



# Exploring Heterogeneity in Risk and Protective Factors of Harmful and Hazardous Drinking

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## BACKGROUND

Emerging and young adults, including college students, have consistently been shown to have high rates of excessive alcohol use and binge drinking, as well as negative alcohol-related problems, including alcohol use disorder or AUD (Hingson et al., 2017; Kanny et al., 2018). Although this problem has long been recognized, current prevention and treatment efforts are still largely ineffective (Litten et al., 2015; Witkiewitz et al., 2019). This lack of progress has been attributed to the wide heterogeneity regarding the multiplicity of factors related to harmful and hazardous drinking (Litten et al., 2015; Kwako et al., 2016; Witkiewitz et al., 2019).

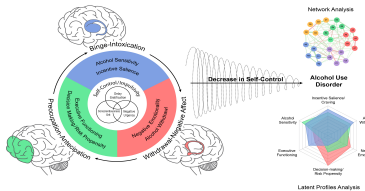
Recognizing that problematic drinking is an etiologically and functionally heterogeneous condition, several researchers (e.g., Litten et al., 2015; Kwako et al., 2016) have highlighted the need for more and better research aimed at understanding this heterogeneity and its implications for intervention and treatment efforts.

Based on the extensive psychological literature on alcohol and addiction research, along with recent advances in the neurobiology of addiction and stages of the addiction cycle (Koob et al., 2001), as well as recent efforts to devise an extensive neurocognitive assessment of addiction (Kwako et al., 2016) and, finally, the most influential theoretical perspectives of drug and alcohol dependence, we identified 7 core functional domains for problematic drinking.

The current study aimed to (Aim 1) determine the unique and specific effects of seven functional domains on alcohol use and related experiences; (Aim 2) determine the classification utility of varying combinations of functional domains in discriminating individuals at risk; (Aim 3) identify common profiles of the hypothesized functional domains that may either protect or place individuals at higher risk; (Aim 4) identify the most "central" domains for the emergence, development, and maintenance of persistent harmful and hazardous drinking (see conceptual model below).

## METHOD

The final sample included data from 552 participants (61% female; 81% White; 18-29 years-old). Participants completed an assessment battery consisting of self-report and behavioral task measures that provided demographic and personal history information, alcohol use and related experiences, and estimates of neurocognitive abilities pertaining to the domains depicted in the conceptual model.



### Executive Functions:

- Attentional Control Scale (ACS)
- Number-Letter
- Adult Executive Functioning Inventory (ADEXI)
- Antisaccade
- N-Back
- Decision-Making/Risk Propensity:
  - General Risk Propensity Scale (GRIPS)
  - Risk Taking Index (RTI)
  - Balloon Analogue Risk Task (BART)
  - Iowa Gambling Task (IGT)
  - UPPS-P Sensation-Seeking

### Alcohol Sensitivity:

- Self-Rating of the Effects of Alcohol form (SRE)
- Alcohol Sensitivity Questionnaire (ASQ)

### Alcohol Withdrawal:

- Hangover Symptoms Scale (HSS)
- Alcohol Dependence Scale (ADS)
- Withdrawal Symptoms

### Incentive Salience/Craving:

- Obsessive-Compulsive Drinking Scale (OCDS)
- Appetitive Rating Task (ART)
- Adolescent Reinforcement Survey Schedule
- Negative Emotionality:
  - Affect Balance Scale (ABS)
  - Big Five Inventory (BFI) – Neuroticism
  - Drinking Motives Questionnaire-Revised (DMQ-R)
  - Profile of Mood States (POMS)

### Self-Control/Disinhibition:

- Brief Self-Control Scale (BSC)
- Delaying Gratification Inventory (DGI)
- UPPS-P – Negative Urgency
- Crit Scale
- Big Five Inventory-2 (BFI-2-S) – Conscientiousness
- Abbreviated Impulsiveness Scale (ABIS)
- Externalizing Spectrum Inventory (ESI-Bf)

## RESULTS

### Fit Indices of Measurement Models Used to Derive Factor Score Estimates for Each Functional Domain

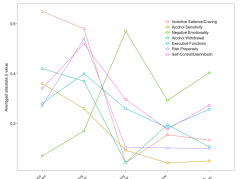
Functional Domain	Model Fit							
	$\chi^2$	df	SRMR	RMSEA [90% CI]	CFI	TLI	FD	H
Executive Functions	2.18	3	0.011	0.000 [0.000-0.064]	1.00	1.00	.84	.71
Decision-Making/Risk Prop.	0.47	4	0.003	0.000 [0.000-0.006]	1.00	1.00	.94	.89
Negative Emotionality	39.14***	9	0.026	0.078 [0.054-0.104]	0.97	0.95	.93	.87
Alcohol Withdrawal	10.86***	2	0.028	0.090 [0.043-0.145]	0.99	0.96	.99	.98
Incentive Salience/Craving	2.94	2	0.014	0.029 [0.000-0.094]	1.00	0.99	.88	.84
Alcohol Sensitivity	6.97	2	0.015	0.049 [0.000-0.099]	0.99	0.98	.99	.98
Self-Control/Disinhibition	141.89***	25	0.043	0.092 [0.078-0.107]	0.95	0.92	.95	.92

NOTE. df = degrees of freedom; SRMR = standardized root-mean residual; RMSEA = root-mean-square error approximation; CFI = confidence interval; CFI = comparative fit index; TLI = Tucker-Lewis index; FD = factor scores determinacy; H = construct replicability. \*\*\*p < .001

### Aim 1: To determine the unique and specific effects of seven functional domains on alcohol involvement

Table 8. Summary of Regression Analyses Predicting Alcohol-Related Outcomes from Hypothetical Functional Domains, Controlling for Age, Sex, and SES.

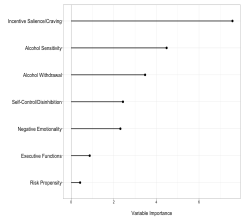
Outcome	Age-Adjusted							Age-Adjusted + Sex							Age-Adjusted + Sex + SES						
	SES	SES	SES	SES	SES	SES	SES	SES	SES	SES	SES	SES	SES	SES	SES	SES	SES	SES			
Alcohol Involvement	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			



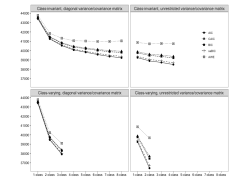
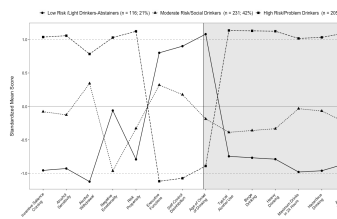
### Aim 2: To determine the classification utility of varying combinations of functional domains

Table 9. Classification Performance for Self-Reported Alcohol-Related Experiences Predicting Risk for Harmful and Hazardous Drinking.

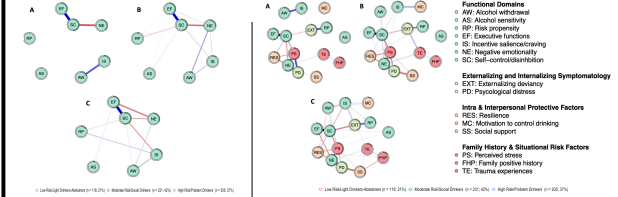
Model	Classification Performance									
	Accuracy	Specificity	Sensitivity	ROC Area	ROC Error	ROC CI	ROC SE	ROC SD	ROC P	ROC Q
Executive Functions	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85



### Aim 3: To identify common profiles of the hypothesized functional domains



### Aim 4: To identify the most "central" domains for persistent harmful and hazardous drinking



## CONCLUSIONS

- All functional domains were differentially associated with measures of alcohol use and related experiences and failed to consistently show robust associations with all alcohol-related measures, when tested simultaneously. Negative Emotionality showed a handful of unexpected negative associations.
- The combination of Incentive Salience/Craving, Alcohol Withdrawal, and Alcohol Sensitivity produced the single most parsimonious and optimal combination with the best classification utility. Incentive Salience/Craving demonstrated by far the strongest predictive utility and diagnostic value.
- We identified three homogeneous and well-separated classes characterized by distinct underlying risk profiles of neurocognitive abilities pertaining to the functional domains, as well as unique patterns of alcohol use and related experiences: Low Risk/Light Drinkers-Abstainers (n = 116, 21%); Moderate Risk/Social Drinkers (n = 231, 42%); and High Risk/Problem Drinkers-Abstainers (n = 205, 37%).
- Self-Control/Disinhibition was consistently identified as the most interconnected and highly central domain. No significant differences were found in either local or global connectivity of the class-specific network architectures.

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