Interactive Effects of the BIS and the BAS on Trajectories of Alcohol Misuse after University Graduation

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ABSTRACT: Reinforcement Sensitivity Theory predicts that those with a strong behavioral inhibition system (BIS) likely experience considerable anxiety and uncertainty during the transition out of university. Accordingly, they may continue to drink heavily to cope during this time (a period associated with normative reductions in heavy drinking), but only if they also have a strong behavioral approach system (BAS) to enhance the anxiolytic effects of drinking. The purpose of this study was to test this hypothesis. Participants completed online measures prior to and at 3-month intervals over the course of the year following graduation. As hypothesized, results showed that an elevated BIS predicted impeded maturing out, but only when the impulsivity facet of BAS was also elevated. In contrast, a strong BIS predicted rapid maturing out if BAS impulsivity was weak. Study findings advance our understanding of BIS-related alcohol misuse trajectories in young adulthood and provide direction for clinical interventions.

KEYWORDS: young adults, maturing out, alcohol misuse, behavioral inhibition system, behavioral approach system

Introduction

Alcohol use varies developmentally – increasing in late adolescence, peaking in the early 20s, and declining sharply thereafter.[1–3] Alcohol use among young adults is twice that of adults and many experience problems related to heavy drinking (eg, blackouts and sexual victimization).[4] While most individuals mature out of alcohol misuse (defined as reductions in both alcohol use and related problems) postuniversity with no lasting problems,[5] some young adults continue to drink heavily and go on to develop an alcohol use disorder (AUD).[6,7] Indeed, reports suggest that ~6.8% of Canadian adults meet the criteria for AUDs.[8] Accordingly, more theory-guided research is needed to identify and understand the key predictors of continued alcohol misuse risk during this transition. Such work has the potential to inform clinical intervention efforts to reduce the development of AUDs in adulthood.

An estimated 82% of Canadian young adults attend college/university.[9] The typical process is to move through undergraduate studies, in ~three to five years, and then transition out.[10] When young adults graduate from university, there is a normative (and expected) transition into adult roles, which include getting married, starting a family, and finding meaningful employment.[10] Research shows that transitioning into these roles is associated with maturing out of alcohol misuse.[11,12] Research also shows that this transition comes with new and often added stress[13] and that young adults who drink to cope appear less likely to mature out of heavy drinking postuniversity relative to those who drink for other reasons.[14] Anxious individuals may have particular trouble navigating the uncertain and stressful transition out of university. Evidence shows that those who struggle with anxiety drink alcohol to cope with negative emotions, putting these individuals at risk for alcohol misuse.[15,16] In addition, the literature consistently demonstrates a high comorbidity of anxiety disorders and AUDs in adulthood.[17,18] However, earlier in the risk pathway (ie, university studies), studies linking anxiety to alcohol misuse are mixed.[19–21] Research shows that those with elevated anxiety are at risk for alcohol problems during the undergraduate years; however, their level of alcohol use is largely indistinguishable from their peers.[22,23] This is presumably because university is associated with normative heavy drinking. When we look later in young adulthood, we

speculate that the transition out of university may be important for solidifying the anxiety–alcohol misuse association. Specifically, at a time when nonanxious peers normatively mature out of alcohol use, anxious persons may have problems on alcohol use patterns during this period, as a way to cope with life change, increased uncertainty, and new stressors.

Gray's reinforcement sensitivity theory (RST)[24] posits that the behavioral inhibition system (BIS) is central to understanding the anxiety pathway to alcohol misuse. Over a decade ago, the RST was revised (rRST) and extensive changes were made to the BIS.[25] These changes are only beginning to be integrated into etiological models of alcohol misuse.[26,27] The revised BIS is a motivational conflict resolution system,[28] which is distinct from the original theory, which viewed the BIS as purely a punishment sensitivity system. The BIS inhibits behavior in response to goal conflict (eg, reward–punishment conflict) and engages a risk assessment,[29] which results in anxiety, attention to threat, and typically behavioral avoidance.[30] To date, the evidence linking BIS to alcohol misuse is mixed.[31,32] This is not surprising because the rRST predicts that the BIS–alcohol misuse relation is complex. On one hand, BIS-anxiety may promote coping-related drinking, while, on the other hand, conflicting reward (eg, tension-reduction) and punishment (eg, sickness) drinking cues should activate the BIS, leading to behavioral ambivalence about drinking and increased attention to alcohol's negative outcomes. Therefore, a strong BIS may reduce the likelihood of heavy use.

The rRST suggests that the behavioral approach system (BAS) may moderate the effect of BIS on alcohol misuse.[29] The rRST posits that the BAS controls approach behavior to both conditioned – as in Gray's original theory[24] – and unconditioned reward cues. The BAS is multifaceted and is associated with biased attention to reward, goal persistence, impulsiveness, and approach behavior.[28,30,33] Accordingly, a concurrently strong BAS should enhance the negatively reinforcing effects of alcohol use and this should be salient to persons high in BIS, resulting in alcohol approach to relieve anxiety. Our published work supports this prediction[26] and we more recently showed that these individuals might be at risk for alcohol misuse because they expect rewarding outcomes from drinking.[34] In contrast, BIS may reduce the risk of alcohol misuse if BAS is low. Without a strong BAS drawing attention to the anxiolytic effects of alcohol use, those with a strong BIS may hyperfocus on alcohol's negative outcomes and thus should not drink heavily.

With the exception of one study,[27] most studies testing the BIS by BAS interaction are cross-sectional.[26,31,35] Those high in BIS should experience marked anxiety during the transition out of university since it is wrought with signals of reward (eg, getting dream job) and punishment (eg, remaining unemployed). This high anxiety may put them at continued risk for alcohol misuse, but only if they have a concurrent strong BAS. That is, those with both a strong BIS and BAS should not be maturing out as normatively as others. In contrast, those high in BIS, but low in BAS, should focus on

alcohol's negative impact on functioning during this transition (eg, missed work due to hangover and interpersonal dysfunction). Thus, an elevated BIS may be associated with more rapid maturing out if BAS is low.

Our goal was to examine the trajectories of anxiety-related drinking as young adults make the meaningful transition out of university. While the extant literature has looked extensively at factors that predict normative maturing out,[5,10] less attention has been given to factors that are central to continued alcohol misuse. We aimed to begin filling this gap in the literature. We used a repeated measures longitudinal online study, where we followed young adults over the course of the year following graduation. Based on theory[29] and evidence,[26,27] we expected that having an elevated BIS would be associated with increased prospective risk (ie, impeded maturing out) for alcohol misuse during the transition out of university, but only when BAS was also elevated. On the flip side, we expected that having an elevated BIS would be associated with more rapid maturing out than when BAS was low. Some extant literature has examined the unique effects of four facets of the BAS (eg, impulsivity, goal-drive persistence, reward interest, and reward reactivity) on alcohol misuse.[26] Accordingly, these facets of BAS were considered as potential moderators in the current study.

Method

Participants and procedure. A sample of 121 undergraduates were recruited from English-speaking universities in Montreal. Two participants were excluded as they were outliers on age (>3SD above mean), resulting in a final initial sample of $N = 119$ ($M_{age} = 23.18$, $SD_{age} = 2.17$; 71% women). All interested students completed a brief online screening to confirm eligibility before participating. To participate, students had to (a) be in their graduating year of undergraduate studies; (b) not have taken more than one-term (ie, four consecutive months) off from school (excluding summer and including the transition from CEGEP to university); (c) be a full-time student; (d) be fluent in English; and (e) have no history of alcohol abuse (ie, ≥35 drinks per week). Participants completed one-hour online assessments at baseline just before graduation and at three-month intervals post graduation for a total of five measurements spanning one year. Of the initial sample, 61% of students were Caucasian and minority ethnicities represented were East Asian, South-East Asian, and Pacific Islander (9%); Middle Eastern, North African, and Central Asian (9%); Hispanic (6%); Black (4%); South Asian (3%); Aboriginal (1%); and 7% reported "other." Participants received $15 per survey with a potential $25 bonus for completing all time points. The Ethics Review Board at Concordia University approved all study procedures. Our study complied with the principles outlined in the Declaration of Helsinki, and participants gave their informed consent to participate in the research.

Of the initial sample, 85% completed the three-month assessment ($n = 101$), 74% completed the six-month assessment ($n = 88$), 70% completed the nine-month assessment ($n = 82$),

and 62% completed the final one-year assessment ($n = 74$). Of those who completed all time points ($n = 66$), employment status at one-year was as follows: 52% full time, 32% part time, and 16% unemployed. Also, at one-year follow-up, 71% of participants were not enrolled in any postsecondary education, 23% were in a graduate program, and a small minority (6%) returned to complete part-time undergraduate studies.

Measures. *The Reinforcement Sensitivity Theory of Personality Questionnaire.* The Reinforcement Sensitivity Theory of Personality Questionnaire (RST-PQ) includes 79 items and measures the rRST systems.[36] The item content of the RST-PQ was derived from novel items developed by Corr and Cooper (2015) and from existing measures of the original RST (eg, Carver and White's [1994] BIS/BAS Scales). The RST-PQ was given at baseline. Of interest in the current study was the single BIS subscale (23 items; eg, "The thought of mistakes in my work worries me") and the four BAS subscales, which include BAS reward interest (7 items; "I regularly try new activities just to see if I enjoy them"), BAS goal-drive persistence (7 items; "I put in a big effort to accomplish important goals in my life"), BAS reward reactivity (10 items; "I am especially sensitive to reward"), and BAS impulsivity (8 items; "I think I should 'stop and think' more instead of jumping into things too quickly"). Participants indicated how accurately these items described them on a 4-point response scale ranging from 1 (*not at all*) to 4 (*highly*). Responses were summed to provide a BIS and four BAS subscale scores. High scores indicate elevated sensitivity of a given rRST system. The RST-PQ subscales used in the current study have been shown to have acceptable to excellent internal reliabilities (Cronbach's $\alpha = 0.76$–0.92).[36,37] In our sample, the range of internal reliabilities was comparable (Cronbach's $\alpha = 0.71$–0.93).

The Alcohol Use Disorders Identification Test. The Alcohol Use Disorders Identification Test (AUDIT) includes 10 items and provides an assessment of alcohol misuse, which includes measurement of alcohol use and related problems (eg, "Have you or someone else been injured as a result of your drinking?").[38] The AUDIT was administered at all five time points and was used as the primary measure to assess maturing out of alcohol misuse. Participants responded to items on response scales, with the first 8-items ranging from 0 (*never*) to 4 (*four or more times a week*), while items 9 and 10 range from 0 (*no*) to 2 (*yes, during the last year*). Total sum scores were used. The AUDIT has been shown to have adequate internal consistency ($\alpha = 0.72$–0.76) and very good test–retest reliability ($r = 0.84$).[39] The internal consistency of the AUDIT total scores was adequate ($\alpha = 0.76$).

Data analytic overview. Following data screening and preliminary analyses (missing data analysis, descriptive statistics, and bivariate correlations), latent growth curve modeling (LGM) was used to test hypotheses. Preacher et al's guidelines[40] for LGM were followed. Before examining any models, the mean trajectory of alcohol misuse over the five assessment points was plotted to better understand the nature of change

(ie, linear and quadratic) and guide model specification. Next, model testing proceeded in two stages. First, the unconditional growth model (ie, model without covariates) was tested, which involves testing the intercept-only model followed by examining the model with growth. Second, provided there was good fit to the data of the unconditional model, the conditional model was tested. This involved specifying baseline (Time 1) BIS, BAS, and the BIS × BAS interaction term as predictors of intercept and slope values of alcohol misuse and then examining model fit. A total of four conditional models were run, each testing a different domain of the BAS as a moderator of the effect of BIS on alcohol misuse during the transition out of university.

Model fit was considered good if the χ^2 was not statistically significant, the comparative fit index (CFI)[41] was >0.95, the root mean square error of approximation (RMSEA) was ≤ 0.05, and the standardized root mean square residual (SRMR) was <0.08.[42–44] For supported moderation effects, we used the guidelines outlined by Aiken and West[45] and by Preacher et al.[46] to examine simple slopes within the LGM framework. Predictor variables (BIS and BAS) were centered to reduce multicollinearity and facilitate interpretation. The simple slopes of BIS predicting intercept and slope values of alcohol misuse were conditioned at high (+1SD above the mean) and low (–1SD below the mean) values of BAS.

Results

Missing data analysis. Missing data analysis indicated that those with complete data ($n = 66$) did not differ significantly at baseline from those with incomplete ($n = 53$) data in terms of alcohol misuse ($t_{(117)} = 1.63$, $p = 0.11$), BIS strength ($t_{(117)} = 0.63$, $p = 0.53$), BAS impulsivity ($t_{(117)} = 1.04$, $p = 0.30$), BAS goal-drive persistence ($t_{(117)} = -1.53$, $p = 0.13$), BAS reward interest ($t_{(117)} = 1.55$, $p = 0.13$), and BAS reward reactivity ($t_{(117)} = 0.36$, $p = 0.72$). Also, missingness was uncorrelated with gender ($r = 0.11$, $p = 0.25$) and age ($r = -0.04$, $p = 0.63$). Given the lack of differences, we assume that data are missing at random (MAR).[47] In addition to having incomplete data across assessments, the AUDIT scores were nonnormally distributed at each time point. Accordingly, full information maximum likelihood (FIML) was used to estimate our LGM. FIML is considered the preferred method for handling missing data because it uses all available information to estimate model fit and parameters.[48,49] In our study, this means that FIML uses all available data from 119 participants to estimate the model parameters. Parameter estimates obtained using FIML have also been shown to be relatively unaffected by nonnormal distributions.[48] Furthermore, FIML requires data to be at least MAR and thus was appropriate to use in the current study.

Descriptive statistics and bivariate correlations. Descriptive statistics and correlations are presented in Table 1. Of particular note, BIS was uncorrelated with alcohol misuse at any of the five assessments, whereas BAS impulsivity was positively correlated with alcohol misuse at baseline, three months, six months, and one year postuniversity. Measures of the BIS

Table 1. Descriptive statistics and correlations for variables used in latent growth curve models.

	1	2	3	4	5	6	7	8	9	10	MEAN	SD
1. T1 BIS	1.00	0.22[a]	−0.04	−0.14	0.06	0.11	0.07	0.12	0.06	0.18	55.78	13.87
2. T1 BAS impulsivity		1.00	0.27[b]	0.56[b]	0.47[b]	0.19[a]	0.21[a]	0.25[a]	0.11	0.27[b]	18.53	4.16
3. T1 BAS goal-drive persistence			1.00	0.54[b]	0.53[b]	−0.09	−0.06	−0.03	−0.26[b]	−0.11	22.13	3.89
4. T1 BAS reward interest				1.00	0.41[b]	0.10	0.01	0.06	0.00	0.03	19.52	4.28
5. T1 BAS reward reactivity					1.00	0.01	0.05	0.06	−0.01	0.15	29.57	4.99
6. T1 Alcohol misuse (AUDIT)						1.00	0.69[b]	0.66[b]	0.67[b]	0.62[b]	6.84	4.71
7. T2 Alcohol misuse (AUDIT)							1.00	0.65[b]	0.61[b]	0.72[b]	5.53	4.57
8. T3 Alcohol misuse (AUDIT)								1.00	0.74[b]	0.76[b]	5.25	4.48
9. T4 Alcohol misuse (AUDIT)									1.00	0.64[b]	4.82	4.17
10. T5 Alcohol misuse (AUDIT)										1.00	4.46	3.70

Notes: [a] $p < 0.05$. [b] $p < 0.01$.
Abbreviations: T1, baseline; T2, nine months postuniversity; T3, six months postuniversity; T4, nine months postuniversity; T5, one year postuniversity; BIS, behavioral inhibition system; BAS, behavioral approach system; AUDIT, Alcohol Use Disorders Identification Test.

and BAS impulsivity were positively correlated at baseline, but the BIS was uncorrelated with other facets of the BAS. The correlations between assessments of alcohol misuse across time were statistically significant and positive.

Hypothesis testing: latent growth curve modeling. Preliminary inspection of the mean alcohol misuse trajectory showed that growth was linear in a decreasing direction. The model with just the intercept provided poor fit to the data ($\chi^2_{(13)} = 33.01$, $p = 0.00$, CFI = 0.85, RMSEA = 0.11, 90% confidence interval (CI) [0.07, 0.16], SRMR = 0.10), suggesting that the intercept-only model did not accurately capture the data. Next, a linear slope factor (loadings were 0, 1, 2, 3, and 4) was added to the model and the intercept and slope were freely correlated. The addition of the linear slope significantly improved model fit ($\Delta\chi^2_{(3)} = 18.64$, $p < 0.001$). The model provided excellent fit to the data ($\chi^2_{(10)} = 13.71$, $p = 0.19$, CFI = 0.97, RMSEA = 0.05, 90% CI [0.00, 0.12], SRMR = 0.05) and, therefore, was retained as the unconditional growth model.

The mean ($\mu = 6.59$, $p = 0.00$) and the variance ($\Psi = 15.65$) of the intercept factor were statistically significant, indicating that individuals reported an average starting point of growth that was different from zero and that there was variability around this average. The significant mean of the slope factor ($\mu = -0.46$, $p = 0.00$) suggests that, on average, individuals were decreasing alcohol use postuniversity. The variance of the slope ($\Psi = 0.15$, $p = 0.55$) factor was not statistically significant; however, as discussed elsewhere,[43,50,51] there may still be meaningful variability in outcome changes over time, irrespective of statistical significance. In this situation, it has been argued that predictors can still tease apart meaningful variability in the slope.[52] This is presumably because there is increased power when predictors of change are added to the model. Accordingly, we tested the expected conditional growth models, where baseline BIS, BAS, and the BIS × BAS interaction term were specified as predictors of baseline and change in alcohol misuse post graduation. The

correlation between the intercept and slope ($r = -0.62$, $p = 0.02$) indicated that persons who started out with high levels of alcohol use decreased drinking over time.

In the first conditional growth model, BAS impulsivity was tested as a moderator of the effect of BIS on intercept and slope alcohol misuse. This model fits the data well ($\chi^2_{(19)} = 25.25$, $p = 0.15$, CFI = 0.97, RMSEA = 0.05, 90% CI [0.00,0.10], SRMR = 0.06; Fig. 1). BIS was not a statistically significant predictor of either the intercept or the slope factors. BAS impulsivity was a statistically significant positive predictor of intercept alcohol misuse, but not of change in alcohol misuse. As expected, the BIS × BAS impulsivity interaction term was a statistically significant predictor of both intercept and slope alcohol misuse. For the intercept, simple slopes analyses revealed some (albeit nonstatistically significant) support for BIS as a positive predictor of elevated baseline levels of alcohol misuse, at low ($B = 0.07$ [standard error {SE} = 0.04], $t = 1.73$, $p = 0.08$), but not high ($B = -0.05$ [SE = 0.04], $t = -1.48$, $p = 0.14$) BAS impulsivity. Regarding slope, as hypothesized, simple slopes analysis (Fig. 2) revealed that elevated levels of BIS predicted impeded maturing out of alcohol misuse at high BAS impulsivity ($B = 0.03$ [SE = 0.01], $t = 1.95$, $p = 0.05$). Also, results supported the hypotheses that BIS predicted rapid maturing out of alcohol misuse over the one-year postuniversity period at low levels of BAS impulsivity ($B = -0.02$ [SE = 0.008], $t = -2.38$, $p = 0.02$).

The results of the remaining three conditional LGMs are reported in Table 2. All models fit the data well. First, there were no statistically significant first-order effects of BIS and BAS goal-drive persistence on intercept or slope alcohol misuse. BAS goal-drive persistence moderated the effect of BIS on intercept (but not slope) alcohol misuse, such that BIS predicted elevated alcohol misuse prior to graduation at low ($B = 0.07$ [SE = 0.03], $t = 1.97$, $p = 0.05$), but not at high BAS goal-drive persistence ($B = 0.01$ [SE = 0.01], $t = 1.10$, $p = 0.27$). Second, the first-order effects of BIS and BAS reward interest on intercept and slope alcohol misuse were not statistically significant.
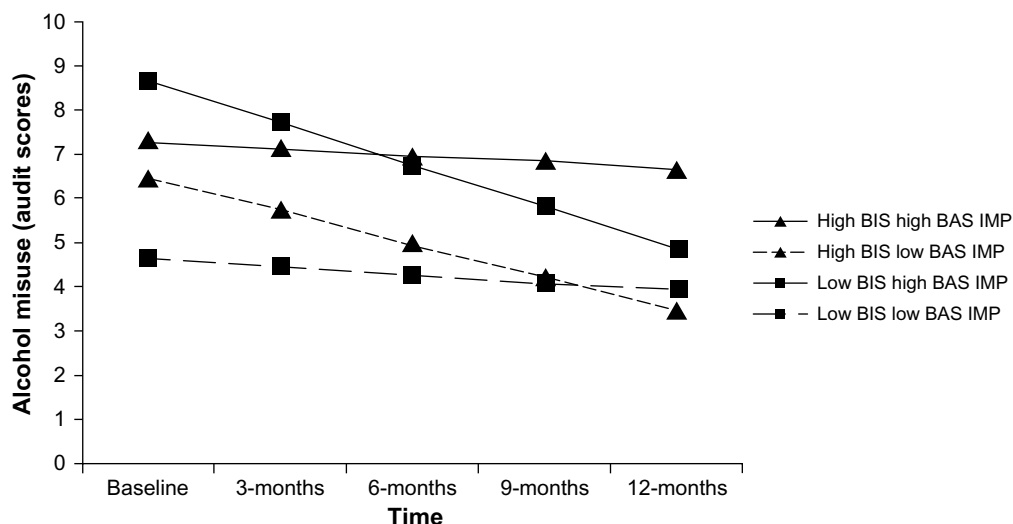
Figure 1. The conditional latent growth curve model with the BIS, the impulsivity facet of the BAS, the BIS × BAS impulsivity interaction term predicting intercept and slope alcohol misuse. Path coefficients are presented in this order: unstandardized estimates (standard error) and standardized estimates. The path coefficients for the slope (0, 1, 2, 3, and 4) specify a linear slope at three-month intervals for the year post graduation.
Abbreviations: T1, baseline; T2, three months post graduation; T3, six months post graduation; T4, nine months post graduation; T5, one year post graduation.
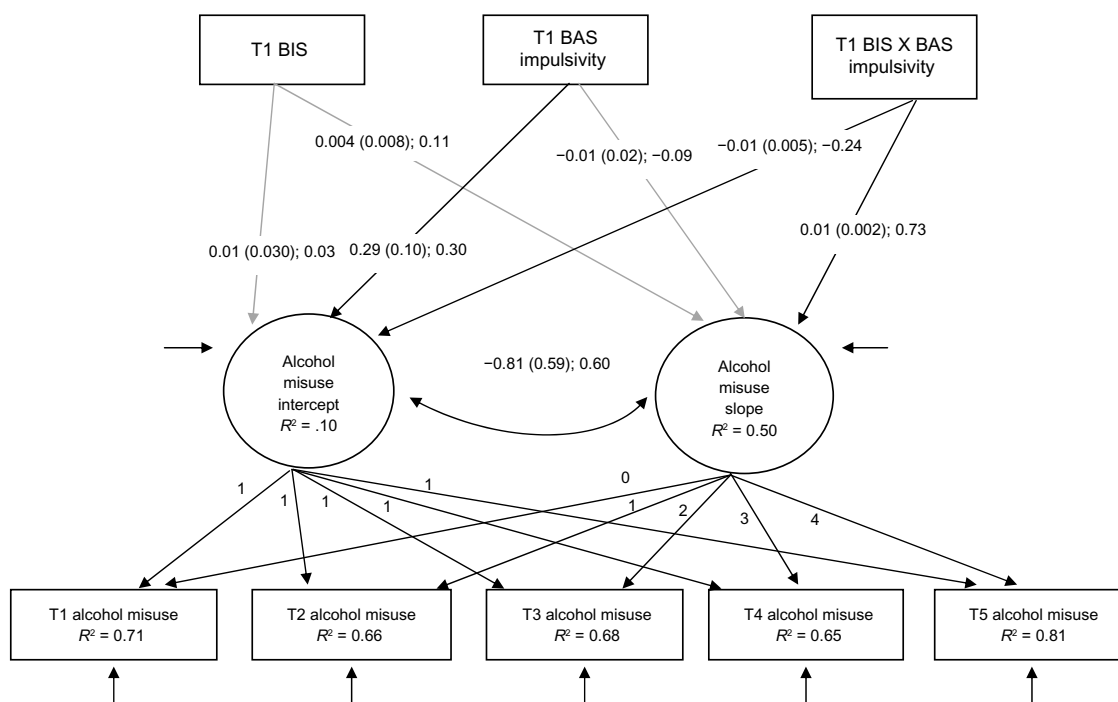

Figure 2. The conditional growth trajectories of alcohol misuse over time for the interactive effects of the BIS and the impulsivity facet of the BAS (IMP).

As expected, BAS reward interest moderated the effect of BIS on slope (but not intercept) alcohol misuse. However, follow-up simple slopes analysis did not support BIS as a predictor of the alcohol misuse slope at low ($B = -0.01$ [SE $= 0.01$], $t = -1.27$, $p = 0.20$) or at high ($B = 0.02$ [SE $= 0.02$], $t = 1.14$, $p = 0.26$) BAS reward interest. Instead, the supported BIS by BAS reward interest interaction term seemed to reflect the opposing

direction of the simple slopes, and while these were not statistically significant, the direction aligns with hypotheses. Finally, no statistically significant first-order effects of BIS and BAS reward reactivity were observed. BAS reward reactivity moderated the effect of BIS on intercept (but not slope) alcohol misuse, such that BIS predicted elevated alcohol misuse prior to graduation at low ($B = 0.07$ [SE $= 0.04$], $t = 1.88$, $p = 0.06$),

Table 2. Summary of conditional latent growth curve models.

PARAMETER	UNSTANDARDIZED ESTIMATE (SE)	STANDARDIZED ESTIMATE	P-VALUE	MODEL FIT
Intercept alcohol misuse factor				
BIS	0.03 (0.02)	0.10	0.27	$\chi^2_{(19)}$ = 27.19, p = 0.10, CFI = 0.96, RMSEA = 0.06 90% CI [0.00, 0.11], SRMR = 0.05
BAS goal-drive persistence	−0.09 (0.10)	−0.09	0.35	
BIS x BAS goal-drive persistence	−0.01 (0.006)	−0.17	0.05	
Slope alcohol misuse factor				
BIS	0.01 (0.01)	0.02	0.95	
BAS goal-drive persistence	−0.01 (0.02)	−0.06	0.81	
BIS x BAS goal-drive persistence	0.003 (0.002)	0.47	0.08	
Intercept alcohol misuse factor				
BIS	0.03 (0.03)	0.13	0.32	$\chi^2_{(19)}$ = 21.28, p = 0.32, CFI = 0.99, RMSEA = 0.03 90% CI [0.00, 0.09], SRMR = 0.04
BAS reward interest	0.14 (0.09)	0.15	0.14	
BIS x BAS reward interest	−0.01 (0.01)	−0.14	0.11	
Slope alcohol misuse factor				
BIS	0.01 (0.01)	0.13	0.67	
BAS reward interest	−0.02 (0.01)	−0.14	0.40	
BIS x BAS reward interest	0.003 (0.002)	0.48	0.05	
Intercept alcohol misuse factor				
BIS	0.02 (0.03)	0.08	0.43	$\chi^2_{(19)}$ = 21.64, p = 0.31, CFI = 0.99, RMSEA = 0.03 90% CI [0.00, 0.09], SRMR = 0.04
BAS reward reactivity	0.03 (0.09)	0.04	0.70	
BIS x BAS reward reactivity	−0.01 (0.005)	−0.21	0.04	
Slope alcohol misuse factor				
BIS	0.01 (0.01)	0.11	0.68	
BAS reward reactivity	0.02 (0.02)	0.20	0.33	
BIS x BAS reward reactivity	0.002 (0.001)	0.38	0.09	

but not at high BAS reward reactivity (B = −0.03 [SE = 0.04], t = 1.18, p = 0.24).

Discussion

The main objective of the present study was to examine the trajectories of alcohol misuse for BIS-related drinking as young adults transition out of university. This transition is highly stressful and uncertain, and we speculated that this provides a context for those with an elevated BIS and an elevated BAS to continue or even escalate alcohol misuse in an effort to cope with life changes. Consistent with previous works on maturing out,[5,11] we found that young adults, overall, decreased their alcohol misuse after graduating from university. Further, as expected, anxiety-prone individuals showed impeded maturing out during the one-year post graduation if they also had elevated BAS impulsivity. Also as predicted, those high in BIS showed rapid maturing out if they were concurrently low in BAS impulsivity. We did not find clear support for the moderating role of other facets of BAS on the effect of BIS on the trajectory of alcohol misuse over time.

Our study is the first in the literature to show that the interactive effects of BIS and BAS are useful for differentiating between those who may mature out as opposed to those who may continue to struggle with alcohol misuse. While we only looked at a short period of time, we observed that the trajectories of BIS-related drinking after university depended particularly on one's concurrent level of BAS impulsivity. Recently, it has been argued by several authors that impulsivity plays a central role in distress-related drinking.[26,53–56] Inherent in this perspective is the notion that concurrently elevated impulsivity is needed to clarify why some anxiety-prone individuals – who are by nature indecisive, inhibited, and focused on threat (eg, the negative outcomes of drinking) – approach alcohol for coping-related purposes. Our study moves this literature forward by suggesting that the stressful and uncertain transition out of university is a particularly relevant context for impulsivity and anxiety to interact to promote continued alcohol use risk. We speculate that elevated impulsivity, in anxiety-prone individuals, may bias focus on alcohol's immediately gratifying effects (eg, anxiety relief) and thus draw attention away from the potential longer term consequences of alcohol misuse (eg, occupational problems).[57,58] Conversely, anxiety-prone individuals may be more apt to overfocus on drinking's negative outcomes (and its subsequent impact on functioning) if they are low on impulsivity and this may deter alcohol misuse postuniversity.

Our models supported three facets of BAS (ie, impulsivity, goal-drive persistence, and reward reactivity) as moderators of the BIS effect on baseline alcohol use (ie, alcohol misuse intercept). Consistent with our previous work,[26] these findings suggest that impulsivity-related and drive aspects of BAS are particularly important moderators of the effects of BIS on alcohol misuse. However, the nature of the moderating effects was unexpected, as elevated BIS was associated with increased alcohol misuse at baseline, when BAS was low. This is in contrast to what has been found with similar investigations, using cross-sectional data.[26] Foremost, these findings further highlight the complexity of BIS as a risk factor for alcohol misuse. They also point to potential developmental and contextual nuances of the BIS by BAS effect on drinking, which are difficult to capture in a cross-sectional framework. We speculate that those high in BIS, and low in BAS, may not be dissuaded from alcohol use when the perceived risks are low. In our data, the baseline assessment was completed at the end of the academic year, when academic responsibilities were winding down and drinking would not have had a big negative impact. It would be an interesting direction for future research to explore what might motivate drinking for individuals with a high BIS and low BAS when anxiety may not be elevated. Taking a prospective lens, our results suggest that despite what may have promoted heavy drinking in university for those high in BIS and low in BAS, with the transition into adult roles (and arguably increased stress), these individuals showed a notable decline in their drinking.

Theory would predict that persons high in BIS and high in BAS are at continued alcohol misuse risk postuniversity because of cognitive mechanisms that support distress-related drinking.[22] While we did not examine mechanisms, our results provide direction for future work in this area. Specifically, shifts in coping drinking motives during the transition out of university may help explain our results.[5] Drinking to cope emerges as the most prominent motivator of alcohol misuse postuniversity[59] and coping motives are the only reasons for drinking that steadily increase from ages 22–30.[14] This suggests that risky coping-motivated drinking unfolds throughout the broader course of young adulthood. This may be particularly relevant for those high in BIS and BAS, as they may strengthen coping motives in response to having difficulty navigating stressful roles of young adulthood. In turn, due to strong coping motives, they may continue to misuse alcohol when others have long-matured out. As such, future research should take a longer scope (ie, across young adulthood, ages 20–30) and test the mediating role of coping motives in the BIS pathway. Another closely related possibility is that their drinking norms shift during the transition out of university. In particular, those high in BIS and high in BAS may come to view drinking to cope as an acceptable behavior in adulthood (ie, drinking to relax at the end of the day is normal and typical for adults), whereas norms for undergraduate drinking supported social heavy use. Future work should examine shifts in coping-related drinking norms

to better understand the cognitions that mediate prospective alcohol misuse risk among those high in BIS and high in BAS.

There are some limitations of our study. First, we were limited in only being able to look at drinking behavior in the earliest stages of transition. Due to this, there are a number of important longer term aspects of the postuniversity transition (eg, getting married and starting a family) that we were unable to integrate into our models of alcohol use. This is a notable limitation because the literature shows marked changes in drinking behavior as young adults navigate the period of time between 22 and 30 years old.[60] Accordingly, it would be interesting for future work to examine the trajectories of BIS-related drinking over a longer period of time (eg, five years). This would provide a broader perspective on anxiety-related drinking patterns during transition and may have relevance for clarifying who is at risk for the onset of AUDs later in adulthood. Second, due to the small sample size, our study findings should be considered a preliminary step toward examining BIS-related trajectories of drinking postuniversity. Replication of our findings in a larger sample is warranted. Finally, we were unable to test gender-specific pathways given our preponderance of women. Research suggests that this is an important direction for future work, given gender differences for anxiety-related drinking[54] and alcohol misuse patterns postuniversity.[59]

Conclusion

Our study represents an important first step in understanding the trajectories of anxiety-related drinking postuniversity. We show that BIS-related drinking during the stressful transition out of university depends on impulsivity facets of the BAS. Our work has the potential to inform prevention and clinical intervention efforts. Healthcare providers at universities could provide general psychoeducation (via workshops, brochures, and online resources) to students about normative maturing out and the potential costs of anxiety-related drinking. Regarding those most at risk, clinicians should work with anxiety-prone, impulsive individuals to reduce coping reasons for drinking. This may allow them to adopt more positive coping strategies to deal with the stressful transition out of university.

Author Contributions

Conceived and designed the experiments: MTK, RMO. Analyzed the data: MTK. Wrote the first draft of the manuscript: MTK. Contributed to the writing of the manuscript: MTK, RMO. Agreed with manuscript results and conclusions: MTK, RMO. Jointly developed the structure and arguments for the paper: MTK, RMO. Made critical revisions and approved the final version: MTK, RMO. Both the authors reviewed and approved the final manuscript.

Ethics

The Ethics Review Board at Concordia University approved all study procedures.

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