expense of longer-term outcomes (Bechara et al., 2001; Bechara, Tranel, Damasio, & Damasio, 1996). However, at the start of the task, individuals know nothing of the relative risks and benefits of each deck. Therefore, selections on the first 40 trials measure decision making under ambiguity, whereas selections from the last 60 trials represent decision making under risk (Brand, Recknor, Grabenhorst, & Bochura, 2007).

Although most research to date has assessed IGT performance based on the number of advantageous minus disadvantageous selections, either as a whole or broken down into blocks of trials, a growing number of researchers has raised concerns that Decks A and B may not be equally disadvantageous. Decks A and B both result in a higher immediate reward but long-term negative consequences; however, Deck B results in a net gain on 90% of the trials, whereas Deck A results in a net gain only 50% of the time (Bechara, 2008). In addition, the immediate losses in Deck B are of a larger magnitude than those in Deck A. A similar difference is seen between Decks C and D, as Deck D is associated with more frequent gains (90%) but a higher magnitude of losses, while Deck C has more frequent losses (50%) but they are of a lower magnitude. A significant minority of healthy control samples shows a preference for Deck B (e.g., Bark, Dieckmann, Bogerts, & Northoff, 2005; Fernie & Tunney, 2006; Overman et al., 2004; Toplak, Jain, & Tannock, 2005). This preference may suggest a greater focus on the high frequency of immediate gains rather than the longer-term outcomes of the decks (Lin, Chiu, Lee, & Hsieh, 2007).

Caroselli, Hiscock, Scheibel, and Ingram (2006) likened Decks B and D to “cherry dribbler” slot machines, as these machines tend to pay out a high number of smaller payoffs. This high frequency of positive reinforcement increases the likelihood of continued use of that machine, despite the potential for long-term costs. Using this analogy, Deck B on the IGT may be more attractive to healthy control participants because the frequent rewards are offset by a smaller frequency of losses than in Decks A and C. The IGT clinical manual further distinguishes between Decks A and B (Bechara, 2008). It states that although both decks are considered disadvantageous, Deck A is avoided by most “neurologically intact” individuals. Fewer selections from Deck B are generally considered good decision making; however, as stated previously, Deck B selections may not discriminate well between controls and patients, making continued selection from Deck A more indicative of pathological risk taking.

Adaptations of the IGT have been created to further assess the relative emphasis on long-term outcomes versus frequency of wins/losses among controls. Utilizing the Soochow Gambling Task (Lin et al., 2007), healthy control participants preferred decks with a high frequency of wins but a long-term negative outcome over decks with a lower frequency of wins but long-term positive outcomes (Chiu et al., 2008; Lin, Chiu, & Huang, 2009). Using a different modified IGT, Caroselli et al. (2006) found that healthy control participants’ selections from “Deck A,” with a 50% win frequency but long-term negative outcomes, decreased as the task progressed, while selections from “Deck B,” with a long-term negative outcome but a 90% win frequency, increased. Collectively, these studies provide evidence that decision making in healthy controls may be guided more by the frequency of gains rather than the overall, long-term outcome associated with a particular behavior, contrary to the original conceptualization of the IGT decks.

The present study sought to further understand decision making on the IGT by examining the pattern of deck selections among smoking and nonsmoking college students. Substance-dependent individuals may make risky decisions in everyday life, such as driving under the influence, continuing substance use despite known negative consequences, or returning to the substance after a period of abstinence. Risky decision making on the IGT has been shown across various substances of abuse, including alcohol, marijuana, cocaine, and opioids (e.g., Bechara et al., 2001; Ernst et al., 2003; Mintzer & Stitzer, 2002; Pirastu et al., 2006; Verdejo-Garcia et al., 2007; Verdejo-Garcia, Perales, & Perez-Garcia, 2007), but mixed results have been found with nicotine. No differences have been found between smokers and nonsmokers (Businelle, Apperson, Kendzor, Terlecki, & Copeland, 2008; Lujuez et al., 2003); but recent (Xiao et al., 2008) and dependent (Rotherham-Fuller, Shopstaw, Berman, & London, 2004) smokers performed worse than nonsmokers.

The effects of abstinence from a substance of dependence on decision making have also been examined, with abstinence either impairing (Fein, Klein, & Finn, 2004; Field, Santaracangelo, Summall, Goudie, & Cole, 2006; Goudriaan, Oosterlaan, de Beurs, & van den Brink, 2005) or improving (Bartokoski et al., 2000) task performance. Few researchers have studied the effects of nicotine abstinence on decision making in the IGT. Nicotine is rewarding to the brain and therefore affects performance on cognitive tasks by targeting the dopaminergic mesocorticolumbic pathway (Kelley & Berridge, 2002; Pomerleau & Pomerleau, 1984). A reward deficit may occur when nicotine levels are not maintained in the brain (Kenny & Markou, 2005), such as during a period of acute nicotine withdrawal. Worse performance is seen on various risk-taking and executive function measures in abstinent versus ad libitum (satiated) smokers (Havermans, Debaere, Smulders, Wiers, & Jansen, 2003; Powell, Dawkins, & Davis, 2002; Zack, Belsito,
Scher, Fissenberg, & Corrigal, 2001). Deeper delay discounting, or a preference for smaller but more immediate rewards over larger but more distant rewards, is seen in smokers but not nonsmokers (Mitchell, 1999; Ohmura, Takahashi, & Kitamura, 2005; Reynolds, 2004); however, ex-smokers perform similarly to nonsmokers (Bickel, Odum, & Madden, 1999). These findings on non-IGT tasks argue for the transience of nicotine’s effects on decision making. The preference for an immediate over a larger but longer-term reward provides support for the idea that abstinent smokers, likely experiencing a reward deficit, may show a preference for the large, immediate gains associated with Deck A on the IGT. The salience of the immediate reward in Deck A may overshadow the smaller rewards and long-term gains associated with Decks C and D, thereby driving continued selections from this risky deck.

In the present study, IGT deck selections were compared in nonsmokers, 12-hour abstinent smokers, and ad libitum smokers. Several hypotheses were made. For the nonsmokers, two potential outcomes were anticipated: Participants would focus on the long-term outcomes and choose primarily from Decks C and D as the task progressed, or they would instead focus on the frequency of gains and losses and instead switch to Decks B and D. Based on the above-noted findings of nicotine abstinence on cognitive task performance and the reward deficit theory, it was hypothesized that ad libitum smokers would perform similarly to the nonsmoker group, while abstinent smokers, driven by reward deficit, would make more Deck A selections than the other groups due to the salience of the immediate rewards in that deck.

METHOD

Participants

Participants were undergraduate students enrolled in psychology courses at a medium-sized Midwestern university who received course credit and $20 for participation. Funding for the present study was provided by the Ohio University Department of Psychology and the Ohio University Graduate Student Senate. All potential participants first completed the 10-item Fagerstrom Test of Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991) as part of an online screening. For the present study, a “nonsmoker” was defined as an individual not currently using cigarettes or chewing tobacco (i.e., no cigarette use in the past month, no prior history of regular tobacco use) and who scored a 0 on the FTND. A smoker was defined as an individual answering “yes” to the question “Are you a current daily smoker?” and scoring a 3 or higher on the FTND. Smokers were randomly assigned via a coin flip to either an overnight (12-hour) nicotine abstinence or a smoke-as-usual (ad libitum) condition.

One hundred forty-four undergraduates participated in the study. Five nonsmokers were removed from further analysis due to current chewing tobacco use, and 1 due to reported tobacco use within the past 12 hours. Two additional participants were removed from analysis after examination of selections indicated invalid completion of the IGT (i.e., first 60 selections were all from Deck D). This left a final sample of 136 undergraduates (48 male; ages 18–33 years \( M = 19.24, SD = 2.13 \)). Seventy participants were nonsmokers, and the remaining 66 smokers were divided into two groups: 31 in the abstinence group and 35 in the ad libitum group.

Measures

The standard computerized version of the IGT was administered (Bechara, 2008). IGT scores were calculated by counting the total selections for the first 40 (Block 1) and last 60 (Block 2) trials for each deck. The totals were then converted into a selection percentage (i.e., Block 1 selections/40, Block 2 selections/60) to ensure a standard scale of comparison. Level of nicotine dependence was reassessed in the testing session with the FTND and the Hooked on Nicotine Checklist (HONC; DiFranza et al., 2002). Level of nicotine withdrawal symptoms was assessed with the 32-item Questionnaire on Smoking Urges (QSU; Tiffany & Drobes, 1991), which assesses both the desire to smoke and anticipation of relief from withdrawal symptoms. Participants also completed the two-subtest version of the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999; Vocabulary and Matrix Reasoning subtests) to assess for between-group differences in estimated intellectual ability.

Procedure

The present study was approved by the institutional review board at Ohio University. Data were collected between September 2007 and June 2009. All participants provided written informed consent. Participants first completed a breath carbon monoxide reading (PiCO Microsmokerlyzer, Bedfont Scientific Ltd.), with a cut-off score of 10 ppm used to confirm overnight nicotine abstinence per manufacturer guidelines. Participants next completed the FTND, HONC, QSU, WASI, and a series of paper-and-pencil questionnaires and cognitive tests as part of a larger study. All participants then completed the computerized version of the IGT.

Data Analysis

Prior to testing hypotheses, between-group differences in the demographic variables were examined using one-way
analysis of variance (ANOVA) and Pearson chi-square tests as appropriate. Significant omnibus ANOVAs were followed-up with Tukey HSD (Honestly Significant Difference) post-hoc pairwise comparisons. The relationship between smoking status and deck selection on the IGT was analyzed using a repeated-measures ANOVA for each of the four decks, with smoking status group as the between-subjects variable and IGT block (Trials 1–40 or Trials 41–100) for each deck as the within-subjects variable. In addition, mixed-measures ANOVAs, with group as the between-subjects variable and deck as the within-subjects variable, comparing Block 2 selections from Decks B and D, Decks C and D, and Decks A and B were conducted to examine preference for decks based on long-term outcomes versus frequency of wins and losses.

RESULTS

Demographics

Demographic data are presented in Table 1. There were no differences between groups with regard to age, $F(2, 133) = 1.53, \ p = .221$; gender, $\chi^2(2, \ N = 136) = 0.96, \ p = .620$; or estimated intellectual level, $F(2, 118) = 0.01, \ p = .995$. Smokers collectively reported an average cigarette use of one-half pack per day. Scores on the FTND fell on average in the low-to-moderate range of nicotine dependence and were not significantly different between the two smoker groups ($p = .563$). Similar results were found using the HONC, in that both groups of smokers scored significantly higher than the nonsmokers ($p < .001$) but were not different from one another ($p = .998$). Abstinent smokers reported significantly greater symptoms of nicotine withdrawal on the QSU than ad libitum smokers ($p = .002$), and breath carbon monoxide levels were significantly lower in abstinent than in ad libitum smokers ($p < .001$).

IGT Performance by Deck Type

**Deck A.** There was a significant group × block interaction, $F(2, 130) = 3.589, \ p = .030$, partial eta-squared = .052. Examination of the patterns of performance indicated no between-group differences on Block 1, but abstinent smokers selected significantly more from Deck A on Block 2 compared with ad libitum smokers ($p = .019$). Although nonsmokers selected less often from Deck A on Block 2 than Block 1, there were no differences in selection patterns between the nonsmokers and the two smoker groups ($p > .251$).

**Deck B.** The group × block interaction was not significant, $F(2, 130) = 1.95, \ p = .146$, and neither were the main effects of group, $F(2, 130) = 0.80, \ p = .451$, or block, $F(1, 130) = 2.37, \ p = .127$. Thus, as the task progressed, participants chose a similar number of cards from Deck B as they did during the early trials.

**Deck C.** The group × block interaction was not significant, $F(2, 130) = 0.05, \ p = .953$. No significant main

<table>
<thead>
<tr>
<th>Variables</th>
<th>Nonsmokers (n = 70)</th>
<th>Abstinent Smokers (n = 31)</th>
<th>Ad Libitum Smokers (n = 35)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>18.94 (1.21)</td>
<td>19.39 (2.54)</td>
<td>19.69 (3.00)</td>
<td>.221</td>
</tr>
<tr>
<td>Gender (% Male)</td>
<td>31.4%</td>
<td>38.7%</td>
<td>40.0%</td>
<td>.620</td>
</tr>
<tr>
<td>WASI</td>
<td>102.12 (8.85)</td>
<td>102.25 (12.00)</td>
<td>101.97 (10.93)</td>
<td>.955</td>
</tr>
<tr>
<td>FTND</td>
<td>0.60 (0.00)</td>
<td>2.77 (1.93)</td>
<td>3.09 (1.62)</td>
<td>.006</td>
</tr>
<tr>
<td>HONC</td>
<td>0.00 (0.00)</td>
<td>6.48 (2.77)</td>
<td>6.51 (2.45)</td>
<td>.001</td>
</tr>
<tr>
<td>QSU</td>
<td>1.31 (0.50)</td>
<td>4.37 (1.14)</td>
<td>3.67 (0.94)</td>
<td>.001</td>
</tr>
<tr>
<td>CO</td>
<td>1.86 (1.28)</td>
<td>6.10 (3.77)</td>
<td>10.91 (6.50)</td>
<td>.006</td>
</tr>
<tr>
<td>IGT</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>A1</td>
<td>20.72 (5.83)</td>
<td>21.17 (6.25)</td>
<td>21.25 (5.98)</td>
<td>.894</td>
</tr>
<tr>
<td>A2</td>
<td>16.45 (8.23)</td>
<td>20.28 (12.63)</td>
<td>13.82 (7.87)</td>
<td>.024</td>
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<tr>
<td>B1</td>
<td>32.14 (10.44)</td>
<td>31.17 (9.60)</td>
<td>31.25 (10.79)</td>
<td>.875</td>
</tr>
<tr>
<td>B2</td>
<td>27.27 (13.81)</td>
<td>27.50 (13.98)</td>
<td>32.94 (17.64)</td>
<td>.171</td>
</tr>
<tr>
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<td>21.00 (7.36)</td>
<td>19.26 (6.35)</td>
<td>.439</td>
</tr>
<tr>
<td>C2</td>
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<td>23.11 (15.06)</td>
<td>20.54 (11.83)</td>
<td>.679</td>
</tr>
<tr>
<td>D1</td>
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<td>26.67 (9.01)</td>
<td>28.24 (13.68)</td>
<td>.672</td>
</tr>
<tr>
<td>D2</td>
<td>33.24 (16.93)</td>
<td>29.11 (17.88)</td>
<td>32.70 (18.22)</td>
<td>.549</td>
</tr>
</tbody>
</table>

WASI = Wechsler Abbreviated Scale of Intelligence, two-subscale estimated Full-Scale IQ; FTND = Fagerstrom Test of Nicotine Dependence; HONC = Hooked on Nicotine Checklist; QSU = Questionnaire on Smoking Urges; CO = breath carbon monoxide level; IGT = Iowa Gambling Task, percentage of selections by deck type and block.

*Non-smoker < abstinent and ad libitum smokers; abstinent = ad libitum smokers.*

*Non-smoker < abstinent and ad libitum smokers, abstinent > ad libitum smokers.*

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effect of group, $F(2, 130) = 0.72$, $p = .489$, or block, $F(1, 130) = 2.06$, $p = .153$, was found. Participants across all three groups chose a similar number of cards from Deck C across Blocks 1 and 2.

**Deck D.** The group × block interaction was not significant, $F(2, 130) = 0.87$, $p = .421$, and there was not a significant main effect of group, $F(2, 130) = 0.40$, $p = .674$. A significant block effect was found, $F(1, 130) = 9.31$, $p = .003$, partial eta-squared = .067. Regardless of smoking status, participants selected significantly more from Deck D as the task progressed.

**Block 2 Deck Comparisons**

**Deck B versus Deck D.** Because Decks B and D both have a 90% gain frequency and a higher magnitude of losses, selections from these decks were compared to assess whether participants may have focused on the long-term outcomes associated with the decks. No preference was seen for either deck, $F(1, 130) = 0.89$, $p = .348$, and the group × deck interaction was not significant, $F(2, 130) = 0.64$, $p = .530$. There was no main effect of group, $F(2, 130) = 2.45$, $p = .090$.

**Deck C versus Deck D.** Selections from Decks C and D, the two “advantageous” decks, were compared to examine whether participants focused on the frequency of gains and losses, rather than the long-term outcomes, in making deck selections. The group × deck interaction was significant, $F(2, 130) = 0.437$, $p = .647$, and the main effect of group, $F(2, 130) = 0.71$, $p = .496$, were not significant. There was a main effect of deck, $F(1, 130) = 14.38$, $p < .001$, partial eta-squared = .100, indicating that participants, regardless of smoking status, preferred Deck D (90% gains) to Deck C (50% gains) on Block 2.

**Deck A versus Deck B.** Deck A and B selections were compared to further assess for a focus on frequency of gains and losses. The group × deck interaction was significant, $F(2, 130) = 3.97$, $p = .021$, partial eta-squared = .058. Ad libitum smokers made fewer selections from Deck A and more from Deck B on Block 2 than did abstinent smokers.

**CONCLUSIONS**

The present results provide some evidence of differences in decision making on the IGT by smoking status. Although in general all three groups of participants chose more from Deck D as the task progressed, abstinent smokers also showed a tendency to continue to select from Deck A—even after the risks associated with this deck became apparent. This continued selection from a disadvantageous deck widely agreed to be avoided by healthy controls (Bechara, 2008) suggests impaired decision making was occurring among the abstinent but not ad libitum smokers. Further, this difference between the two smoker groups lends credence to previous findings of worse performance on risky decision making and other executive function measures in abstinent smokers (Field et al., 2006; Havermans et al., 2003; Powell et al., 2002; Zack et al., 2001). Although the nonsmokers in this study did not significantly differ from either group of smokers, their pattern of Deck A selections was more similar to that of the ad libitum smokers (i.e., avoidance of Deck A on Block 2).

We did not find evidence of a Deck B preference among either smokers or nonsmokers. As the task progressed, nonsmokers and smokers alike chose a consistent percentage of cards from Deck B. This finding is contrary to multiple previous studies that have shown a Deck B preference among healthy controls (e.g., Bark et al., 2005; Fernie & Tunney, 2006; Overman et al., 2004; Toplak et al., 2005). Instead of a Deck B preference, we found all three groups chose more often from Deck D, with its small immediate gains, low frequency of losses, and overall long-term gain, as the task progressed. In a direct comparison of Deck B and D selections on Block 2 only, during decision making under risk (Brand et al., 2007), no preference was seen for Deck B over Deck D. This lack of preference between the decks—one with frequent gains but a long-term negative outcome (Deck B) and one with frequent gains but a long-term positive outcome (Deck D)—provides some evidence that our participants were focusing more on the frequency of gains and losses than on the overall long-term outcomes. Further evidence of this focus on the win/loss frequency comes from our finding that all three groups of participants preferred Deck D to Deck C, which both have the same long-term outcome but differ in win/loss frequency.

Our analysis of the pattern of IGT deck selections may help explain some of the differing findings of the effects of substance saturation level on the IGT. In these previous studies, the number of selections from Decks A and B have been combined to find a summed total of “advantageous” selections. Our results underscore the importance of analyzing selections from each deck separately, as there was a difference in the number of Deck A selections between abstinent and ad libitum smokers. Such an analysis would allow for consideration of whether individuals deemed “risky” on the IGT (i.e., more disadvantageous than advantageous selections on the later trials) prefer Deck A, the deck more sensitive to impaired decision making, or instead prefer Deck B, a deck sensitive to risky decision making but less sensitive to decision-making impairments.
The present study also provides some support for the theory that a reward deficiency drives IGT performance in substance dependence. As nicotine is an addictive substance, once the brain becomes accustomed to a particular situation level, a reward deficit can occur when this level is not maintained. Risk taking of various forms, such as making risky selections on the IGT, could then mimic the “thrill” of nicotine in the brain’s reward pathway. The “thrill” associated with a high-level immediate gain on Deck A may not be offset by the significant losses and overall net loss from the deck. In our study, abstinent smokers reported a significantly higher level of symptoms of nicotine craving, suggesting that they were experiencing acute nicotine withdrawal and therefore likely the reward deficit. In addition, abstinent smokers chose significantly more from Deck A on Block 2 than did the ad libitum smokers, who showed a preference for Deck B over Deck A on Block 2. Collectively, these results provide support that the reward deficit outlined previously is less pronounced in ad libitum than in abstinent smokers.

These results have implications for real-world decision making. During a period of acute nicotine abstinence, when risky decision making may be more pronounced on the IGT, individuals may be more likely to make a risky decision. This could include deciding to return to smoking or to engage in other behaviors that produce the same “thrill” that the brain is seeking. There is evidence from other clinical populations that performance on the IGT can relate to risky decision making in the real world. For example, pathological gamblers—individuals who have a history of making risky decisions with money that have a strong potential for negative outcomes—perform worse on the IGT, failing to shift to the advantageous decks over time, compared with control participants (Cavedini, Riboldi, Keller, D’Annunci, & Bellodi, 2002; Goudriaan, Oosterlaan, de Beurs, & van den Brink, 2004, 2005; Linnet, Rojskaer, Nygaard, & Maher, 2006). However, as the present deck-type analysis has shown, assessing risky decision making on the IGT appears more complex than originally thought. Future studies should utilize the IGT, alternative versions of the IGT that have been designed to assess different aspects of risk taking (including frequencies of rewards/punishments and extent of short-term versus long-term gains/losses [Caroselli et al., 2006; Lin et al., 2007]), and other reward-based measures (e.g., Brand et al., 2005; Frank, Seeberger, & O’Reilly, 2004; Lejuez et al., 2002) to more fully assess risky decision making and how it may relate to real-world decision making.

Several limitations may have affected the results of this study. The average nicotine dependence level among smokers fell in the low-to-moderate range. Similarly, a college student sample of smokers was utilized and may have had a briefer smoking history than the older participants in other nicotine dependence studies. It is possible evidence for the reward-deficit theory would be more pronounced in more severely nicotine-dependent individuals during a period of nicotine abstinence, as well as in individuals with a longer smoking history.

In sum, no support was found for a Deck B preference among healthy control participants; however, some support was found for the reward-deficit theory of substance dependence affecting risky decision making on the IGT. The present study highlights the importance of assessing patterns of individual deck selections on the IGT, as combining data from two “disadvantageous” decks that might not be equally disadvantageous may mask subtle differences in risky decision making in healthy controls and patient populations alike. Future research should continue to examine IGT performance by deck type, and additional research with individuals with a longer and/or more severe smoking history is important to further assess the effects of the nicotine abstinence-related reward deficit on risky decision making.

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