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Autistic traits in young adults who gamble

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Abstract

Background. Little is known about the relationship between autistic traits and addictive behaviors such as problem gambling. Thus, the present study examined clinical characteristics and multiple facets of cognition in young adults who gamble and have autistic traits.
Methods. A total of 102 young adults who gamble were recruited from two Mid-Western university communities in the United States using media advertisements. Autistic traits were examined using the brief Autism-Spectrum Quotient (AQ-10). Clinician rating scales, questionnaires, and cognitive tests were completed. Relationships between AQ10 scores and demographic, gambling symptom, and neurocognitive measures were evaluated.
Results. Autistic traits were correlated with disordered gambling symptoms, attention-deficit/hyperactivity disorder (ADHD) symptoms, trait impulsivity, and some types of obsessive–compulsive symptoms. In regression, ADHD no longer significantly related to autistic traits once disordered gambling symptoms were accounted for; whereas the link between autistic traits and disordered gambling symptoms was robust even controlling for ADHD.
Conclusions. These data suggest a particularly strong relationship between autistic traits and problem gambling symptoms, as well as certain aspects of impulsivity and compulsivity. The link between ADHD and autistic traits in some prior studies may have been attributable to disordered gambling symptoms, which was likely not screened for, and since individuals may endorse ADHD instruments due to other impulsive/compulsive symptom types (eg, gambling). The contribution of autistic traits to the emergence and chronicity of disordered gambling now requires further scrutiny, not only in community samples (such as this) but also in clinical settings.

Introduction

Gambling behavior in young adulthood has been associated with increased rates of nicotine use, misuse of illicit substances, high rates of problematic internet use, and high rates of attention-deficit/hyperactivity disorder (ADHD).[1,2] Additionally, impulsivity, anxiety/depressive symptoms, peer group influences, genetics, brain development, and life transitions all appear to play some role in mediating these various behaviors.[3-7] Although many variables have been examined as potentially contributing to the onset of problematic/addictive behaviors, little research has focused on problems in social interactions. One could easily make a case that deficits in social interactions may have considerable significance in the onset of addictive behaviors, such as gambling (ie, the person does not have friends and can enjoy themselves gambling alone).

Interestingly, little is known about the relationship between autistic traits (a more extreme form of social deficit), and addictive behaviors such as problem gambling.[8] This area may have garnered little research interest as a couple of studies have suggested that the personality traits seen in autism spectrum disorders did not lend themselves to addictive behaviors. Two studies[9,10] reported low risk of comorbid substance problems in autism spectrum disorder (ASD). This has been questioned, however, by a more recent, larger study using Swedish population-based registers. Butwicka et al[11] identified 26 986 individuals diagnosed with ASD during 1973 to 2009, and their 96 557 non-ASD relatives. ASD, without diagnosed comorbidity of ADHD or intellectual disability, was related to a doubled risk of substance use-related problems. Further, risks of substance use-related problems were increased among full siblings of ASD probands, half-siblings and parents. This evidence strongly suggests that ASD may be a risk factor for substance use-related problems. The Butwicka et al's study, while provocative, did not examine problem gambling and only looked at the diagnosis of ASD, not autistic traits along a continuum. Autism spectrum disorders have traditionally been conceptualized as diagnostic categories, but traits representing stereotypy and deficits in social interactions may be more beneficial to understand vulnerability markers. Personality traits such as "cognitive rigidity" have been implicated in ASD, and may extend to first-degree relatives too.[12] Meta-analysis of the "Big 5" personality traits found that ASD was associated with lower openness, lower conscientiousness, lower extraversion, lower agreeableness, and lower emotional stability.[13]

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Further complicating this relationship between autistic traits and addiction is the fact that autistic traits commonly co-occur with ADHD symptoms,[14] which in turn also commonly co-occur with addictions such as problem gambling. Clinic- and population-based studies have found elevated autistic trait scores in children and adults meeting diagnostic criteria for ADHD.[15-17] Similarly, the presence of clinically significant ADHD symptoms has been identified in children and adults with ASD.[18] Furthermore, the relationship between ADHD and addictions has been studied extensively. Both adolescents and adults with ADHD show elevated rates of comorbid substance misuse and gambling problems.[19–22] Elkins et al[23] found that hyperactive–impulsive symptoms predicted the initiation of substance use, nicotine dependence, and cannabis use disorders, even after controlling for conduct disorder.

Despite the high comorbidity between autistic traits and ADHD, as well as that between ADHD and addictive behaviors, few studies have explored whether autistic traits have any more direct relationship to addictive behaviors that is not accounted for purely by ADHD symptoms. Examination of autistic traits might better facilitate our understanding of the relationship between social deficits and addictive behaviors. Such dimensional indices of symptomatology also allow the examination of whether rates of addictive behaviors might be elevated at nonclinical thresholds of autism, hence providing better clues regarding potential prevention and intervention.

Considering these limitations of the extant literature, more information is needed to discern what if any relationship is there between autistic traits and gambling behavior. Thus, the present study examined clinical characteristics and multiple facets of cognition in young adults who gamble and have autistic traits. We chose young adults in order to control for cognitive deficits related to aging. Based on the extant literature, we hypothesized that greater levels of autistic traits would be associated with more severe symptoms of gambling behavior and more cognitive impulsivity.

Methods

A total of 102 participants were recruited (via fliers and online advertisements) from the surrounding communities (both large metropolitan centers) near two large Mid-Western universities (University of Chicago and University of Minnesota) for a study on autistic traits in young adults who gamble. Recruitment was conducted from spring 2019 until winter of 2020. Inclusion criteria were age 18 to 29 years, being nontreatment seeking, and having gambled at least five times in the past year (ie, this threshold was chosen as a proxy for some minimal level of baseline impulsive behavior which has no identified association with problematic gambling or as a predictor for the development of gambling disorder); this nominal inclusion criterion was used as the funding for this study was from the National Center for Responsible Gaming, and the research was conducted as part of a broader program focusing on gambling behaviors. Subjects were excluded if they were unable to give informed consent or were unable to understand/undertake the study procedures. Because the inclusion criteria were stated in the advertisement, no one who sought participation was excluded.

All study procedures were carried out in accordance with the Declaration of Helsinki. The Institutional Review Board of the University of Chicago approved the study and the consent statement. Participants were compensated with a $50 gift card for a local department store.

Assessments

Participants completed standard diagnostic interviews, basic demographic information, self-report inventories about gambling and other behaviors, and a computerized cognitive battery focusing on impulsivity. Quality of life was measured using the Quality of Life Inventory (QOLI).[24] This tool comprehensively assesses overall life satisfaction and well-being, and has excellent psychometric properties.[24]

The Brief Autism-Spectrum Quotient, AQ-10, is a short version of the AQ-50, which screens for autistic traits.[25] It covers items such as difficulty working out people's intentions, focusing on small details, noticing small sounds, and so forth. A cut-off score of 6 or more out of 10 is used to identify children and young people who have a likely diagnosis of autism, with excellent sensitivity and specificity in UK populations.[26] For the purposes of this study, total AQ-10 scores were used to explore relationships between autistic spectrum symptoms and other measures, since use of cut-offs is often arbitrary, and leads to loss of dimensional information. Thus, "autistic traits" was defined as total scores on the AQ-10. It should be noted that this differs from what is meant by a diagnostic of ASD: this is a formal diagnosis requiring a detailed clinical interview.

Gambling symptoms during the past 12 months were evaluated using the Structured Clinical Interview for Gambling Disorder (SCI-GD), a nine-item instrument original developed for Diagnostic and Statistical Manual of Mental Disorders (DSM)-IV pathological gambling and since modified to cover the DSM-5 criteria.[27] Gambling symptom severity for the past week was evaluated using the Yale Brown Obsessive Compulsive Scale Modified for Pathological Gambling (PG-YBOCS).[28]

Psychiatric disorders were assessed using the Mini International Neuropsychiatric Inventory (MINI)[29] by trained raters.

ADHD symptoms were examined using the six-item Adult ADHD Self Report Scale (ASRS v1.1) developed by the World Health Organization.[30] The ASRS six-item screen was developed for community-based studies and exhibits strong concordance with clinician diagnoses as well as sound psychometric properties. For each item, the individual rates the frequency of a given difficulty or behavior (eg, difficulty wrapping up the final details of a project) on a scale of 0 (never) to 4 (very often) based on their experiences over the preceding 6 months. Previous data suggest that this approach has a sensitivity of 68.7% and specificity of 99.5% for detection of true ADHD cases. Total scores on the ASRS were used.

Participants also completed self-report questionnaires and computerized cognitive tasks focusing on impulsivity and compulsivity. Questionnaires comprised: The Barratt Impulsivity Scale-11 (BIS-11), a 30-item self-report of three domains of impulsivity[31-33]; and the Padua Obsessive–Compulsive Inventory (Washington Revision), a 39-item questionnaire designed to measure obsessive–compulsive (OC) symptoms dimensionally.[34,35]

Cognitive tasks were completed in a quiet room using a touchscreen computer, supervised by a trained assessor. The tasks focused on set-shifting, response inhibition, and decision-making. Dysfunction in these domains have been commonly reported in developmental disorders such as ADHD and autism; and in gambling disorder.[36–39]

The intra-extra dimensional set shift task (IED)[40] was used to examine cognitive flexibility. Subjects are presented with four boxes: two contain pink shapes and two are blank. Using a rule set by the computer, subjects are notified that one of the displayed

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shapes is correct and the other is incorrect. Individuals must learn this rule and then select the correct shape in as many trials as possible. Once the subject chooses a number of correct shapes the computer switches the rule to introduce a new "correct" shape. The subject must adapt; this is the intra-dimensional set shift. Following this portion of the task the computer introduces a set of white shapes overlaying the pink shapes. The new correct shape is one of the white shapes. This addition of stimuli is the extra-dimensional set shift (ED). The number of total errors throughout the task and the number of errors specifically pertaining to the extra-dimensional set shift were the measures of interest.

The stop signal task (SST) was used to quantify participants' abilities to quickly stop a directed action when a stop signal is introduced into the activity. The computer screen shows an arrow facing left or right. The participant must press the corresponding left or right arrow on the keyboard. However, occasionally a beep will sound. When the beep sounds the participant attempts to withhold their motor response.[41,42]

The Cambridge gambling task (CGT) was used to measure dissociable aspects of decision-making. The computer screen shows 10 boxes in varying ratios of blue and red colors. Behind one of the 10 boxes is a token. The participant must first decide which color box he or she believes has a higher probability of hiding the coin. They then must decide how many imaginary points they want to bet on their guess. Possible bets first start at lower values and steadily increase. Halfway through the task the direction of possible bets reverses and possible bets start at higher values and steadily decrease. The participant must press the screen when their desired bet presents itself.[43]

Statistical analysis

Relationships between AQ scores and the other measures of interest were characterized using Pearson's correlations. Least square regression was used to explore relationships between AQ scores, disordered gambling symptoms, and ADHD symptoms. All analyses were conducted using JMP Pro software version 13.2.0 (SAS Institute) and significance was defined as $P < .05$.

Results

The sample comprised n = 102 participants, mean (standard deviation) age of 21.5 (3.4) years, 59.8% being male. The proportions of subjects with different levels of education were as follows: at least some college education 92.2%, high school diploma 4.9%, and less than high school 2.9%.

The mean AQ10 score was 2.72 (1.64), with 7.1% scoring 6 or greater. AQ10 scores did not differ significantly between men and women ($F = 0.283$, $P = .596$). An overview of correlations between AQ10 scores and the other measures is displayed in Table 1. AQ10 scores correlated significantly with worse quality of life ($r = -0.2925$; $P = .004$).

The mean SCI-GD was 1.0 (1.5), with 8.8% scoring a 4 or higher indicative of a GD diagnosis. The AQ10 scores were significantly correlated with endorsing more symptoms consistent with GD ($r = 0.239$; $P = .016$). AQ10 total scores were significantly correlated with PG-YBOCS total severity scores ($r = 0.239$, $P = .016$), but not with money lost in the past year ($r = 0.119$; $P = .232$).

AQ10 scores did not differ significantly between those with vs without one or more mainstream mental disorders (eg, depressive and anxiety disorders) on the MINI ($F = 2.873$, $P = .093$).

In terms of impulsivity, AQ10 scores were significantly correlated with attentional impulsivity on the BIS-11 ($r = 0.231$; $P = .0257$), but not with other domains on the BIS-11 or with the SSRT. AQ10 total scores were significantly correlated with ADHD total scores ($r = 0.198$, $P = .048$).

In terms of compulsivity, AQ10 scores correlated with the Padua Inventory OC symptom domains of checking compulsions ($r = 0.199$, $P = .045$), and OC thoughts of harm to self/others ($r = 0.239$, $P = .016$), as well as against total OC scores ($r = 0.216$, $P = .029$). Other measures of compulsivity, such as the IED errors (block 8), showed no significant correlation with AQ10 scores.

To further understand the relationships between ADHD symptoms, disordered gambling symptoms, and AQ10 scores, a least squares regression model was fitted (Y: AQ10 scores; model effects: SCI-GD scores and ADHD scores). The model was significant ($F = 4.228$, $P = .0174$) and fit was adequate (lack of fit test $F = 0.985$, $P = .514$). SCI-GD scores were significant predictors of AQ10 scores in the model (Log Worth 1.401, $P = .0340$), whereas ADHD scores were not (0.983, $P = .104$). This indicates that disordered gambling symptoms were significantly associated with AQ10 scores accounting for ADHD; whereas ADHD was not significantly related to AQ10 scores once disordered gambling symptoms were accounted for.

Discussion

This study examined autistic traits in a community-based sample of young adults who gamble, and associations with demographic, clinical, and cognitive measures, with a particular focus on impulsivity and compulsivity. Prior research had reported comorbid overlap between autistic symptoms and ADHD, and between autism and certain addictive behaviors, but there is a paucity of studies examining both aspects in one setting, particularly with respect to gambling behavior.

Autism scores correlated significantly with ADHD symptoms; however, in regression modeling, we found that this relationship was no longer significant once the link between autism scores and disordered gambling symptoms were accounted for. In contrast, autism scores correlated with disordered gambling symptoms, and this relationship remained robust once ADHD symptoms were accounted for. The vast majority of ADHD and autism literature (be it in clinical, or community settings) has not assessed for the presence of confounding symptoms such as those of gambling disorder. This study serves to highlight that the previous high rates of ADHD in autism reported in the literature may in fact be potentially explained by the presence of other unmeasured confounding symptom types. This is unfortunate because well-validated convenient clinical tools exist to screen for gambling disorder, and other related conditions such as the impulse control disorders.[2,27,44] These data also may indicate that people can endorse ADHD rating scales for reasons other than ADHD—such as due to the presence of other types of impulsive or compulsive symptomatology, for example disordered gambling symptoms. This is extremely relevant because many studies overlook this. For example, one study reported that digital media use was associated with subsequent *de novo* ADHD,[45] whereas in fact this association may have been attributable to individuals endorsing ADHD instruments due to other unmeasured symptoms such as gambling, which is commonly fueled by digital technology use.

As expected, we also found that autistic tendencies were correlated with trait impulsiveness on the BIS-11. This was specific to

Table 1. Relationship of Autistic Traits to Demographic, Clinical, and Cognitive Measures

Against AQ Total Score	Pearson's Correlations	
	Correlation	*P* value
Age, y	−0.133	0.181
Education level	−0.063	0.531
Dollars lost to gambling, past year	0.119	0.232
Nicotine c/quantity (packs per day equivalent)	−0.102	0.329
SCI-GD criteria, number endorsed	0.239	0.016*
PG-YBOCS	0.239	0.016*
ASRS	0.198	0.048*
BIS attentional impulsivity	0.231	0.019*
BIS motor impulsivity	0.109	0.275
BIS nonplanning impulsivity	0.110	0.27
Quality of life score	−0.293	0.003*
PADUA contamination obsessions, washing compulsions	0.114	0.256
PADUA dressing/grooming compulsions	0.034	0.737
PADUA checking compulsions	0.199	0.045*
Padua thoughts of harm to self/others	0.239	0.016*
Padua impulses to harm self/others	0.147	0.142
Padua total scores	0.217	0.029*
IED total errors (adjusted)	−0.034	0.732
IED errors (block 8)	−0.017	0.867
SST SSRT	0.172	0.084
CGT delay aversion	−0.008	0.936
CGT overall proportion bet	0.017	0.864
CGT quality of decision making	0.002	0.912
CGT risk adjustment	0.027	0.788

Abbreviations: ADHD, attention-deficit hyperactivity disorder; AQ, Autism Quotient; ASRS, ADHD Rating Scale; BIS, Barratt Impulsivity Scale; CGT, Cambridge Gamble Test; IED, Intra-Dimensional/Extra-Dimensional Set-Shift task; SCI-GD, Structured Clinical interview for Gambling Disorder; SSRT, Stop-Signal Reaction Time; SST, Stop-Signal Test.
*<.05.

attentional impulsivity scores, suggesting that it is particular aspects of impulsivity that are related, rather than necessarily all types of impulsivity. Contrary to expectation, autism scores did not correlate with cognitive measures of impulsivity, that is with response inhibition or delay aversion impulsivity on the gambling task. This may suggest that self-report questionnaires offer potential sensitivity advantages over cognitive tests in terms of measuring concepts such as impulsivity. Factor analysis indicates that self-report and cognitive measures of impulsivity are only partly overlapping constructs.[46] Additionally, other studies have found that self-report measures are more closely related to psychopathology than cognitive tasks, in the context of self-regulation.[47]

In terms of compulsivity, we found a significant correlation between autistic scores and total scores on the Padua Obsessive–Compulsive Inventory. When examining domain scores from the Padua Inventory, this link was due to overlap with checking compulsions, and thoughts of harm to self/others. In a previous study, Padua scores correlated with AQ10 scores, as found herein; however, the previous study used a Japanese version of Padua Inventory that appears to have a different factor structure, making it hard to draw parallels in terms of the domain scores.[48] Again, contrary to expectation—but in keeping with the findings for impulsivity—we did not find a significant correlation between autistic tendencies and the neurocognitive measure of compulsivity; that is set-shifting.

It is informative to note that not all forms of impulsivity and compulsivity were related to autistic traits in this study. In particular, no significant correlation with autistic traits was observed for motor and nonplanning impulsivity on the BIS scale, nor with specific aspects of OC scores on the Padua Inventory (contamination obsessions, washing compulsions; dressing/grooming compulsions; and impulses to harm self/others). Our study highlights that more nuanced understanding of links with autism can be gleaned using a dimensional approach (such as factor scores), relationships likely to be overlooked if studies only rely on case–control designs. Additionally, we would highlight the importance of caution when using clinical terms to indicate psychopathological dimensions; for example, compulsivity does not mean obsessive–compulsive disorder (OCD), since OCD refers to a categorical disorder. We did not detect significant correlations between autism scores and cognition. It should be noted that cognitive impairments have been found in patients with autistic spectrum disorder vs controls; and in patients with gambling disorder vs controls. For example, meta-analyses have reported impulsivity in gambling disorder, such as on decision-making and stop-signal tests[49]; and theory of mind deficits in autistic spectrum disorder.[50] Whether common deficits occur in both disorders is unclear.

Several limitations should be considered. Because this study was conducted in community-recruited participants who gamble, the findings may not generalize to other groups, such as clinical populations, or people who never gamble. Also, the sample was a well-educated group of young adults and therefore may not generalize to all young adults in the community. Because the study was cross-sectional, direction of effect cannot be shown, though of course autistic tendencies would be present prior to disordered gambling symptoms (ie, autistic traits appear to increase propensity for developing disordered gambling, including when ADHD is controlled for). Though a sample size of 102 is sufficient to detect correlations even with small effect sizes, follow-up work in larger samples would be valuable. This being an exploratory study, we did not correct for multiple comparisons, but this could be done in future studies with larger samples needed to overcome loss of power that results from multiple corrections. We used total scores (and factor scores) rather than examining item-level relationships with autism scores, in order to minimize multiple comparisons. Nonetheless, future work should examine what particular questionnaire items account for the relationships observed here. Last, we note that autism and ADHD can of course co-exist—this study does not intend to suggest that these are unrelated disorders.

In conclusion, this study found, in a community-recruited sample of nontreatment seeking young adults, that autistic traits were associated with disordered gambling symptoms, even accounting for concurrent ADHD symptoms. Self-report measures of impulsivity and compulsivity were also found to be associated with autistic tendencies, even when neurocognitive measures were insensitive. These results highlight the need to carefully screen for gambling disorder symptoms, and other often overlooked types of symptoms, when examining links between ADHD and autism. They also suggest that autistic tendencies may contribute to

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disordered gambling symptoms, and that more research is needed in this area. For example, taking account of autistic tendencies may help better understand the emergence and progression of disordered gambling; and is likely to be relevant for treatment.

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