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Variation in BAS-BIS Profiles across Categories of Cigarette Use

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Abstract

Cigarette smoking is a major health concern, especially among college students. Research suggests a number of individual difference variables may be useful for identifying people at risk of becoming smokers and their likelihood of successfully quitting. The current study focuses on individual differences relating to Behavioral Inhibition System sensitivity (BIS) and the fun seeking, reward responsiveness, and drive aspects of Behavioral Approach System sensitivity (BAS). The former relates to mitigation of potential threat, whereas the latter three relate to different motivations for approach. Noting that existing literature suggests the considerations influencing whether a person experiments with cigarettes differ from those influencing who becomes a habitual smoker which in turn differ from those influencing whether a person quits smoking, we hypothesized that never smokers, experimenters, smokers, and former smokers would differ from each other on BIS, fun seeking, reward responsiveness, and drive in predictable ways. Moreover, we predicted these groups would differ from each other in terms of member

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¹Allowing these interactions did not change the significance or lack of significance of the effect of interest.

Contributors

Dr. Baumann was responsible for theoretical development, primary analyses, and primary writing of the manuscript, contributed to survey development, and coordinated amongst investigators across different institutions. Mr. Oviatt assisted in primary analyses and writing. Dr. Garza was principal investigator on the overall award. Ms. Gonzalez-Blanks and Dr. Lopez contributed to survey development and organized data collection at their respective institutions. Dr. Delpech, Ms. Petrova, and Dr. Beason coordinated data collection at their respective institutions. Mr. Hale assisted in analyses. All authors contributed to later stages of the writing process and have approved of the final form of the manuscript.

Conflict of Interest

All authors declare they have no conflicts of interest

profiles across these four variables. We assessed these predictions in a sample of college students from geographically diverse institutions within the United States ($N = 1840$). Results indicate the profile for never smokers was characterized by high BIS and low fun seeking, that of experimenters by moderately high BIS, high fun seeking, and moderate reward responsiveness, and of former smokers by moderate BIS, high fun seeking, high reward responsiveness, and high drive. Contrary to expectations, current smokers were low on all four of these characteristics.

Keywords

Cigarette use; college students; BIS/BAS; personality profile

Cigarette smoking is a major health concern in the United States, especially amongst college students and other young adults. According to a recent report by the Substance Abuse and Mental Health Services Administration (SAMSA), nearly 41% of 18 to 25 year olds in the U.S. have smoked one or more cigarettes in the past month (SAMSA, 2011). Identifying factors related to which people become smokers and which smokers successfully quit has implications for understanding the development of cigarette use, early identification of those at risk, and the design of cessation programs.

A number of factors have been shown to be related to which people become smokers and which smokers successfully quit. These include demographic factors such as age and gender (SAMSA, 2011), race and ethnicity (Patterson, Lerman, Kaufmann, Neuner, & Audrain-McGovern, 2004), and a complex set of psychological variables (Baker, Brandon, & Chassin, 2004). The current study examines the role of differences in Behavioral Activation and Behavioral Inhibition System sensitivity (BAS and BIS; Gray, 1982, 1990). The BAS and BIS were originally proposed as systems regulating approach and avoidance motivation, respectively. Many individual differences researchers currently treat BAS as composed of three separate aspects relating to approach (e.g., Carver & White, 1994; Smillie, Jackson, & Dalgleish, 2006) and BIS as composed of a single aspect relating to the detection of and response to threat and conflict (e.g., Smillie, Dalgleish, & Jackson, 2007). Although BIS and each of the three aspects of BAS has been shown to relate to alcohol abuse (e.g., O'Connor, Stewart, & Watt, 2009), illicit substance use (Franken & Muris, 2006; Franken, Muris, & Georgieva, 2006) and gambling (e.g., O'Connor et al., 2009), their relationship to cigarette use has been largely unexplored.

To explore the roles of BAS and BIS in cigarette use, we first briefly review the BAS/BIS literature. We then examine possible roles BIS, each aspect of BAS, and their interactions may play at key junctures in the development of cigarette use. Based on this examination, we predict the shapes of the BIS/BAS profiles (i.e., the pattern across the four scores) for never smokers, experimenters, current smokers, and former smokers, as well as differences between these profiles. Finally, we test these hypotheses using a sample drawn from several colleges and universities.

1.1 BAS and BIS

The BAS was originally proposed as a neurological system motivating approach behaviors in response to signals of reward (e.g., Gray, 1982). Current conceptualizations of BAS retain the original focus on approach but are less focused on reward. The most common conceptualization divides BAS into three aspects: “fun seeking”, “reward responsiveness”, and “drive” (Carver & White, 1994). An individual can be highly sensitive on any combination of the three aspects. The three aspects each relate to approach, but differ in what motivates the approach. People high in fun seeking are motivated to seek out new experiences. In this respect, fun seeking resembles sensation seeking conceptualizations of impulsivity. For people high in the second aspect, reward responsiveness, approach is motivated by rewards. These people are more drawn to pleasant stimuli than are people low in reward responsiveness. The third aspect, drive, resembles perseverance. The higher a person is in drive, the more tenaciously he or she will pursue an outcome once selected. Thus, although each aspect relates to approach, they are not interchangeable.

Although BAS is superficially similar to impulsivity, psychometric (e.g., Smillie et al., 2006; Quilty & Oakman, 2004) and neurological (e.g., Stuetgen, Hennig, Reuter, & Netter, 2005) studies suggest at least the reward responsiveness and drive aspects of BAS are distinct from impulsivity. Whereas people high in impulsivity generally fail to consider costs and benefits before acting and have difficulty pursuing long term goals (e.g., Whiteside & Lynam, 2001), people high in reward responsiveness are very sensitive to benefits and those high in drive are dogged in their pursuit of goals (e.g., Carver & White, 1994; Quilty & Oakman, 2004). Accordingly, although a great deal is known about the relationship between impulsivity and cigarette use (e.g., Baker et al., 2004; Spillane, Smith, & Kahler, 2010), that knowledge provides little insight into the relationship of reward responsiveness or drive to cigarette use.

The BIS motivates avoidance in response to signals of conflict or threat (Smillie et al., 2007). Although individuals high in BIS sensitivity can be anxious (e.g., Keiser & Ross, 2011), rather than just worry they attempt to mitigate threats (e.g., Sherman, Mann, & Updegraff, 2006). Put differently, when high BIS individuals detect a potential threat, they try to avoid it. Thus, the finding that individuals high in certain anxiety-related individual differences (e.g., neuroticism) are more likely to become smokers (e.g., Kassel, Stroud, & Paronis, 2003; Munafo, Zetteler, & Clark, 2007) does not necessarily imply high BIS individuals are more likely to become smokers.

To predict how BAS and BIS relate to cigarette use requires considering the context in which these systems function (cf. Kassel et al., 2003). In the current study, we focus on the context created by the categories of cigarette use examined, the portrayal of cigarette use in U.S. culture, and the relationships of BIS and BAS components to each other.

1.2 Context: Categories, Profiles, and Culture

Trying one’s first cigarette is thought to be about exploring unknowns (e.g., Arnett, 2005). In contrast, choosing to continue to smoke involves weighing the negatives of use against the positives (Mayhew, Flay, & Mott, 2000) and choosing to attempt to quit is influenced by

the negatives of use, the positives of quitting, and one's belief that he or she can successfully quit (e.g., DiClemente et al., 1991). The differences between the issues considered at each transition suggest an individual's current stage of cigarette use is an important contextual variable to consider when predicting the roles BIS and aspects of BAS may play. How interested a person is in seeking out the unknown will vary with fun seeking, suggesting this aspect of BAS may play a role in who does or does not experiment with cigarettes. In contrast, the weight a person gives to costs and benefits is impacted by BIS and reward responsiveness, respectively, suggesting these variables may play a role in continuation and in quitting. For quitting, the addition of beliefs one can quit suggests a role for drive as presumably one has some awareness of his or her typical level of perseverance. In short, differences in the nature of the issues considered at each transition suggests that those who have never tried cigarettes (never smokers), those who have tried cigarettes a few times but not developed the habit (experimenters), current smokers, and former smokers will differ from each in BIS and the aspects of BAS in predictable ways.

Of course, the difference in issues involved in transitioning from one stage of cigarette use to another is not the only contextual variable to consider. The extent to which BIS, fun seeking, and reward responsiveness impact behavior will depend on perceptions of the negatives, newness, and positives of the behavior in question. Culture is one factor that may influence these perceptions, and thus constitutes another important contextual variable.

It is also worth noting that BIS, fun seeking, reward responsiveness, and drive may create context for each other. The correlation of BIS with each aspect of BAS is generally not large (e.g., Smits & Boeck, 2006; Voigt et al., 2009). A person may be high in BIS and on all aspects of BAS, low on all, or any other combination. An individual who is high in BIS and drive but low on other aspects of BAS is likely to behave quite differently than one who is high in BIS and fun seeking while low on other aspects of BAS. This suggests it is important to consider overall profiles of BIS and BAS when examining their relationship to cigarette use.

In recent years, people in the U.S. have been exposed to many messages on the hazards of cigarette use (e.g., the "Tips from Former Smokers" campaign, U.S. Centers for Disease Control and Prevention, 2013). Such messages should be particularly persuasive to high BIS individuals, leading such individuals to be less likely to experiment with cigarettes compared to their low BIS counterparts. For people who experiment with cigarettes in spite of having high BIS, such messages would be more likely to discourage them than their low BIS counterparts from continuing to smoke. As such, one would expect never smokers to be higher BIS than experimenters and experimenters to be higher BIS than current smokers. Unlike anxiety prone individuals who enjoy the calming effects of cigarettes (e.g., Kassel et al., 2003; Munafo et al., 2007), high BIS individuals would be repelled by the health hazards.

Although BIS is likely to be important for distinguishing between certain categories of cigarette use, it does not act alone. The fun seeking aspect of BAS is related to the novelty seeking aspects of impulsivity, which have in turn been linked to experimentation with cigarettes (e.g., Bernow et al., 2011; Lipkus, Barefoot, Williams, & Siegler, 1994;

O'Loughlin, Karp, Koulis, Paradis, & DiFranza, 2009; Spillane et al., 2010). Thus, one would expect experimenters to be higher in fun seeking compared to never smokers.

Once one has experimented with cigarettes, the experience ceases to be new. In addition, continuation from experimentation to smoker status is thought to involve weighing costs and benefits of continuation (Mayhew et al., 2000). This suggests continuation may be influenced by BIS and reward responsiveness rather than by fun seeking. A high BIS individual's concern over the negatives of smoking may discourage continuation. In contrast, assuming positive early experiences, a high reward responsiveness individual's concern with the positives of smoking (including any pleasure he or she may feel when smoking) would encourage continuation. This suggests that compared to experimenters, current smokers will be lower in BIS and higher in reward responsiveness.

Finally, BIS, reward responsiveness, and drive are likely to play a role in distinguishing between current and former smokers. People high in BIS are more motivated by warnings of danger than are their lower BIS counterparts (e.g., Sherman et al., 2006). A similar effect has been found for reward responsiveness (Westmaas & Woicik, 2005). Accordingly, smokers scoring higher in BIS and reward responsiveness would be more likely to attempt to quit compared to other smokers. Believing one can successfully quit also plays an important role in attempting to do so (e.g., DiClemente et al., 1991). Compared to those high in drive, people low in drive should be less likely to believe they can succeed, and therefore less likely to attempt to quit. Drive is also likely to influence the success of a cessation attempt. Successfully quitting requires overcoming a number of physiological and affective obstacles associated with withdrawal (e.g., Piasecki, Jorenby, Smith, Fiore, & Baker, 2003), and many smokers who attempt to quit fail or relapse (e.g., Hughes, Keely, Naud, 2004; Piasecki, 2006). Those higher in drive should be more likely to persevere in the face of those obstacles and successfully quit.

The above reasoning leads us to predict specific BIS-BAS profiles for each category. Never smokers are expected to be relatively high in BIS and relatively low in fun seeking. Experimenters are expected to be relatively high in BIS and fun seeking but relatively low in reward responsiveness. Current smokers are expected to be relatively low in BIS, relatively high in fun seeking, moderate in reward responsiveness, and relatively low in drive. Finally, former smokers are expected to be relatively high on all four components.

2. Methods

2.1 Participants

Data were obtained as part of a larger effort examining cigarette use amongst minority college students. A total of 2337 responses were obtained from students at four geographically and ethnically diverse institutions in the U.S. (one each in California, Florida, New York, and Texas). Participants were recruited through email lists, flyers, and classroom announcements depending on the policies of each university, and compensated either with a \$20 (U.S.) credit at Amazon.com or credit towards course research activities requirements. After screening out participants whose responses indicated a lack of attention to the questionnaire (e.g., those whose responses were internally inconsistent), 2010

participants were retained. This level of inattentive responding is consistent with other research using similar methodology (e.g., Goodman, Cryder, & Cheema, 2012). Of those retained, 1887 fell into one of the four cigarette use groups of interest. Consistent with the emphasis of the larger project, the final sample included a large number of minority students. The number of participants listing their race / ethnicity as “other” was small, and therefore this category was excluded from our analyses. This resulted in a final analyzed sample of 1840. Demographics and cigarette use by demographic variables can be found in Table 1.

2.2 Measures and classifications

2.2.1 BIS and aspects of BAS—Carver & White’s (1994) BIS/BAS scale was used to assess BIS and the aspects of BAS. This scale consists of 24 self-descriptive statements. Seven of these pertain to BIS (e.g., “I worry about making mistakes”), four to fun seeking (e.g., “I crave excitement and new sensations”), five to reward responsiveness (e.g., “When good things happen to me, it affects me strongly”), and four to drive (e.g., “When I want something, I usually go all out to get it.”). For all items, participants indicate their response from 1 (very true for me) to 4 (not at all true for me). Each scale is scored by summing across relevant items and reverse scoring so that higher scores indicate higher levels of the relevant construct. Scale reliabilities in the current sample were $\alpha = .61, .72, .87$, and $.76$, respectively. Means and theoretical ranges are in Table 2.

2.2.2 Cigarette use group—Participants were classified as *never smokers* if they answered “no” to the question “have you ever tried a cigarette, even one or two puffs?” ($n = 746$). They were classified as *experimenters* ($n = 545$) if they reported having tried cigarettes but had smoked “fewer than 10” and are no longer smoking. Participants who reported having smoked at least 100 cigarettes in their lifetime were classified as *current smokers* if they reported still smoking ($n = 413$) and *former smokers* if they reported no longer smoking ($n = 136$).

2.2.3 Demographics and control variables—Participants were asked to indicate their age, gender, and race / ethnicity using single item measures.

2.3 Procedure

The study, including consent, was accomplished using a web based survey with branching. Approval was obtained from each institution’s IRB. The questionnaire took an average of 30–50 minutes to complete and consisted of questions pertaining to cigarette use as well as behavioral and attitudinal items not relevant to the current study. Trait measures (i.e., BIS/BAS) were administered as the last block of the questionnaire.

3. Analyses

All analyses were conducted using SAS 9.3 (SAS Institute, 2011). In all analyses, age, gender, race / ethnicity, and sample (i.e., which institution the participant attended) were each entered as control variables. Age, gender, and race / ethnicity were used as controls in recognition of previous findings demonstrating relationships between these variables and

cigarette use (e.g., Patterson et al., 2004; SAMSA, 2011). Sample was included to account for regional differences in prevalence of cigarette use (SAMSA, 2011) and the fact that our samples had been selected in part to represent regions known to differ. In all cases, control variables and predictors were entered simultaneously. However, they were not allowed to interact as allowing such interactions resulted in sparsely populated cells and potentially unstable estimates of effects.¹ All test statistics reported were calculated controlling for all other terms in the model (i.e., type III analyses).²

Multivariate analysis of variance (MANOVA) was used to compare the profiles of BIS and BAS scores across cigarette usage groups. To examine which aspects of these profiles distinguished between adjacent cigarette use groups, we treated group membership as binary and used logistic regression. Significance for logistic regression was assessed using change in fit tests (denoted G^2) due to limitations of Wald tests (Hauck and Donner, 1977). Effect sizes are reported in terms of proportional improvement in fit (denoted R_L^2). This metric is loosely analogous to R^2 in linear regression, but typically yields smaller values (Menard, 2000). All terms used in the MANOVA were entered simultaneously, as were all terms used in the logistic regressions.

4. Results

Prior to conducting our primary analyses, we examined the correlations between BIS, fun seeking, reward responsiveness, and drive. As can be seen in Table 2, the magnitude of the correlations varied widely and the scales had different potential ranges. To account for the unequal correlations, profiles were analyzed using MANOVA. To place all scales on a common metric and reduce the risk of collinearity, scores on all four scales were converted to z-scores prior to analysis. The MANOVA revealed a significant interaction between scale and cigarette use group ($p < .001$), but no between-subjects effect of group ($p = .055$). This indicates that the patterns of means (i.e., the shape of the profile) varied by cigarette use group whereas the grand mean (i.e., combined across scales) did not. Multivariate contrasts revealed the shape of the profile for never smokers differed from that of experimenters ($p < .001$), current smokers ($p < .001$), and former smokers ($p = .024$). The shape for experimenters differed from that of current ($p = .010$) but not former ($p = .989$) smokers. Profiles of current and former smokers did not differ from each other in shape ($p = .113$), but did differ in overall mean ($p = .012$). Profiles are presented in Figure 1, and full results can be found in Table 3.

To examine the roles of BIS, fun seeking, reward responsiveness, and drive in distinguishing between neighboring groups, we conducted a series of logistic regressions. Terms representing z-scores of each of these four variables were entered as continuous predictors and allowed to interact freely with each other. Significant effects of the control variables, when found, were consistent with findings for this age group reported by SAMSA (2011). For example, the probability of being a smoker relative to an experimenter was higher for

²Omission of the control variables increased the effect size for the effects of interest, but did not substantively alter the interpretation of effects.

Results on other aspects of the project were presented at the National Conference on Tobacco or Health (2012), and preliminary results pertaining to BIS/BAS were presented at the 2013 meeting of the Society for Personality and Social Psychology.

males than for females and for participants from regions with higher cigarette use (Texas and Florida) compared to participants in other regions (California and New York). Results also revealed older participants were more likely to be in later stages of cigarette use (e.g., experimenters instead of never smokers, smokers instead of experimenters) than were younger participants.

As shown in Table 4, never smokers and experimenters were distinguished from each other by fun seeking ($p < .001$) and the four-way interaction of BIS, fun seeking, reward responsiveness, and drive ($p = .041$). Experimenters were distinguished from smokers by reward responsiveness ($p < .001$). Contrary to expectations, current smokers were lower in reward responsiveness than were experimenters (see Figure 1). Current smokers were also lower in reward responsiveness than former smokers ($p = .004$). Several interactions involving BIS, reward responsiveness, and drive also achieved significance when comparing current and former smokers. Descriptively, these interactions suggest high levels of BIS and reward responsiveness can, to at least some extent, compensate for low levels of drive. For example, participants who were high in BIS but low in drive had a higher probability of being former smokers relative to current smokers than were participants who were low in both BIS and drive.

5. Discussion

We began by noting that unlike other areas in the addiction literature, research on cigarette use has largely overlooked BIS and the aspects of BAS. The frequent and graphic reminders of the hazards of cigarette smoking in U.S. culture led us to expect BIS would be relevant to cigarette use in this sample. Research on the context provided by transitions from never smoker to experimenter, experimenter to smoker, and smoker to former smoker led us to predict the roles of BIS, fun seeking, reward responsiveness, and drive in distinguishing between cigarette use groups would vary depending on the groups being compared. Finally, the loose associations between BIS, fun seeking, reward responsiveness, and drive allowed us to treat them as context for each other and to examine their interactions in addition to their individual relationships with cigarette use.

Our analyses supported the value of examining the pattern of BIS and BAS scores in concert rather than as independent predictors. Multivariate analyses revealed significant interactions between scale and cigarette use group. In most cases, it was the shape of the profile rather than the overall mean that varied. Similarly, logistic regression revealed terms representing higher order interactions of BIS with aspects of BAS often made significant contributions to distinguishing between usage groups. An examination of the effect sizes reveals these associations were somewhat larger than meta-analytic estimates of the associations of extraversion or neuroticism to cigarette use (e.g., Munafo et al., 2007).

The shapes of the profiles were mostly consistent with our predictions. Never smokers were high (above average) on BIS but low on fun seeking, experimenters were moderately high on both BIS and high on fun seeking, and former smokers were moderate on BIS while high on fun seeking, reward responsiveness, and drive. However, current smokers deviated from our predictions. Rather than being high in fun seeking and moderate in reward

responsiveness, current smokers were well below average on each. Importantly and contrary to predictions, smokers were also lower in reward responsiveness than the experimenters. We offer several possible explanations for this discrepancy. The first involves the positive association between reward responsiveness and the likelihood of forming intentions to quit (e.g., Westmass & Woicik, 2005). Based on this association we reasoned reward responsiveness might influence which smokers attempt to quit. It is possible that in our sample those smokers who were high in reward responsiveness had already successfully quit (i.e., were former smokers). Another possibility can be found in research suggesting prolonged nicotine use inhibits reward sensitivity (e.g., Versace et al., 2011; Paelecke-Habermann, Paelecke, Giegerich, Reschke, & Kubler, 2013). Our current smokers may have had relatively high reward responsiveness when they became smokers, but over time became lower in reward responsiveness due to the inhibitory effects of the nicotine they consumed. Third, our current smokers were particularly low in BIS. As such, even relatively low reward responsiveness may have provided sufficient motivation to continue smoking. Finally, although the results of the MANOVA did not reveal a significant between-subjects effect of cigarette use group collapsing across predictors, the effect did approach significance ($p = .055$). This may suggest smokers' sensitivity to both threat and reward are unusually low to start with or become dampened by prolonged exposure to one or more substances in cigarettes. Given that ours was a cross-sectional design, we cannot evaluate which of these possibilities, if any, is correct, but we consider it an intriguing question for future research.

Our cigarette use groups represent a static picture of a fluid process (i.e., experimenters may become smokers and smokers may become former smokers). However, this snapshot provides insight into the role BIS and the aspects of BAS may play in predicting which individuals transition from one stage to another. Taken together, our data suggest the roles of BIS, fun seeking, reward responsiveness, and drive vary with the stage of cigarette use. Contrary to expectations, BIS by itself (i.e., the main effect of BIS) did not distinguish between never smokers and experimenters, experimenters and smokers, or smokers and former smokers. As predicted, fun seeking distinguished between never smokers and experimenters, but not between experimenters and smokers. Also as predicted, reward responsiveness distinguished current smokers from former smokers but did not distinguish never smokers from experimenters. Reward responsiveness also distinguished experimenters from current smokers, but not in the direction predicted. Equally important, our data suggest BIS, reward responsiveness, and drive interact in complex ways. Alone, neither BIS nor drive distinguished between the cigarette use groups compared. However, BIS and drive interacted with each other and reward responsiveness to distinguish between current and former smokers. The overall pattern suggests that people person who do not easily persevere (i.e., are low drive) may still successfully quit if they have strong enough reason to want to quit (e.g., higher BIS, higher reward responsiveness, or both). However, those who easily persevere will not quit unless they perceive a reason to try.

On a methodological note, our results suggest researchers need to be cautious in collapsing across categories of cigarette use. Those who have never tried cigarettes, those who experimented but never formed a habit, and former smokers could all be called “non-

smokers” and in some studies have been. However, these groups differ from each other in theoretically interesting and practically useful ways. Combining such groups into one generic category overlooks such differences and may reduce the usefulness of the results.

One of the more disturbing implications of our findings stems from the fact current smokers scored low on all four predictors. This suggests the smokers in our sample will be relatively unaffected by campaigns based on the hazards of smoking or benefits of quitting and that alternate approaches are needed. We do not mean to suggest interventions based on the hazards of smoking or benefits of quitting cannot be effective. Indeed, our predictions assumed such campaigns prevent some people from taking up smoking and encourage others to quit. However, our data suggest that participants in our sample who were still smoking are unlikely to stop smoking in response to such interventions.

Like any study, our results may have been influenced by the nature of our sample. Because the larger effort of which this study was a part focused on college students, we used a college sample. Thus, our results are most applicable to persons between 18 and 25 years of age. Some may consider a college sample to be relatively high socioeconomic status (SES) as well. However, because college students have not yet completed their education and are at best transitioning into the workforce, it is common to assess their SES in terms of parental SES (Krieger, Williams, & Moss, 1997). Institutional data from the schools involved reveals that as many as one-third of students at the participating institutions come from families in which neither parent attended college. A similar proportion reports annual parental income of less than \$30,000 (U.S.). Thus, although we cannot rule out restricted SES in our sample, the range of SES is likely to be less restricted than is often assumed for college students.

Overall, our findings suggest that further research examining the relationships of BIS and BAS to cigarette use is likely to yield useful and interesting results. We particularly encourage longitudinal research evaluating the ability of profiles consisting of BIS, fun seeking, reward responsiveness, and drive to prospectively identify at risk individuals.

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HIGHLIGHTS

- Profiles consisting of standing on BIS and aspects of BAS vary with cigarette use
- BIS is negatively related to smoking, suggesting BIS is not simply negative affect
- Fun seeking distinguishes never smokers from experimenters
- Reward responsiveness distinguishes experimenters from smokers
- Reward responsiveness distinguishes smokers from former smokers

Figure 1.
Mean scores (standardized within scale) on BIS and BAS components by cigarette use category. Error bars represent standard error of the mean.

Table 1

Sample characteristics and percentage of participants falling into each cigarette use group, by control variables.

Control Variable	Cigarette Use Group				n
	Never Smokers	Exp.	Current Smokers	Former Smokers	
Gender					
Male	33.2%	25.2%	34.1%	7.5%	822
Female	47.3%	33.2%	12.3%	7.2%	1018
Age					
18–19	55.0%	30.6%	11.5%	2.9%	571
20–21	42.8%	33.9%	18.6%	4.7%	441
22–23	38.2%	28.6%	25.9%	7.3%	293
24–25	29.6%	28.0%	34.4%	8.0%	186
over 25	23.3%	23.8%	35.0%	17.9%	349
Ethnicity or Race					
Hispanic	37.1%	31.3%	24.5%	7.1%	1067
Non-Hispanic White	34.8%	28.2%	25.4%	11.6%	422
Asian	52.2%	30.2%	14.1%	3.5%	199
Black / African Am.	65.1%	21.1%	11.2%	2.6%	152
Texas	35.3%	33.2%	21.9%	9.6%	703
California	59.0%	26.6%	9.4%	5.0%	410
New York	50.3%	34.4%	9.3%	6.0%	385
Florida	19.5%	19.8%	53.5%	7.2%	342
Overall	40.5%	29.6%	22.5%	7.4%	1840

Table 2

Overall sample means and correlations of primary study variables. Values on diagonal represent scale reliability.

	Theoretical Range	Mean	SD	1	2	3	4
1. BIS	7 – 28	19.70	3.70	(.61)			
2. BAS Fun Seeking	4 – 16	11.66	2.67	.28	(.72)		
3. BAS Reward Responsiveness	5 – 20	16.17	3.60	.48	.65	(.87)	
4. BAS Drive	5 – 20	11.21	2.72	.17	.63	.61	(.76)

Table 3

Multivariate tests of differences in profile by cigarette use category

Comparison	<i>F</i>	df (den / num)	<i>p</i>	Wilks'Λ
All categories				
Category	2.54	3 / 1819	.055	.996
Category × Scale	2.63	9 / 4422.3	<.001	.973
Pairwise Contrasts				
Never vs Experimenter				
Category	1.09	1 / 1819	.297	.999
Category × Scale	7.73	3 / 1817	<.001	.987
Never vs Current				
Category	0.93	1 / 1819	.334	.999
Category × Scale	12.41	3 / 1817	<.001	.980
Never vs Former				
Category	3.64	1 / 1819	.057	.998
Category × Scale	3.20	3 / 1817	.024	.995
Experimenter vs Current				
Category	3.27	1 / 1819	.071	.998
Category × Scale	3.81	3 / 1817	.010	.994
Experimenter vs Former				
Category	1.69	1 / 1819	.194	.999
Category × Scale	0.04	3 / 1817	.989	1.000
Current vs Former				
Category	6.31	1 / 1819	.012	.997
Category × Scale	2.00	3 / 1817	.113	.997

Table 4

Logistic regressions examining control variables, BIS, BAS components, and the interactions of BIS and BAS components for distinguishing between adjacent cigarette use groups.

Term	Never vs Experimenter			Experimenter vs Current			Current vs Former		
	G^2	p	R_L^2	G^2	p	R_L^2	G^2	p	R_L^2
Gender	0.03	.865	.000	32.11	<.001	.030	11.48	.001	.023
Age	27.87	<.001	.017	36.13	<.001	.034	24.64	<.001	.048
Race / Ethn.	31.02	<.001	.019	1.37	.850	.001	7.20	.126	.015
Sample	30.27	<.001	.018	63.8	<.001	.058	22.52	<.001	.044
BIS	1.06	.827	.000	1.06	.304	.001	0.13	.718	.000
FS	15.49	<.001	.009	0.78	.376	.001	1.70	.192	.004
RR	3.04	.081	.002	14.53	<.001	.014	8.15	.004	.016
DR	0.30	.583	.000	2.98	.085	.003	0.10	.754	.000
BIS $\times$ FS	0.61	.436	.000	0.43	.514	.000	1.03	.309	.002
BIS $\times$ RR	0.98	.322	.001	2.37	.123	.002	0.98	.323	.002
BIS $\times$ DR	2.18	.140	.001	0.02	.887	.000	4.37	.037	.009
FS $\times$ RR	0.35	.557	.000	0.01	.933	.000	1.37	.242	.003
FS $\times$ DR	0.43	.511	.000	2.66	.103	.003	0.09	.766	.000
RR $\times$ DR	0.07	.799	.000	0.72	.395	.001	1.38	.240	.003
BIS $\times$ FS $\times$ RR	0.37	.545	.000	0.18	.673	.000	2.29	.130	.005
BIS $\times$ FS $\times$ DR	1.24	.266	.001	0.99	.320	.001	9.02	.003	.018
BIS $\times$ RR $\times$ DR	0.30	.581	.000	1.20	.274	.001	4.26	.039	.009
FS $\times$ RR $\times$ DR	0.00	.983	.000	0.02	.885	.000	0.00	.966	.000
4-way	4.17	.041	.003	0.33	.563	.000	4.66	.031	.009

Note: N varies by comparison as some categories had more people than others. In order, the n 's for each comparison were 1291, 958, and 549. All reported G^2 are based on change in fit when the parameter for that term is entered last. FS = fun seeking, DR = drive, and RR = reward responsiveness.