

The Impact of Personality on the Physical Activity and Alcohol Use Relationship

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Studies have shown positive associations between levels of physical activity and alcohol use at both between-persons and within-person levels. This relationship has been of interest to researchers developing physical activity-based treatments for alcohol use disorders, which have had mixed results, one reason perhaps being because they have not controlled for individual differences. The current study investigated whether differences in Five-Factor Model personality traits moderated the physical activity-alcohol use relationship in an undergraduate sample (N = 263). Results showed lifestyle physical activity, extraversion, and neuroticism were each predictive of alcohol use, but there were no interaction effects among these variables, indicating that personality traits do not impact the strength of this relationship. Therefore, individuals high in traits of extraversion or neuroticism are not specifically at risk for increased alcohol use when participating in physical activity. If exercise-based interventions for alcohol use disorders are implemented, individuals high in extraversion and neuroticism continue to possess independent risk factors for alcohol use.

Keywords: physical activity, alcohol, personality, Five-Factor Model, moderation.

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Introduction

Engaging in deliberate physical activity (PA) is generally considered a health-promoting behavior; whereas, using alcohol is considered a health-risk behavior and linked to negative consequences such as aggression, dating violence, and blackouts [2]. Despite this contrast, studies have shown a consistent positive association between PA and alcohol

intake on both cross-sectional (between-persons) [16] and longitudinal (within-person) levels [4; 11]. This pattern aligns closely with an established profile of moderate drinkers, who, in addition to consuming alcohol, highly value their physical health, as opposed to episodic drinkers, who consume only marginally more alcohol but are less health-oriented in values and behaviors [21].

These contrasting patterns of alcohol use and PA behaviors have been of interest to researchers developing treatments for alcohol use disorders (AUDs). To this end, treatments that have focused on increasing PA as a replacement for alcohol use have had mixed results. Although some studies (e.g., [5]) have shown increases in participants' PA during interventions, they usually have not shown decreases in participant alcohol use compared to controls. Conversely, treatment studies using PA as an adjunctive facet of a traditional AUD intervention have found more promising results [7]. The mixed results of these treatments and the differences between moderate and episodic drinkers suggest both types of interventions may be lacking in potency by not addressing individual differences. An intervention that works for one individual may be ineffective, or even iatrogenic, for another individual if the motivations, frequencies, or intensities that they participate in these behaviors differ. Thus, the question becomes: which individual differences impact PA and alcohol use?

Research has examined demographic, motivational, and social factor differences in PA and alcohol use and has found factors such as age and gender may be important moderators of this relationship [17]. One understudied factor that has been implicated as another possible moderator is personality. To date, one study has demonstrated the role of impulsivity as a moderator of the PA-alcohol use relationship [16], another has found conscientiousness predicted both PA and alcohol use but did not moderate the relationship [1], and a third has found no main or moderating effects of extraversion or impulsivity on this relationship [3]. However, no other relationships with personality have been studied, nor have these existing results been replicated.

Although research examining the role of personality traits in the PA-alcohol use relationship is scarce, many studies have examined the relationships of personality to PA and alcohol use separately. These studies commonly use the Five Factor Model (FFM) of personality, which conceptualizes normative personality using five traits: neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness [19]. Each of these traits has its own unique relationship to patterns of alcohol use and PA, complicating the picture of the positive association between these two variables.

Higher levels of extraversion and neuroticism, and lower levels of conscientiousness have been linked directly to higher levels of alcohol use [12]. In contrast, although agreeableness and openness to experience have been shown not to have direct associations with alcohol use, research has suggested that these variables may have indirect effects on alcohol use. That is, agreeableness has a negative indirect relationship to alcohol use and openness to experience has a positive indirect effect on alcohol use [18]. Individuals high in extraversion are more likely to report exercising on a regular basis than their less-extraverted peers (e.g., [20]), and highly conscientious individuals also report exercising or participating in athletic activities with greater frequency than others [20]. On the other hand, individuals who exercise regularly are more likely to report low neuroticism

scores [23]. The roles of openness and agreeableness in relation to PA are less clear-cut; one meta-analysis found higher levels of openness were associated with more PA, with a small effect size [23], but no consistent associations have been found between agreeableness and PA [23].

Some of these trait patterns, such as extraversion (high alcohol /high PA), support the positive association between PA and alcohol use, while others, such as neuroticism (high alcohol/low PA) or conscientiousness (low alcohol/high PA), suggest these variables would be more likely to show a negative association. This raises the question of whether PA and alcohol use are positively associated at all levels across all personality types. If differences are found among these varied personality profiles, they may clarify some differences seen across studies using exercise as a component of treatment for AUDs.

The current study is a secondary analysis of data collected by Henderson and colleagues [13] examining daily (within-person) and usual (between-person) relations between PA and alcohol use. Abrantes and colleagues' extensive examination of factors contributing to the complex relationship between PA and alcohol use [1] suggested the need for further study of moderating factors on this relationship in our own dataset. Thus, the current study aimed to examine whether differences in personality trait profiles moderate the PA-alcohol use relationship.

Hypotheses included: (a) individuals who are more physically active on average will consume more alcohol, and (b) on days when people are more active than usual, they will consume more alcohol. FFM personality traits were examined as potential moderators of these daily and usual relations. Further hypotheses were: (c) extraversion and openness would be enhancing moderators, in which increasing levels of these moderators increase the salience of the PA-alcohol use relationship and (d) neuroticism and conscientiousness would be buffering moderators, in which increasing levels of these moderators decrease the salience of the relationship.

Methods

Participants

The sample for the current study comprised 263 undergraduate participants recruited from a mid-sized regional Southern University. Of the 263 total participants, the majority were female (60.8%) and averaged 21.68 years of age ($SD = 5.34$). Most participants identified as Caucasian (57.8%). Nineteen percent of participants identified as African American/Black, and 25% of participants identified as Hispanic. Table 1 contains a detailed list of demographic data.

Measures

Baseline survey. Participants were asked to provide details regarding their age, gender, race, and ethnicity, along with baseline levels of PA and alcohol use over the past 30 days. At baseline, participants were also asked to provide self-report data on personality characteristics using either the Ten-Item Personality Inventory [10] or the Big-Five Inventory [14]. Researchers began the study administering the BFI; however, the switch to the TIPI was made midway (along with making other adjustments to shorten the

assessment battery) to reduce participant burden. The convergent validity of the TIPI compared to the BFI is substantial, with a mean convergent correlation of $r = .77$. Participant scores on the TIPI and BFI were converted to z-scores for analyses.

The Ten-Item Personality Inventory (TIPI; [10]). The TIPI is a 10-item self-report scale of FFM personality traits. Each item consists of two descriptive words using the common stem “I see myself as:” and is rated on a 7-point scale, with 1 corresponding to “Disagree Strongly” and 7 corresponding to “Agree Strongly.” Each personality trait is assessed by two items, one of which is reverse-coded. We scored the TIPI in the current study by summing subscale values, resulting in trait scores between 2 and 14. Internal consistency measures of the TIPI are low, due to the presence of only two items for each subscale. Specifically, Cronbach alphas were .68 (poor), .40 (poor), .50 (poor), .73 (fair), and .45 (poor) for the Extraversion, Agreeableness, Conscientiousness, Emotional Stability (Neuroticism), and Openness to Experience scales respectively.

The Big-Five Inventory (BFI; [14]). The BFI is a 44-item self-report scale of FFM personality traits. Each item consists of a short phrase using the common stem “I see myself as someone who...” and is rated on a 5-point scale, where 1 corresponds with “Disagree strongly” and 5 corresponds with “Agree strongly”. The measure contains subscales representing each FFM trait, and we scored each subscale by summing item responses, resulting in subscale scores between 8 and 50. In U.S. and Canadian samples, the alpha reliabilities of the BFI scales typically range from .75 to .90 (fair to excellent) and average above .80 (good).

Physical Activity. The Actical PA monitor (Philips Respironics, Bend, OR) is a research-grade accelerometer designed to track energy expenditure and step count that is worn on the wrist. It can collect data in segments as short as one second and track 25 fitness-related statistics. For this study, raw PA counts were recorded in 60-second periods over the 14-day follow-up. Periods of time with no activity over the course of 60 minutes were counted as non-wear time. Activity count classifications were adopted from Giffuni and colleagues [8]: for the purposes of the current study, PA was divided into lifestyle activity (100–1 725 counts/min) and exercise (1 726–4 117+ counts/min) and was calculated as the total number of minutes within each intensity level for that day beginning at 6am and ending at 12am¹. The Actical accelerometer has been validated in several studies for objective assessment of PA [6].

Alcohol Use. Alcohol use was measured using a self-report question in a daily survey sent to participants. Each day, participants responded to the following question: “Since yesterday, did you use alcohol?”. Response options were dichotomous “Yes/No”. This daily data collection method allowed researchers to avoid problems and inconsistencies with individuals’ recall that may be associated with retrospective measures.

Procedures

Participants were recruited via the university’s Department of Psychology online research participation site and compensated with research credits. Researchers met with

¹ Activity was not tracked between 12am and 6am to account for sleep.

participants for a baseline session in which students gave informed consent, were oriented to the goals and requirements of the study, and completed the baseline survey. Researchers then distributed individually calibrated Actical PA monitors. Participants were directed to wear the monitor on their wrist continuously for the 14-day period of the study, including when they were sleeping, and to remove the Actical monitor only when participating in water-related activities. Finally, participants provided an email address to receive daily surveys.

Alcohol use surveys were sent to participants daily for 14 days, with participants receiving instructions to complete each survey no later than 12pm the following day. Researchers sent text messages to participants' cell phones throughout the day as motivational reminders to complete surveys. Because the Actical monitor was initially activated at different times for each participant, researchers offset start times such that periods of PA monitoring began at midnight of day 1.

Data Analysis

The current study drew on the methods used in the parent study [13]. Although some moderators of the PA-alcohol use relationship, including personality, were considered in the parent study, these relationships were examined only in relation to moderate and vigorous PA (i.e., the "exercise" category of the current study), and did not include analyses in relation to lifestyle activity.

Multilevel logistic regression models with days nested within people were used to test hypotheses regarding within- (daily) and between-person (usual) associations between PA levels (lifestyle and exercise) and alcohol use. Although the missing at random (MAR) assumption cannot be directly evaluated, we examined the missingness mechanism through correlations between key study variables (demographic characteristics, PA levels, alcohol use, day of week) and a binary variable representing missing alcohol use data. As correlations were negligible ($r/\varphi < .10$), we treated incomplete data as MAR and used Full Information Maximum Likelihood estimation to reduce bias.

When PA distributions were examined in the parent study, they were found to be highly positively skewed, and a logarithmic transformation was applied to improve normality of the data. Transformed PA data were also used in the current study and included as predictors of daily alcohol use, along with personality data. After each predictor was tested, interactions between personality z-scores and PA levels were tested as predictors of daily alcohol use. Product interaction variables were formed by centering the main effects of the PA and personality predictor variables and multiplying the centered variables together.

Results

Participants did not provide daily alcohol use responses in 32% of the total number of days available, and 7 participants did not provide enough data to estimate within-person associations. Activity data were captured at a higher rate (92% of days). After removing cases with missing alcohol data or lack of daily variability, the final dataset consisted of 2 190 daily reports from 228 students. Descriptive statistics for these data are shown in

Table 1. Participants reported an average of 1.23 drinking days over the two-week period ($SD = 1.71$, range = 0-6). On average, they reported 392.58 minutes of lifestyle PA ($SD = 145.44$), and 29.11 minutes of exercise ($SD = 23.30$) per day.

Table 1

Demographics and descriptive statistics

	N (Total = 263)	Percentage
Gender		
Male	103	39.2
Female	160	60.8
Ethnicity		
Caucasian	152	57.8
African American	50	19.0
Asian	3	1.1
American Indian or Alaskan Native	2	0.7
Native Hawaiian or Pacific Islander	1	0.3
Other	32	12.2
Declined to Report	23	8.7
Body Mass Index		
Underweight	12	4.6
Normal Weight	135	51.3
Overweight	66	25.1
Obese	50	19.0
	Mean	Standard Deviation
Age	21.68	5.34
Days of Alcohol Use	1.23	1.71
White, non-Hispanic	1.14	1.72
Black/African American	1.30	1.48
Hispanic	1.24	1.77
Male	1.41	1.97
Female	1.12	1.69

	Mean	Standard Deviation
Activity Counts		
Lifestyle	392.58	145.44
Exercise	29.11	23.30
Big Five Inventory		
Extraversion	26.92	6.39
Agreeableness	40.38	6.34
Conscientiousness	34.71	5.10
Neuroticism	21.61	6.35
Openness to Experience	36.12	5.72
Ten Item Personality Inventory		
Extraversion	8.13	2.46
Agreeableness	8.32	1.93
Conscientiousness	9.54	2.24
Neuroticism	9.27	2.19
Openness to Experience	8.31	2.49

Notes. Days of alcohol use are calculated as days of use over two weeks (14 days). Activity counts are measured in minutes per day.

First, we tested whether PA and day of the week variables predicted daily alcohol use using multilevel regression. These results are shown in Table 2. Analyses revealed the only significant predictors at the daily level were day of the week, in which the social weekend (Thursday-Sunday) was positively associated with a higher likelihood of drinking (b 's = .79–1.68, p 's < .01). This relationship was strongest on Saturdays. In contrast, neither lifestyle PA ($b = -.25$, $p = .63$) nor exercise ($b = .69$, $p = .84$) were significant predictors of alcohol use on a daily level.

Next, we added personality and PA levels as usual-level predictors (see Table 2). Analyses revealed lifestyle PA ($b = 2.34$, $p = .05$), extraversion ($b = .44$, $p < .01$) and neuroticism ($b = .33$, $p = .04$) significantly predicted usual alcohol use. Exercise and other personality variables were not significant predictors of alcohol use on a usual level.

Finally, after determining the presence of main effects for extraversion and neuroticism, four product interaction variables were formed by combining each of these personality variables with each of the two PA variables. The results of these interaction analyses are shown in Table 2. Analyses revealed that none of the product interaction variables significantly predicted alcohol use on a usual level.

Table 2

Alcohol use regression analyses

Predictors	<i>b</i>	SE	<i>z</i>	<i>p</i>
Daily Level				
Lifestyle Activity	-0.25	-0.52	-0.49	0.63
Exercise	0.69	3.40	0.20	0.84
Thursday	0.79	0.27	2.97	< 0.01
Friday	1.21	0.24	5.03	< 0.01
Saturday	1.68	0.24	6.88	< 0.01
Sunday	1.15	0.26	4.51	< 0.01
Usual Level				
Lifestyle Activity	2.34	1.18	1.99	0.05
Exercise	-6.11	6.50	-0.94	0.35
Extraversion	0.44	0.15	2.91	< 0.01
Agreeableness	0.09	0.16	0.56	0.58
Conscientiousness	0.07	0.15	0.46	0.65
Neuroticism	0.33	0.16	2.03	0.04
Openness to Experience	< 0.01	0.16	0.06	0.95
Interaction Effects				
Lifestyle Activity*Extraversion	-1.02	1.16	-0.88	0.38
Lifestyle Activity*Neuroticism	-0.71	1.12	-0.63	0.53
Exercise*Extraversion	-2.54	8.39	-0.30	0.76
Exercise*Neuroticism	8.78	7.26	1.21	0.23

Notes. Significant findings in bold. Personality trait ratings are z-scores based on the combination of both Big Five Inventory (BFI) and Ten Item Personality Inventory (TIPI) scores. Listed interactions represent a timed model of usual-level interactions after removing non-significant main effect variables.

Discussion

The current study investigated the moderating effects of FFM personality traits on the association between PA and alcohol use by identifying main effects among daily- and usual-level PA, alcohol use, and personality variables, then investigating interaction effects among these relationships. Our results showed between-persons positive associations

among light PA, extraversion, neuroticism, and alcohol use; they also showed within-persons associations among day of the week and alcohol use, indicating that participants were most likely to drink alcohol on the social weekend (Thursday–Sunday). No significant moderating effects were found for our personality variables.

Given the results of the parent study [13], which utilized the same dataset, the limited relationships between PA and alcohol use found in this sample were unsurprising. Although these analyses were consistent with the findings of the parent study, they suggest a more limited scope of the PA-alcohol use relationship in our sample than has been shown on both between-persons (e.g., [16]) and within-person [4] levels in previous studies. Despite differences from previous samples, our findings display consistency with a more recent failure to replicate the within-person daily association of this relationship within a college student sample [3], and a finding that only light PA is predictive of increased odds of alcohol use when PA is measured with an accelerometer [9]. Also consistent with previous literature (e.g., [12]) is a main effect showing a positive association between extraversion and alcohol use. However, despite literature showing a positive association between extraversion and PA (e.g., [8; 20]), no significant interaction effect emerged when extraversion was tested as a moderating variable. Similarly, our finding that neuroticism was positively associated with alcohol use was in concordance with previous literature [12]; however, no interaction effect emerged when it was tested as a moderator.

Taken together, these results suggest personality traits do not moderate the relationship between PA and alcohol use. Although extraversion and neuroticism predict alcohol use alone, they do not interact with PA levels to predict whether a person is more likely to drink. Therefore, individuals high in extraversion or neuroticism are not specifically at risk for increased alcohol use when participating in PA; however, if PA-based interventions for AUDs are implemented, highly extraverted or neurotic individuals continue to possess independent risk factors for alcohol use that are not necessarily addressed by these interventions. Instead, these personality risk factors may be related to alcohol use through factors such as their impact on general levels of positive and negative affect, which have been shown to interact with PA [13], or through their relationship to drinking motives.

Research on drinking motives has revealed differences in alcohol use among individuals who drink to cope with negative affect and those whose alcohol use is socially or mood enhancement motivated [22]. These differences suggest that those who experience more negative affect (i.e., higher neuroticism) and those who seek out social situations (e.g., higher extraversion) may be using alcohol for different reasons. These differences in motivations, which could be related to higher levels of these personality traits, may partially explain why previous PA-based intervention studies have shown mixed effectiveness. Problematic alcohol use among individuals who exhibit higher levels of these personality traits may need to be addressed by more personalized, motivation-based treatment strategies than have been implemented previously. For example, rather than applying a standardized treatment strategy that simply increases PA for all intervention participants, designers of future interventions could include adjunctive instruction in coping skills for negative affect for individuals high in neuroticism that is replaced by psychoeducation about alternative mood enhancement strategies for individuals high in extraversion.

Limitations and Future Directions

The current study had several limitations that deserve attention. First, our demographically homogenous (i.e., predominately white) undergraduate sample reported low levels of drinking and high counts of lifestyle PA. Therefore, our findings may not generalize to a wider population of individuals, particularly those who would seek treatment for an AUD or those from diverse racial and ethnic backgrounds. These sample limitations may also partially explain differences between the results of the current study and past studies that have found broader associations between PA and alcohol use in adult samples with a wider age range (e.g., [4]). Second, alcohol use was measured dichotomously in this study, which may have been partially responsible for the lack of associations between predictor and criterion variables. Because we did not differentiate participants who consumed wider ranges of alcohol, these differences could not be accounted for. In other words, a participant who consumed one alcoholic drink on a day could have been lumped in with another participant binge drinking on the same day. Future studies may benefit from using not only a dichotomous alcohol use variable, but also a measure of number of drinks consumed per day. This addition would allow for more accurate representations of alcohol use behaviors and would allow for analyses of differences among levels of alcohol use.

Finally, the FFM measures used in the current study had several disadvantages. Perhaps the most significant disadvantage in these measurements for the current study was that the personality measure was changed from the BFI to the TIPI in the middle of data collection. This change necessitated the use of personality z-scores in our analyses, which may not have accurately represented the data collected from either instrument. Ideally, the current study should be replicated in a wider sample, using one consistent measure of personality. Additionally, both personality instruments were self-report measures, and the Cronbach alpha values for the TIPI are considerably low by nature of its very brief design, utilizing only two items per factor. The use of self-report measures always introduces a challenge to the validity of a study's findings, particularly if individuals have reasons for engaging in impression management, possess a lack of insight, or are experiencing fatigue. Due to the length of our intake battery, there is the possibility that participants may have experienced this fatigue, especially if they filled out the longer, 44-item BFI as opposed to the 10-item TIPI. Nevertheless, these self-report measures of personality have been found to display acceptable validity levels and are widely used in personality research.

In addition to addressing the limitations of the current study, future research should also examine other potential moderators of the PA-alcohol use relationship through exploratory analyses to continue adding to the literature surrounding the effectiveness of exercise-based interventions for AUDs.

Conclusion

The current study highlights the importance of personality considerations in examining the effectiveness of PA-based interventions for AUDs. Although personality traits appear not to directly moderate the relationship between PA and alcohol use, several of these traits display independent associations with alcohol use, which could have

implications for the effectiveness of PA-based treatment methods in certain individuals. These findings add to the scant literature on the role of personality in the PA-alcohol use relationship, which has shown conscientiousness to be associated with PA and alcohol use but has not previously shown significant findings related to extraversion or neuroticism [1]. Although more research is certainly needed to examine other potential moderators of the PA-alcohol use relationship, the current study adds significantly to the understudied role of personality in this unique, important relationship.

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Влияние личностных черт на связь между физической активностью и употреблением алкоголя

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Современные исследования показывают положительную связь между физической активностью и употреблением алкоголя как на личностном, так и на межличностном уровнях. Эта связь представляет интерес для исследователей, разрабатывающих физические методы терапии расстройств, связанных с употреблением алкоголя. Применение данных методов имеет неоднозначные результаты. Одна из возможных причин такого положения дел связана с тем, что прежде в исследованиях не учитывались индивидуальные различия людей, употребляющих алкоголь. Задачей данного исследования стало выяснение того, какой модулирующий эффект вносят личностные черты, входящие в состав Пятифакторной модели личности, в связь между физической активностью и употреблением алкоголя. В исследовании участвовали 263 студента. Результаты показали, что повседневная физическая активность, экстраверсия и нейротизм являются предикторами употребления алкоголя. Однако модулирующего эффекта между данными характеристиками выявлено не было, т.е. черты, входящие в Пятифакторную модель личности, не влияют на силу связи между физической активностью и употреблением алкоголя. Таким образом, люди с высокими показателями черт экстраверсии или нейротизма не имеют повышенный риск употребления алкоголя во время физической активности. При применении вмешательств на основе физических упражнений для терапии алкоголизма лица с высокими показателями компонентов экстраверсии или нейротизма продолжают испытывать влияние независимых факторов риска употребления алкоголя.

Ключевые слова: физические упражнения, алкоголь, личность, Пятифакторная модель личности, ослабление связи.

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