Exploring the Link between Autistic Traits, Social Functioning, Anxiety, and Academic Achievement among Emory University Students and Faculty Members

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Abstract

The present study was based on the principles of the Extreme Male Brain Theory of Autism (EMBTA) and aimed to explore the possible link between autistic traits, social functioning, anxiety, and academic achievement among Emory University students and faculty members. Several empirically or theoretically selected socio-demographic and behavioral variables were co-examined to investigate different ways in which patterns traditionally associated with Autism Spectrum Disorder (ASD) were present in non-clinical individuals within the broader autism phenotype. Results suggest that, on average, males had significantly more autistic traits than females, as did participants in the field of “hard” sciences compared to those in other academic fields. Having both parents in a scientific occupation predicted higher autistic traits in offspring. Higher autistic traits were also associated with lower social functioning and higher anxiety levels among respondents. Findings can be utilized by the institution to better understand and accommodate the needs of students and faculty members, or even by the on-campus counseling and medical services to develop appropriate strategies and interventions.

Introduction

Autism Spectrum Disorder (ASD) is a group of developmental disabilities characterized by persistent deficits in social communication and social interaction (e.g., not directing verbalizations to others, reduced eye contact, not understanding development of relationships) across multiple contexts, and restricted, repetitive patterns of behavior, interests, or activities (e.g., arm flapping, obsession with numbers, strictly follow daily routine).[1] According to the 2016 CDC's Autism and Developmental Disabilities Monitoring (ADDM) Network surveillance summary on the prevalence of ASD in the United States, 1 in 68 children aged eight years meets the criteria for ASD (approximately one in 42 boys and one in 189 girls with an overall male-to-female prevalence ratio of 4.5:1).[2] Interestingly, among those with an ASD diagnosis, 44% were classified in the average or above average range of intellectual ability (IQ >85),[2] which may explain the fact that learning, thinking, and problem-solving abilities of people with ASD range from gifted to severely challenged.[3] Results of an epidemiologic study conducted in England by Brugha et al. suggest that the prevalence of ASD in adults is similar to that found in children, with the rate of ASD in adults being significantly higher among men than women (18.2 per 1000 and 2.0 per 1000 respectively).[4]

Sometimes, the person referred for a diagnostic assessment may have more autistic traits than occur in the typical population, but not enough to receive an official ASD diagnosis.[5] These individuals are described as being “atypical” or “sub-threshold” and, while they do not have autism, they are “almost there” and need access to services for the characteristics that are present.[5] The investigation of the characteristics of atypical individuals has the potential to explore, identify, and

describe difficulties that are potentially associated with the presence of autistic traits. Furthermore, findings can serve to guide future interventions tailored to particular populations carrying those characteristics.

Grounded on the Extreme Male Brain Theory of Autism (EMBTA), the purpose of the present study was to explore the possible link between autistic traits, social functioning, anxiety, and academic achievement among Emory University students and faculty members. The study can be characterized as exploratory for the field of public mental health, providing new insights that can help advance the limited knowledge on quantifying where academically successful individuals are situated on the continuum from autism to normality. Findings can be utilized by the institution to inform future program development and interventions, with the goal to promote mental health among Emory University students and faculty members.

Literature Review

Over the past few years, there has been growing scientific interest for this particular non-clinical population of individuals with the broader autism phenotype. Using a self-assessment screening questionnaire - the Autism-Spectrum Quotient (AQ) - in a randomized control trial, Baron-Cohen and colleagues were the first to measure the degree to which adults with normal intelligence present traits associated with the autistic spectrum.[6] Their findings revealed that AQ scores for males and females in the general population differed significantly, with males scoring higher than females (higher AQ score signifies more autistic traits).[6]

Another major finding of the same study showed that university students studying "hard" sciences (i.e., physical sciences, biological sciences, mathematics, computer science, engineering, medicine, and nonspecific science) fell closer to the autistic spectrum compared to students studying humanities (i.e., classics, languages, law, architecture, philosophy, English, theology, history, and music) and social sciences (i.e., geography, economics, social and political sciences, archaeology and anthropology, land economy, and management), suggesting a relationship between autistic traits and scientific skills.[6] The results are consistent with those of an earlier study indicating that autism occurred significantly more often in families of students in the fields of physics, engineering, and mathematics.[7] However, the first to suspect such a relationship was pediatrician Hans Asperger who believed that for success in science and art, a dash of autism is essential.[8]

Baron-Cohen's innovative research on how individuals of normal intelligence vary on autistic traits triggered a series of investigations around the world. His study was replicated (with some variations) in several countries producing similar results,

verifying the differences in autistic traits between male and female students, as well as between students studying "hard" sciences compared to those studying humanities and social sciences.[9-18] In addition to testing for correlations between autistic traits and socio-demographic factors in university students, a number of studies also examined different ways in which AQ scores were related to other traits that are traditionally associated with ASD, but is unclear whether they characterize the broader phenotype of the disorder. This relatively new type of research holds great importance for the field of public mental health, since it has the potential to reveal the major implications of being a university student and having more autistic traits than those that occur in the typical population. In other words, this new wave of research aims to answer the question: "Do students with high autistic traits, but without an ASD diagnosis, present attributes that are usually found in autistic individuals?"

New evidence suggests that students with higher autistic traits have altered cognitive and learning profiles. Reed and colleagues discovered that cognitive performance profiles were altered in male university students with higher autism quotients.[9] Specifically, among 100 undergraduate students recruited from subjects related to the science field (e.g., physics, computer science, mathematics), higher AQ scores predicted lower levels of perceptual learning (i.e., the ability to extract information from stimuli after repeated exposure to those stimuli) and higher levels of perceptual search performance (i.e., the ability to find a target object hidden among distractors or in noise). Maes et al. examined the association between autistic traits and different aspects of executive functioning in a non-clinical population of undergraduate students (n=38).[10] Compared to social sciences students, "hard" sciences students had higher AQ scores and greater non-verbal reasoning ability (i.e., the ability to understand and analyze visual information and solve problems using

visual reasoning). Horder and colleagues looked for sensory processing abnormalities in a sample of 772 university students and staff, both with (n=23) and without (n=749) ASD.[11] Participants' AQ scores were significantly correlated with scores on all three sensory scales used, suggesting a link between autistic traits and abnormal sensory responsivity (i.e., sensory abnormalities including both hypersensitivity and hyposensitivity to various stimuli, as well as strong preferences for or against stimuli that are typically regarded as neutral).

Studies also revealed that students with higher autistic traits had altered behavioral profiles. Austin looked for personality correlates of the broader autism phenotype, as assessed by the AQ, in 201 undergraduate students.[12] Examination of correlations showed that high AQ scores were associated with higher levels of neuroticism and lower levels of extraversion and agreeableness. As expected, males had higher AQ scores than females, "hard" sciences students had higher scores than other students, as did students with a parent or parents in a scientific occupation. Jameel et al. investigated pro-social behavior in 51 undergraduate students who scored high (n=27) and low (n=24) on the AQ, using a novel scenario task.[13] Each scenario involved an opportunity to behave pro-socially, and thus required balancing the needs of a character against the participant's own interests. High AQ participants selected courses of action that were less pro-social than those of the low AQ group. In addition, high AQ participants gave higher self-satisfaction ratings to actions of low pro-social value, and lower self-satisfaction ratings to actions of high pro-social value. Lepage and colleagues focused on quantifying the relationship between empathic ability (i.e., the ability to understand the emotions, actions, and intentions of others and to respond accordingly) and autistic traits in 100 undergraduate students in the "hard" sciences or humanities fields, and in 23 individuals diagnosed with ASD.[14]

Analysis revealed a significant negative correlation, with higher AQ scores predicting lower empathic concern for both groups.

Baron-Cohen et al. also investigated whether IQ and SES influenced AQ scores. Data collected from a general population sample and a university student sample were not significantly different, implying that IQ and SES do not appear to influence AQ.[6]

Despite the fact that several cognitive and behavioral aspects of autistic traits found in non-clinical university populations have already been examined, the social functioning (i.e., the degree to which individuals are able to interact in the normal or usual way in society) of the individuals and how it relates to their autism quotient has yet to be explored. The decision to include an assessment of social functioning in the present study was made for two main reasons. First, although deficits in social communication and social interaction is by definition one of the basic characteristics of ASD,[1] so far the extent to which this relationship applies to non-clinical university student populations has not been investigated. Second, since social functioning is recognized as an increasingly important element of mental health,[19] its assessment could provide an estimate of the sample's overall mental health state to be taken into consideration by the institution. Also, knowing that the prevalence of anxiety disorders is much higher in individuals with ASD than those without ASD or even those with other neurodevelopmental disabilities,[20-22] and that the high levels of stress experienced by university students with ASD can contribute to the development of an anxiety disorder,[5] it was reasonable to investigate whether a similar pattern is present in individuals with the broader autism phenotype. To our knowledge, only two studies so far have empirically examined this relationship in non-clinical samples of university students, suggesting a positive correlation between autistic traits and

anxiety symptoms.[23,24] Furthermore, since affiliation status (i.e., student or faculty) and level of education (i.e., Bachelor's degree, Master's degree, Professional degree - MD/JD, Doctorate degree) can be considered indicators of academic achievement, the inclusion of faculty members as research participants and participants' degree level, served to formulate additional hypotheses not explored so far in the published research. Therefore, in this study a cross-sectional survey was conducted in order to identify the possible link between autistic traits, social functioning, anxiety, and academic achievement among Emory University students and faculty members. The examination of the aforementioned variables provided some preliminary evidence on how the Emory community scored on the AQ test. Participants' AQ scores were also compared to socio-demographic variables (including gender, affiliation status, level of education, field of study, and information about biological parents' occupations) and to the individuals' assessment of social functioning and anxiety levels.

The theoretical approach upon which the study was based is the Extreme Male Brain Theory of Autism (EMBTA). The principles of this particular theory, developed in 2002 by Baron-Cohen[25] and informally suggested by Hans Asperger in 1944,[7] lie in the premise that autism can be considered as an extreme of the normal male profile. This stems from the fact that, typically, the male brain is significantly better at "systemizing" (e.g., strong preference for physical systems and machines, high rates of "extreme" intelligence when it comes to abstract concepts such as those found in mathematics and sciences) than "empathizing" (e.g., responding empathically to the distress of other people, sensitivity to facial expressions, better language ability); while the female brain is defined as the opposite cognitive profile.[25] Since the male pattern is exaggerated to the extreme in individuals with ASD,[6] autism can be considered as an extreme of the normal male profile.[25,26]

Some of the key constructs of the theory which were incorporated in the present study relate to domains associated with social and communication skills, imagination, attention to detail, and attention switching/ tolerance of change. The assessment of these particular domains provided an estimate of the degree to which Emory University students and faculty members presented traits associated with the autistic spectrum. Another cluster of domains central to the EMBTA is composed of aspects of daily social functioning such as work and home tasks, financial concerns, relationships with family, sexual activity, social contacts, and spare time activities. The assessment of this second group of constructs provided an estimate of participants' perceived social functioning. Although the EMBTA does not explicitly refer to anxiety as one of its main constructs, the inclusion of a measure for assessing the severity of anxiety symptoms is supported by the related literature.[5,20-24]

Based on the above literature review and the principles of the EMBTA, this study examined the following research hypotheses:

1. Male students and faculty members were expected to present more autistic traits than the respective females.
2. "Hard" sciences students and faculty members were expected to fall closer to the autistic spectrum compared to those in other fields.
3. Parental occupation was expected to be associated with the presence of autistic traits among participants.
4. Increased autistic traits among participants were expected to predict lower social functioning.
5. Increased autistic traits among participants were expected to predict higher levels of anxiety.

Additionally, assuming that higher levels of education require higher levels of systemizing skills, it could also be hypothesized that:

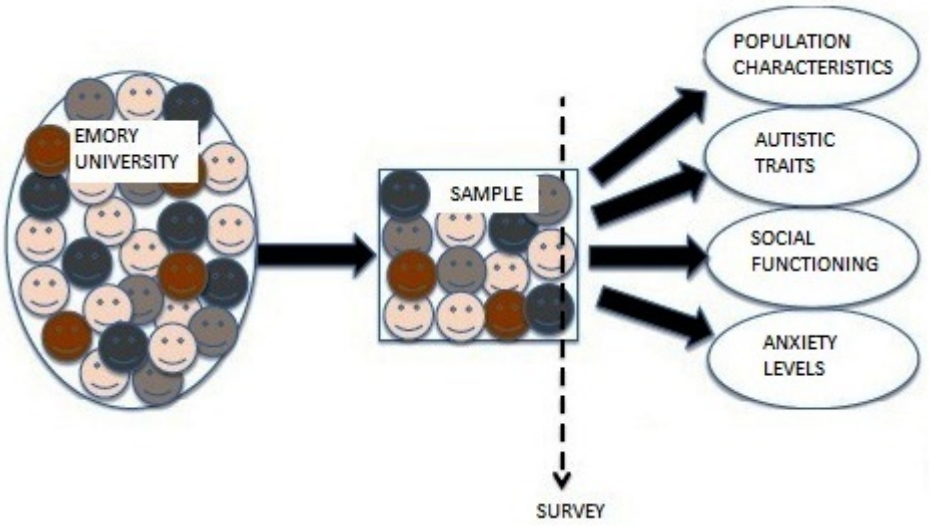
6. The presence of autistic traits was expected to differ significantly among undergraduate students, graduate students, and faculty members.
7. The presence of autistic traits was expected to differ significantly among the levels of education based on degree.

Methodology

Study design

A cross-sectional survey was employed to test for associations among the variables of interest. Existing participants' socio-demographic characteristics, autistic traits, social functioning, and anxiety levels were measured at a given point in time, quantified, and evaluated (see *Figure 1*).

Figure 1: Graphic representation of study design (cross-sectional survey)



Participants

The survey was electronically sent to the majority of Emory University students and faculty members (see *Procedure* section below for details). Using non-probability convenience sampling, a total of 542 participants established eligibility and were recruited. Completion rate was 86%, since not all participants completed the survey. The sample matched a variety of academic fields ("hard" sciences, humanities, social sciences), programs, disciplines, and levels of education (undergraduate, graduate, doctoral). Since the study focused on non-clinical subjects,

individuals with a self-reported history of ASD (including autistic disorder, Asperger's syndrome, PDD-NOS, ASD) or any other major psychiatric condition (such as schizophrenia, bipolar disorder, depressive disorder, anxiety disorder, OCD, PTSD) were excluded to avoid contamination. Although the target population of this study was, clearly, the Emory community, study results can also be generalized to students and faculty members of all major universities in the US with similar characteristics.

Measures

Four self-report survey questionnaires were used for data collection purposes. The AQ-10 questionnaire, an abbreviated version of the 50-item AQ questionnaire, was developed as a brief screener for the assessment of autistic traits in adults with normal intellectual functioning.[27] The test consists of ten statements, each of which is in a four-point likert scale format. It comprises five subscales measuring key traits thought to be important dimensions of ASD: social skills, communication skills, imagination, attention to detail, and attention switching/ tolerance of change (see the items included in the AQ-10 and the original item numbers from the AQ-50 in Appendix A). Each item allows the respondent to indicate "definitely agree," "slightly agree," "slightly disagree," or "definitely disagree." Sample items include "I often notice small sounds when others do not" and "I find it easy to do more than one thing at once." Approximately half the questions are worded to elicit an "agree" response from neurotypical (i.e., non-autistic) individuals, and half to elicit a "disagree" response. The respondent scores one point for each question which is answered "autistically," either slightly or definitely (score range 0-10). A sum score of 6 or more indicates clinically significant levels of autistic traits, suggesting the individual should be referred for a full diagnostic assessment. The instrument has demonstrated

very high test accuracy properties and high internal consistency of scale items (>0.85).[27,28]

In order to assess the sample's social functioning, the Social Functioning Questionnaire (SFQ) was utilized. The SFQ is an eight-item self-report scale developed as the self-rated equivalent of the Social Functioning Schedule (a semi-structured interview covering 14 domains of function each rated on visual analogue scales), following the need for a quick assessment of perceived social functioning.[19] The eight items cover the essential aspects of work and home tasks, financial concerns, relationships with family, sexual activities, social contacts, and spare time activities. These are set in the form of statements describing good or poor social functioning. Sample items include "I get on well with my family and other relatives" and "I feel lonely and isolated from other people." Answers are scored on a four-point likert scale ranging from "very poor" to "good," worded appropriately for each one of the statements (see Appendix B). Score can range from 0 to 24, with a sum score of 10 or more indicating poor social functioning.[19] In a critical survey of self-report measures of social functioning, the psychometric characteristics of the SFQ were found to be more robust than others.[29]

A third questionnaire, the Generalized Anxiety Disorder 7-item scale (GAD-7), was used to assess the sample's anxiety levels (see Appendix C). The GAD-7 is a seven-item self-report scale developed on the basis of review of existing anxiety scales as a screening tool and severity measure for generalized anxiety disorder – one of the most common anxiety disorders seen in the general population.[30-33] The respondent is requested to report how often he/she has been bothered by a number of problems over the last two weeks. Sample items include "Feeling nervous, anxious or on edge" and "Trouble relaxing." Response options range from "not at all," "several

days," "more than half the days," and "nearly every day" scored as 0, 1, 2, and 3, respectively (score range 0 to 21). Sum scores of 5, 10, and 15 are taken as the cut-off points for mild, moderate, and severe anxiety, respectively. When used as a screening tool, further evaluation is recommended when the sum score is 10 or greater.[33] Using the threshold score of 10, the GAD-7 has a sensitivity of 89% and a specificity of 82% for generalized anxiety disorder.[34] It is moderately good at screening three other common anxiety disorders: panic disorder (sensitivity 74%, specificity 81%), social anxiety disorder (sensitivity 72%, specificity 80%), and post-traumatic stress disorder (sensitivity 66%, specificity 81%).[35] The instrument has demonstrated good reliability, as well as criterion, construct, factorial, and procedural validity.[33]

Participants were also asked to complete a socio-demographics questionnaire (see Appendix D) to gather information on gender identity, age, race, ethnicity, as well as the students' and faculty members' academic characteristics such as field of study, level of education. Finally, participants were prompted to provide information about their biological parents' occupations.

Procedure

The survey was built online with the use of REDCap; a secure web-based application for building and managing online surveys and databases.[36] IRB approval from Emory University was obtained after acquiring written agreement from the Deans stating that their Schools were willing to disseminate the survey to students and faculty members. In total, six out of nine Emory University's Schools agreed to disseminate information about the study: Candler School of Theology, Goizueta Business School, Laney Graduate School, Oxford College, Rollins School of Public Health, and School of Law.

After obtaining IRB approval from Emory University, potential participants were reached by their Schools during the Spring semester, at the beginning of January 2016 (see Appendix E for recruitment letter). Goizueta Business School, Laney Graduate School, Oxford College, Rollins School of Public Health, and School of Law reached out to their student and faculty members via e-mail, using the respective listservs. Candler School of Theology published the recruitment letter in the Candler Chronicle, the School's official online outlet for community news. After deciding to take part in the study, participants were prompted to follow a link found in the recruitment letter which redirected them to the survey's website. Before completing the questionnaires, participants had to read and electronically sign the consent form found in the survey's website (see Appendix F). Data were collected in aggregate from January 12th to Feb 9th 2016. No direct identifiers were recorded.

Study participants were directly benefited, as they received feedback related to their test performance in the form of a personalized automated response (see Appendix G) after they completed all questionnaires. In particular, participants scoring at or above the cut-off point for any or all of the screening scales were advised to consult their family physician, Emory University's Student Health and Counseling Services, or the Faculty Staff Assistance Program for more information and a more detailed screening or diagnostic assessment. Participants scoring below the cut-off point for all scales were notified that no further action was required.

Analyses

Quantitative data analyses were conducted using IBM SPSS Statistics Version 22. Descriptive (univariate) analyses provided the sample's basic socio-demographic characteristics, and a description of respondents' mean test performance scores on the AQ-10, SFQ, and GAD-7 questionnaires.

Multiple statistical analyses were used in order to test the study's hypotheses at the conventional .05 level of significance. Independent-samples T-tests were employed when comparisons in mean scores between two independent groups (e.g., males vs. females, "hard" sciences vs. other fields) were required. Analysis of variance was used to perform multiple comparisons in mean scores among three or more groups (e.g., undergraduate students vs. graduate students vs. faculty members). Finally, simple linear regression served for modeling the relationship between two variables (e.g., autistic traits and social functioning), while a multiple linear regression model was utilized to assess the unique contribution of several predictors that were independently, significantly associated with the presence of autistic traits at the bivariate level.

Results

Sample characteristics

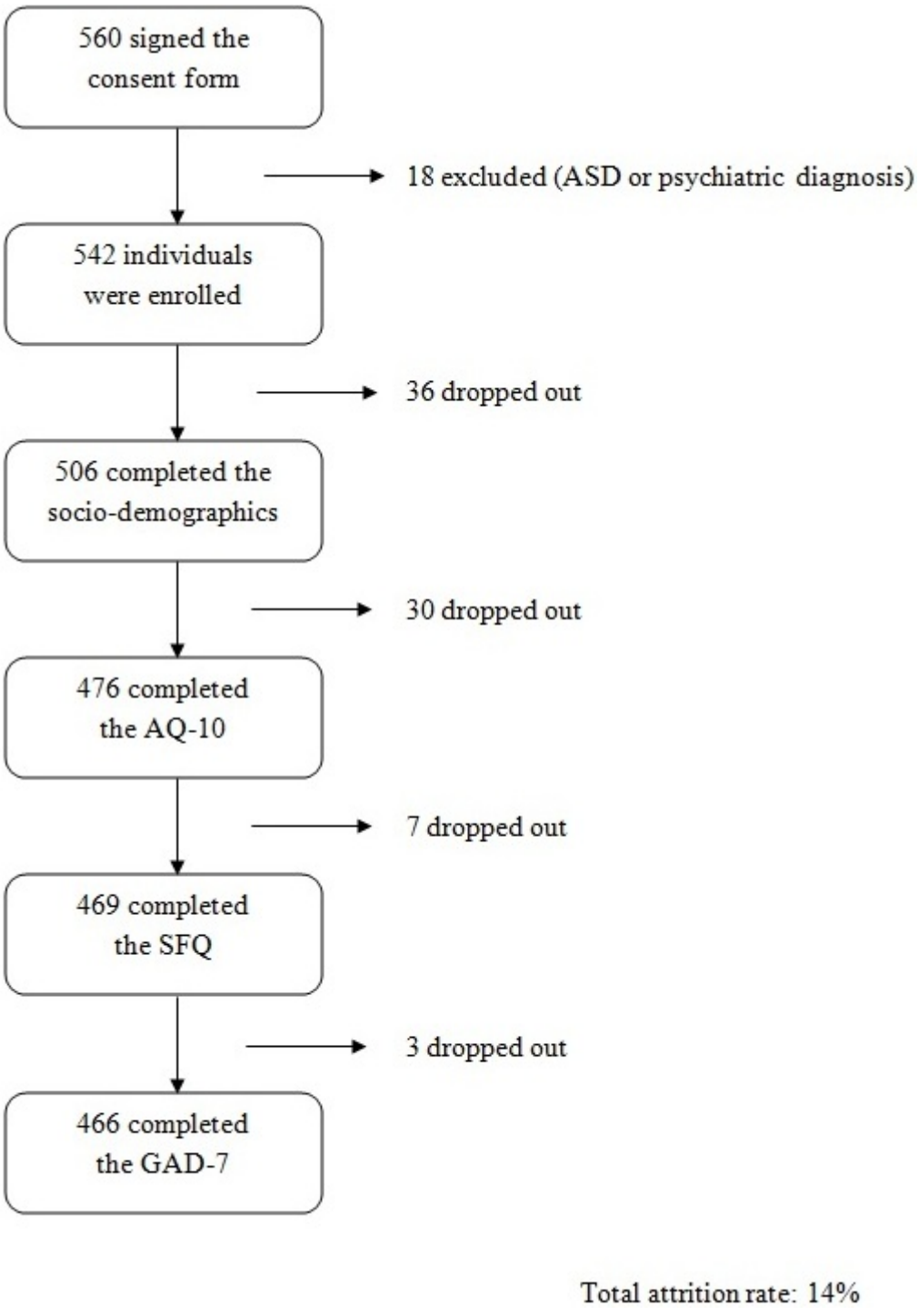
A total of 560 Emory University students and faculty members participated in this study. Individuals who have been diagnosed with ASD or some other major psychiatric condition (n=18, 3.4%) were automatically excluded using a control question in the socio-demographics questionnaire. The remaining 542 subjects were deemed eligible to enroll. As shown in the study flow chart (see *Figure 2*), the number of respondents per questionnaire varied due to attrition.

The majority of participants were females (n=370, 72.7%) with a mean age of 27.9 (sd=9.34), ranging from 18 to 73 years of age. The sample was composed of predominantly White (n=346, 68.4%), non-Hispanic or Latino (n=464, 91.7%), graduate students (n=367, 72.5%). Most respondents were in the field of social sciences (n=232, 45.8%), followed by those in "hard" sciences (n=202, 39.9%), and humanities (n=72, 14.2%). Almost half of the participants had one or both biological parents in the field of "hard" sciences (n=241, 47.6%). A more detailed descriptive analysis of the sample's socio-demographic characteristics is presented in Table 1 (see Appendix H).

The sample (n=476) had a mean AQ score of 2.92 (sd=1.89). Approximately one in ten participants (n=49, 10.29%) scored at or above the cut-off point, indicating clinically significant levels of autistic traits. Cronbach's alpha reliability for this scale was .56. The sample's (n=469) mean SFQ score was 6.29 (sd=2.90). A number of participants (n=66, 14.07%) scored at or above the cut-off point, indicating poor social functioning. Cronbach's alpha reliability for this scale was .61. Reported (n=466) GAD-7 score had a mean of 4.75 (sd=4.17). In total, 64 (13.73%)

participants scored at or above the cut-off point, indicating clinically significant levels of anxiety. Cronbach's alpha reliability for this scale was .87. A summary of the sample's behavioral characteristics is presented in Table 2 (see Appendix H).

Figure 2: Study flow chart with attrition analysis



Hypotheses testing

An independent-samples T-test was employed in order to investigate whether male students and faculty members presented more autistic traits than the respective females (1st hypothesis, see Table 3 in Appendix H). As predicted, results suggest that male students and faculty members had more autistic traits (mean=3.30, sd=1.98) than the respective females (mean=2.78, sd=1.84) (t= 2.68, df=474, p=.008).

To examine whether "hard" sciences students and faculty members would fall closer to the autistic spectrum compared to those in other fields (2nd hypothesis), two statistical tests were used. An independent-samples T-test served to compare the mean AQ score of "hard" sciences students and faculty members, to the mean AQ score of those in social sciences and humanities combined in one group (see Table 4 in Appendix H). Results reveal that "hard" sciences students and faculty members fell closer to the autistic spectrum (mean=3.25, sd=2.05) compared to those in other fields (mean=2.70, sd=1.75) (t=3.03, df=474, p=.003). Analysis of variance served to test for differences in autistic traits among students and faculty members in "hard" sciences, those in social sciences, and those in humanities (see Table 5 in Appendix H). A statistically significant difference in autistic traits was observed among the three fields of study (F=(2, 473)=4.89, p=.008). Tukey post hoc tests suggest that the mean AQ score of students and faculty members in "hard" sciences (mean=3.25, sd=2.05) was significantly higher than the mean AQ score of those in social sciences (mean=2.71, sd=1.78, p=.01). However, there was no significant difference in autistic traits between students and faculty members in "hard" sciences (mean=3.25, sd=2.05) and those in humanities (mean=2.68, sd=1.68, p=.09).[*] Similarly, students and faculty

[*] When compared using an independent-samples T-test (see Table 6 in Appendix H), a significant difference in mean AQ scores is revealed between "hard" sciences and humanities

members in social sciences (mean=2.71, sd=1.78) and those in humanities (mean=2.68, sd=1.68) did not differ in mean AQ scores (p=.99).

Three statistical tests were utilized to explore whether parental occupation was associated with the presence of autistic traits among participants (3rd hypothesis). To assess whether students and faculty members with one or both biological parents in a scientific occupation presented more autistic traits relative to those whose parents were not in a scientific occupation, an independent-samples T-test was used (see Table 7 in Appendix H). This particular hypothesis was not verified, since no significant difference in autistic traits was observed between the two groups (t=.50, df=470, p=.618). To assess whether students and faculty members with both biological parents in a scientific occupation presented more autistic traits relative to those with only one biological parent (either the mother or the father) in a scientific occupation, an independent-samples T-test was employed (see Table 8 in Appendix H). Results suggest that students and faculty members with both biological parents in a scientific occupation (mean=3.68, sd=1.85) had more autistic traits relative to those with only one biological parent in a scientific occupation (mean=2.65, sd=1.80) (t= -3.94, df=224, p<.001). Analysis of variance was employed to investigate possible differences in autistic traits among participants with a biological father in a scientific occupation, those with a biological mother in a scientific occupation, and those with both parents in a scientific occupation (see Table 9 in Appendix H). A statistically significant difference in autistic traits was observed among the three groups (F=(2, 223)=7.90, p<.001). Tukey post hoc tests suggest that the mean AQ score for participants with both parents in a scientific occupation (mean=3.68, sd=1.85) was significantly higher than the mean AQ score of those with a biological father in a

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students and faculty members (p=.04) which is not maintained in the more conservative ANOVA model (p=.09).

scientific occupation (mean=2.61, sd=1.80, p<.001). However, there was no significant difference in autistic traits between participants with both parents in a scientific occupation (mean=3.68, sd=1.85) and those with a biological mother in a scientific occupation (mean=2.82, sd=1.83, p=.067).[*] Similarly, participants whose biological fathers were in a scientific occupation (mean=2.61, sd=1.80) and those whose biological mothers were in a scientific occupation (mean=2.82, sd=1.83) did not differ in mean AQ scores (p=.824).

Simple linear regression served to evaluate whether increased autistic traits among participants would predict lower social functioning (4th hypothesis, see Table 11 in Appendix H). Results reveal that the level of autistic traits was a statistically significant predictor of social functioning (B=.450, 95% CI=.318; .583, p<.001). On average, with each unit increase in autistic traits, there was a .450 point increase in the SFQ score, indicating lower levels of social functioning. The R^2 for this model was .087, indicating that approximately 8.7% of the variance in social functioning can be explained by the presence of autistic traits.

Similarly, simple linear regression also served to evaluate whether increased autistic traits among participants would predict higher levels of anxiety (5th hypothesis, see Table 12 in Appendix H). Results suggest that the level of autistic traits was a statistically significant predictor of anxiety (B=.562, 95% CI=.369; .756, p<.001) indicating that on average, with each unit increase in autistic traits, there was a .562 point increase in anxiety. The R^2 for this model was .066, indicating that approximately 6.6% of the variance in anxiety can be explained by the presence of autistic traits.

[*] When compared using an independent-samples T-test (see Table 10 in Appendix H), a significant difference in mean AQ scores is revealed between participants with both parents in "hard" sciences and those with a biological mother in "hard" sciences (p=.029) which is not maintained in the more conservative ANOVA model (p=.09).

To explore whether the presence of autistic traits differed significantly among undergraduate students, graduate students, and faculty members (6th hypothesis), analysis of variance was performed (see Table 13 in Appendix H). A statistically significant difference was observed in autistic traits among the three groups (F=(2, 473)=7.373, p=.001). Tukey post hoc tests suggest that the mean AQ score of undergraduate students (mean=3.63, sd=2.03) was significantly higher than the mean AQ score of both graduate students (mean=2.86, sd=1.84, p=.005) and faculty members (mean=2.42, sd=1.83, p=.001). However, there was no significant difference in autistic traits between graduate students (mean=2.86, sd=1.84) and faculty members (mean=2.42, sd=1.83, p=.222).

Analysis of variance was also used in order to determine whether the presence of autistic traits differed significantly among the levels of education based on degree (7th hypothesis, see Table 14 in Appendix H). Results do not indicate significant differences in autistic traits among the various degree levels (F=(3, 461)=1.924, p=.125). However, when compared using an independent-samples T-test (see Table 15 in Appendix H), a significant difference in mean AQ scores is revealed between Bachelor-level students/degree holders (mean=3.32, sd=1.88) and Master-level students/degree holders (mean=2.72, sd=1.85) (t= 2.41, df=253, p=.017).

Evidence suggesting that undergraduate students seem to present more autistic traits compared to both graduate students and faculty members, and that Bachelor-level students/degree holders have more autistic traits compared to Master-level students/degree holders, indicate that age might also be a variable of interest. Therefore, an additional simple linear regression model served to assess whether participants' age was associated with the presence of autistic traits (see Table 16 in Appendix H). Results reveal that age was a statistically significant predictor of

autistic traits (B= -.023, 95% CI= -.041; -.0005, p=.012) suggesting that on average, with each additional year of age, there was a .023 point decrease in autistic traits. The R^2 for this model was .013, indicating that approximately 1.3% of the variance in autistic traits can be explained by age.

Analysis of variance served to test for differences in autistic traits among the racial groups (see Table 17 in Appendix H).[*] A statistically significant difference in autistic traits was observed among the five racial groups (F=(4, 468)=5.89, p<.001). Tukey post hoc tests suggest that the mean AQ score was significantly higher for Asians (mean=3.85, sd=2.09) compared to Whites (mean=2.77, sd=1.83, p<.001) and Black or African Americans (mean=2.45, sd=1.80, p=.001). No significant difference in autistic traits was observed between Whites (mean=2.77, sd=1.83) and Black or African Americans (mean=2.45, sd=1.80, p=.849), Whites (mean=2.77, sd=1.83) and those reporting more than one race (mean=3.00, sd=1.50, p=.974), Whites (mean=2.77, sd=1.83) and those of unknown or who wished not to report their race (mean=3.58, sd=1.98, p=.564), Black or African Americans (mean=2.45, sd=1.80) and those reporting more than one race (mean=3.00, sd=1.50, p=.773), Black or African Americans (mean=2.45, sd=1.80) and those of unknown or who wished not to report their race (mean=3.58, sd=1.98, p=.773), Asians (mean=3.85, sd=2.09) and those reporting more than one race (mean=3.00, sd=1.50, p=.286), Asians (mean=3.85, sd=2.09) and those of unknown or who wished not to report their race (mean=3.58, sd=1.98, p=.990), participants reporting more than one race (mean=3.00, sd=1.50) and those of unknown or who wished not to report their race (mean=3.58, sd=1.98, p=.899).

[*] The racial groups of Native Hawaiian or Other Pacific Islanders, and American Indian or Alaska Natives were excluded from the analysis because of their small number of cases (1 and 2 cases respectively).

Finally, certain socio-demographic and behavioral characteristics that were independently, significantly associated with the presence of autistic traits at the bivariate level, were included in a subsequent multivariate linear regression model using the Enter method in order to assess their unique contribution (see Table 18 in Appendix H). Results of the regression model suggest that participants' gender, race, field of study, social functioning, and anxiety were significantly associated with autistic traits. Specifically, on average, female participants had an AQ-10 score that was .519 points lower than that of males when controlling for age, race, field of study, social functioning, and anxiety (B= -.519; 95%CI= -.913, -.126; p=.01). As far as race is concerned, Asians had an average AQ-10 score that was .834 points higher than that of Whites and Black or African Americans combined in one group when controlling for age, gender, field of study, social functioning, and anxiety (B=.834; 95%CI=.356, 1.312; p=.001). On average, participants who were not in the field of "hard" sciences had an AQ-10 score that was .500 points lower than that of "hard" sciences students and faculty members when controlling for age, gender, race, social functioning, and anxiety (B= -.500; 95%CI= -.848, -.151; p=.005). For each unit increase in social functioning (indicating poorer social functioning), autistic traits increased on average by .116 points when controlling for age, gender, race, field of study, and anxiety (B=.116; 95%CI= .42, .189; p=.002). For each unit increase in anxiety, autistic traits increased on average by .063 points when controlling for age, gender, race, field of study, and social functioning (B=.063; 95%CI= .013, .114; p=.014). Participants' age was not significantly associated with autistic traits in this model (p=.329). The total regression model accounted for 16.5% of the variance in autistic traits as measured by the AQ-10.

Discussion

Results can be divided in eight thematic categories. For each category, the relationship between a particular personal characteristic and the presence of autistic traits among non-clinical individuals is discussed.

Gender and autistic traits

As predicted, male participants had significantly more autistic traits than the respective females. The male-biased sex ratio in ASD is probably the most prominent finding in all epidemiologic studies regarding the prevalence of the disorder, with a relatively constant male-to-female prevalence ratio of 4.5:1 for all cases,[2] and as high as 11:1 for individuals with high-functioning autism such as Asperger's syndrome.[37] As previously described, this association seems to hold true among non-clinical university samples as well.[6,9-18] In a systematic review study measuring autistic traits in a non-clinical general population sample of 6,934 adult males and females, Ruzich and her colleagues were able to verify the male bias after reviewing 73 related articles.[38] In a more recent study using a "big data" sample collected through the UK Channel 4 television website following the broadcasting of a popular medical education program, Ruzich et al. found sex differences in autistic traits to be significant among 450,394 individuals.[39]

Scientific field and autistic traits

"Hard" sciences students and faculty members fell closer to the autistic spectrum compared to those in other scientific fields. This finding is consistent with those of earlier studies conducted among university students, indicating a strong relationship between scientific field and autistic traits.[6,9-18] According to the EMBTA, the differences in autistic traits based on scientific field can be explained by the

presence of higher systemizing and lower empathizing abilities among those in the field of "hard" sciences.[25] The body of literature regarding sex differences in autistic traits and correlations between autistic traits and scientific field, supports the EMBTA principle postulating that autism can be considered as an extreme of the normal male profile.[25,26]

Parental occupation and autistic traits

A number of studies have identified that parents of children with ASD could be found in highly systemizing occupations.[40-42] Similarly, in the present study, parental occupation was expected to be associated with the presence of autistic traits in offspring. Contrary to findings by Austin revealing that students with one or both biological parents in a scientific occupation had higher AQ scores compared to those with parents in a non-scientific occupation,[12] in this sample, parental occupation predicted higher autistic traits only for participants with both biological parents in a scientific occupation. Our finding is consistent with the EMBTA and the "assortative mating" phenomenon, according to which the combination of two highly systemizing parents may contribute to the likelihood of producing a child with ASD,[41,43,44] or in this case, offspring with atypical characteristics. However, since genetic susceptibility due to specific mutations in parents or epigenetic changes in earlier generations that become more apparent in offspring has not yet been identified,[45] we should not draw the simplistic conclusion that all technical-minded people carry genes which contribute to autism,[43] nor that the pairing of technical-minded people will always produce a child with ASD or increased autistic traits.

Social functioning and autistic traits

To the best of our knowledge, this is the first time a link between social functioning and autistic traits is explored in a non-clinical population. In particular,

results show that higher autistic traits predicted lower social functioning among study participants, suggesting that deficits in social communication and social interaction seem to be present not only in individuals with ASD,[1] but also manifest among sub-threshold individuals in a linear fashion.

Anxiety and autistic traits

It has been well documented that higher rates of anxiety disorders are common in individuals with ASD, compared to both individuals without ASD and those with other neurodevelopmental disabilities.[20-22] In accordance with previously reported findings suggesting a positive correlation between autistic traits and anxiety symptoms in non-clinical samples,[23,24] we found that higher autistic traits predicted higher levels of anxiety among respondents. Unsurprisingly and analogously to the linear relationship previously revealed between social functioning and autistic traits, results indicate that anxiety symptomatology also seems to uniquely characterize the broader autism phenotype.

Level of education and autistic traits

Assuming that higher levels of education require higher levels of systemizing skills, we also tested for differences in autistic traits among participants based on affiliation status (undergraduate student, graduate student, faculty member) and based on degree (Bachelor's degree, Master's degree, Professional degree - MD/JD, Doctorate degree). Contrary to what was expected, undergraduate students had significantly higher autistic traits relative to both graduate students and faculty members, and Bachelor-level students/degree holders had significantly higher autistic traits compared to Master-level students/degree holders. These results suggest that our initial assumption was flawed. However, since many of the Bachelor-level undergraduate students are expected to progress to higher levels of education,

additional research using a sample with more stable educational characteristics might be more appropriate to investigate the related hypotheses.

Age and autistic traits

Despite the fact that there is a lack of literature supporting an effect of age on autistic traits,[39] such an investigation was deemed necessary in this study due to the previously presented evidence supporting that the younger, undergraduate students had more autistic traits compared to the older, graduate students and faculty members. When tested in isolation, age appeared to be associated with autistic traits, with increased age predicting a decrease in autistic traits among participants. However, participants' age was not significantly associated with autistic traits when controlling for other variables, suggesting that there is no meaningful association between the two variables and that the initial statistically significant association was likely an artifact.

Race and autistic traits

Asians had significantly more autistic traits compared to both Whites, and Black or African Americans. This association remained significant even when controlling for age, gender, field of study, social functioning, and anxiety. In the past, fluctuations in autistic traits as measured by the AQ have been documented across countries and across different ethnic groups within the same country, with behaviors associated with autistic traits being reported to a greater extent in the Eastern compared to the Western cultures.[46] However, it was later suggested that the observed fluctuations in autistic traits between the two cultures are not clinically meaningful, and can rather be explained by the strong influence of culture-specific values, norms, and expectations on the expression of socio-communicative behavior.[47] The adaptation of the AQ in many Eastern countries (including China, Japan, and India)

produced a variety of culturally calibrated instruments, thus eliminating the culture bias.[48-51] In the present study, we utilized the English version of the AQ-10 and did not account for cultural differences in autism-related behaviors between Western and Eastern cultures. Furthermore, Asian participants may be international students/faculty members, immigrants, or natives who have been raised in a traditionally Eastern familial environment. Therefore, we cannot conclude that the observed statistical difference in autistic traits of Asians vs. Whites, and Black or African Americans is also a true and meaningful one.

Limitations

The study presents at least four major limitations. First, the study design does not allow for causal inferences. Since correlation does not mean causation, it is impossible to establish a cause and effect relationship between the variables of interest. For example, although results indicate that undergraduate students had significantly higher autistic traits relative to both graduate students and faculty members, we cannot infer that there is a true causal relationship between affiliation status and autistic traits.

The second limitation is related to the instruments the study utilized for data collection purposes. Since all data were self-reported, over- or under-reporting may have occurred due to social desirability bias. For example, participants may have exaggerated on the level of social functioning because they were too embarrassed to report poor sexual activity. Also, the SFQ and the GAD-7 require participants to provide their answers based on "…how you have been recently." and "Over the last 2 weeks…" respectively. Since mood and behavior can vary significantly at different points in time based on a multitude of factors, it is possible that participants' responses might have been influenced by their current mental state, and do not reflect

their usual (or average) levels of social functioning and anxiety as measured by the two instruments. Future work needs to consider alternative data collection methods and instruments in order to address this limitation.

Another limitation to the current dataset is that there was no mechanism in the online platform by which to limit the number of times individuals could take the survey, and which did not require collecting identifiable information thus increasing the risk of compromising participants' anonymity. Therefore, it was impossible for us to identify and remove potential duplicates. However, we assume that the number of duplicates (if any) was limited and did not have a significant effect on the results.

Lastly, the under-representation of certain Schools in the sample (e.g., only 2 participants from Candler School of Theology, and 3 from Nell Hodgson Woodruff School of Nursing were recruited) may have influenced the results of the study. However, since the sample was composed of participants from all academic fields ("hard" sciences, social sciences, humanities), we assume that the under-representation of Schools had a very limited effect on the results.

Conclusions and Implications

The present study co-examined several empirically or theoretically selected socio-demographic and behavioral variables to investigate different ways in which, patterns traditionally associated with ASD, are present in non-clinical individuals within the broader autism phenotype. The study can be characterized as exploratory for the field of public mental health. Findings can help advance the limited knowledge on quantifying where academically successful individuals are situated on the continuum from autism to normality.

Knowing that "atypical" or "sub-threshold" individuals need access to services for the autistic characteristics that are present,[4] that the handicap created by poor

social functioning is at least as important as that created by physical or psychological symptoms,[52] and the well documented effects of anxiety and its correlates (including associations with depression and suicidality),[53-55] Results from this study can potentially serve to guide future public mental health interventions. In particular, findings can be utilized by the institution to better understand and accommodate the needs of students, or even by the on-campus counseling center and medical services to develop appropriate strategies and interventions. Findings can also be taken into consideration by the university for creating effective faculty development programs. Having identified the value of such interventions, the Massachusetts Institute of Technology (MIT) Student Activities Office created "Charm School." Since 1993, MIT "Charm School" offers classes on topics including money management, dating etiquette, how to ask for a recommendation letter, small talk, networking, nonverbal communication, and table manners.[56] In a different setting, researchers at Sidney Kimmel Medical College (formerly known as Jefferson Medical College) Center for Research in Medical Education and Health Care have developed the Jefferson Scale of Physician Empathy (JSPE) to measure empathy in physicians.[57] Empathy is essential in patient care and has been defined as a cognitive attribute that involves the ability to understand the patient's pain, suffering, and perspective, combined with a capability to communicate this understanding and an intention to help.[58] Currently, several interventions are being developed with the goal to enhance empathy among medical students, such as using a structured visual arts-based program designed to improve listening, communication, and other skills related to empathy.[59]

Future efforts can focus on exploring the effect of social support and other variables as possible confounders of the relationship between autistic traits, social functioning, and anxiety. Also, by considering the evidence suggesting altered

learning,[9] cognitive,[10,11] and behavioral[12-14] profiles for high AQ individuals, future investigations can lead to the development of multi-level, targeted interventions, tailored to the distinct characteristics of the members of the Emory community.

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Appendices

Appendix A

Items of the AQ-10 and original AQ-50 item numbers

Scale	Item	Original item number from AQ-50
Attention to detail	I often notice small sounds when others do not	5
	I usually concentrate more on the whole picture, rather than the small details	28
Attention switching	I find it easy to do more than one thing at once	32
	If there is an interruption, I can switch back to what I was doing very quickly	37
Communication	I find it easy to 'read between the lines' when someone is talking to me	27
	I know how to tell if someone listening to me is getting bored	31
Imagination	When I'm reading a story I find it difficult to work out the characters intentions	20
	I like to collect information about categories of things (e.g. types of car, types of bird, types of train, types of plant, etc.)	41
Social	I find it easy to work out what someone is thinking or feeling just by looking at their face	36
	I find it difficult to work out people's intentions	45

Adapted from: Booth et al.[22]

Appendix B

The Social Functioning Questionnaire (SFQ)

Please look at the statements below and tick the reply that comes closest to how you have been recently (or in the past two weeks for studies involving repeated measurement)

I complete my tasks at work and home satisfactorily.	Most of the time	☐ 0
	Quite often	☐ 1
	Sometimes	☐ 2
	Not at all	☐ 3
I find my tasks at work and at home very stressful.	Most of the time	☐ 3
	Quite often	☐ 2
	Sometimes	☐ 1
	Not at all	☐ 0
I have no money problems.	No problems at all	☐ 0
	Slight worries only	☐ 1
	Definite problems	☐ 2
	Very severe problems	☐ 3
I have difficulties in getting and keeping close relationships.	Severe difficulties	☐ 3
	Some problems	☐ 2
	Occasional problems	☐ 1
	No problems at all	☐ 0
I have problems in my sex life.	Severe problems	☐ 3
	Moderate problems	☐ 2
	Occasional problems	☐ 1
	No problems at all	☐ 0
I get on well with my family and other relatives.	Yes, definitely	☐ 0
	Yes, usually	☐ 1
	No, some problems	☐ 2
	No, severe problems	☐ 3
I feel lonely and isolated from other people.	Almost all the time	☐ 3
	Much of the time	☐ 2
	Not usually	☐ 1
	Not at all	☐ 0
I enjoy my spare time	Very much	☐ 0
	Sometimes	☐ 1
	Not often	☐ 2
	Not at all	☐ 3

Adapted from: Tyler et al.[20]

Appendix C

The Generalized Anxiety Disorder 7-item scale (GAD-7)

Over the last 2 weeks, how often have you been bothered by the following problems?	Not at all	Several days	More than half the days	Nearly every day
1. Feeling nervous, anxious or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it is hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3

Adapted from: Spitzer et al.[32]

Appendix D

The Socio-Demographics Questionnaire

1. Have you ever received a diagnosis of an autism spectrum disorder (including Autistic Disorder, Asperger Syndrome, PDD-NOS, ASD) or any other major psychiatric condition (such as Schizophrenia, Bipolar Disorder, Depressive Disorder, Anxiety Disorder, OCD, PTSD)?

   ☐ Yes ☐ No

2. What is your gender identity? Choose one.

   ☐ Male
   ☐ Female
   ☐ Transgender/Transsexual

3. What is your age?

   ____ years old

4. Do you consider yourself to be Hispanic or Latino?

   ☐ Yes ☐ No

5. What is your racial background? Choose one.

   ☐ White
   ☐ Black or African American
   ☐ American Indian or Alaska Native
   ☐ Native Hawaiian or Other Pacific Islander
   ☐ Asian
   ☐ More than one race
   ☐ Unknown or Wish Not to Report

6. What is your **primary** status with Emory University? Choose one.

   ☐ Undergraduate Student
   ☐ Graduate Student
   ☐ Faculty Member

7. Which is your **primary** school?

- ☐ Candler School of Theology
- ☐ College of Arts and Sciences
- ☐ Goizueta Business School
- ☐ Laney Graduate School
- ☐ Nell Hodgson Woodruff School of Nursing
- ☐ Oxford College
- ☐ Rollins School of Public Health
- ☐ School of Law
- ☐ School of Medicine

8. What is the **highest** degree you received or are a candidate for? Choose one.

- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ Professional degree (MD, JD)
- ☐ Doctorate degree

9. What is your **major** field of study (e.g., nursing, law, genetics, business)?

……

10. Which of the following **best** describes your major field of study identified in question #7? Choose one.

- ☐ Hard sciences (including natural sciences)
- ☐ Social sciences
- ☐ Humanities

11. Are/were either of your **biological** parents in one of the following occupations: mathematics, physics, chemistry, engineering, computer science, biology, medicine?

☐ Yes ☐ No

12. If you answered "Yes" to question #9, which of your biological parents is/was in a scientific occupation? Choose one.

- ☐ Biological father
- ☐ Biological mother
- ☐ Both parents

Appendix E

Dear students and faculty,

My name is Loizos Nikolaou and I am a graduate student at Emory University, Rollins School of Public Health. I would like to invite you to participate in my Master's Thesis research study. I am interested in exploring the link between social skills and functioning, anxiety and academic achievement among Emory University students and faculty members.

Participation is completely voluntary and anonymous. You are not eligible to be in this study if you have ever received a diagnosis of an autism spectrum disorder (including Autistic Disorder, Asperger Syndrome, PDD-NOS, ASD) or any other major psychiatric condition (such as Schizophrenia, Bipolar Disorder, Depressive Disorder, Anxiety Disorder, OCD, PTSD). If you decide to participate you will be asked to complete 4 short online questionnaires (approximate completion time: 5-7 minutes) located in the study's website. After completing the questionnaires you will receive feedback based on your responses.

In case you have any questions about the study, please contact me via e-mail at loizos.nikolaou@emory.edu. If you have chosen to participate, please follow the link below:

https://redcap.emory.edu/surveys/?s=H74TJW3C7T

Thank you very much.

Sincerely,

Loizos Nikolaou

Appendix F

Emory University
Consent to be a Research Subject

Title: Exploring the Link between Autistic Traits, Social Functioning, Anxiety and Academic Achievement among Emory University Students and Faculty Members

Principal Investigator: Loizos Nikolaou, BSW, MSc, MPHc, Graduate student, Department of Behavioral Sciences and Health Education, Rollins School of Public Health, Emory University

Funding Source: Self-funded

Introduction

You are being asked to be in a research study. This form is designed to tell you everything you need to think about before you decide to consent (agree) to be in the study or not to be in the study. **It is entirely your choice. If you decide to take part, you can change your mind later on and withdraw from the research study.**

Before making your decision:

- Please carefully read this form or have it read to you
- Please ask questions about anything that is not clear

You can take a copy of this consent form, to keep. Feel free to take your time thinking about whether you would like to participate. By signing this form you will not give up any legal rights.

Study Overview

The purpose of this study is to explore the link between social skills and functioning, anxiety and academic achievement among Emory University students and faculty members. Approximately 1000 individuals will participate in this research study.

Procedures

You would be asked to complete 4 short online questionnaires (approximate completion time: 5-7 minutes) located in the study's website.

Risks and Discomforts

There is a risk that involves the loss of privacy because of the use of the internet. This risk will be minimized with the use of a secure web-based application.

Benefits

After completing the questionnaires you will receive feedback based on your responses. This study is designed to learn more about the psychosocial

characteristics of academically successful individuals. The study results may be used by Emory University to help others in the future.

Compensation

You will not be offered payment for being in this study.

Confidentiality

Certain offices and people other than the researchers may look at study records. Government agencies and Emory employees overseeing proper study conduct may look at your study records. These offices include the funder(s), the Emory Institutional Review Board, the Emory Office of Research Compliance. Emory will keep any research records we create private to the extent we are required to do so by law. A study number rather than your name will be used on study records wherever possible. Your name and other facts that might point to you will not appear when we present this study or publish its results. Study records can be opened by court order. They may also be produced in response to a subpoena or a request for production of documents.

Voluntary Participation and Withdrawal from the Study

You have the right to leave a study at any time without penalty. You may refuse to do any procedures you do not feel comfortable with, or answer any questions that you do not wish to answer.

Contact Information

Contact Loizos Nikolaou at 6787707180:

- if you have any questions about this study or your part in it, or
- if you have questions, concerns or complaints about the research

Contact the Emory Institutional Review Board at 404-712-0720 or 877-503-9797 or irb@emory.edu:

- if you have questions about your rights as a research participant.
- if you have questions, concerns or complaints about the research.
- You may also let the IRB know about your experience as a research participant through our Research Participant Survey at http://www.surveymonkey.com/s/6ZDMW75.

By clicking “I agree” below you are indicating that you have read and understood this consent form and agree to participate in this research study. Please print a copy of this page for your records.

I Agree

I Do Not Agree

Appendix G

YOUR RESULTS

Autism-Spectrum Quotient (AQ-10):	X points
Social Functioning Questionnaire (SFQ):	Y points
Generalized Anxiety Disorder Scale (GAD-7):	Z points

HOW TO INTERPRET YOUR RESULTS*

The AQ-10 provides an assessment of autistic traits. A score of 6 or more indicates clinically significant levels of autistic traits.

The SFQ provides an assessment of social functioning. A score of 10 or more indicates poor social functioning.

The GAD-7 is an anxiety measure. Further evaluation is recommended when the score is 10 or greater.

RECOMMENDATIONS

If your scores are lower than the above cut-off points in all 3 scales, no further action is required.

If you scored at or above the cut-off score for any or all of the above screening scales, we advise you to consult your family physician, or Emory University's Student Health and Counseling Services or the Faculty Staff Assistance Program for more information and a more detailed screening or diagnostic assessment. You may want to print this page to bring with you.

CONTACT INFORMATION

Student Health and Counseling Services

Student Health Services
1525 Clifton Road (1st & 2nd floors)
tel: 404-727-7551
www.studenthealth.emory.edu/hs

Counseling and Psychological Services
1462 Clifton Road, Suite 235
tel: 404-727-7450
www.studenthealth.emory.edu/cs

Faculty Staff Assistance Program
1762 Clifton Rd., Suite 1100
tel: 404-727-4328
www.fsap.emory.edu

** Please note, these scales are screening tools and are not designed to provide diagnosis.*

Appendix H

Table 1

Descriptive analysis of the sample's socio-demographic characteristics

	Females (n=367)	Males (n=139)	Total (n=506)
Age	26.7 (8.14)	30.1 (11.4)	27.9 (9.34)
Hispanic/Latino	6.3% (32)	2.0% (10)	8.3% (42)
Race			
White	50.6% (256)	17.8% (90)	68.4% (346)
Black/African	7.5% (38)	1.4% (7)	8.9% (45)
Indian/Alaskan	0.2% (1)	0.2% (1)	0.4% (2)
Hawaiian/Pacific	0.2% (1)	-	0.2% (1)
Asian	9.3% (47)	5.3% (27)	14.6% (74)
More than one	3.4% (17)	1.6 % (8)	4.9% (25)
Unknown/NR	1.4% (7)	1.2% (6)	2.6% (13)
Status			
Undergraduate	12.1% (61)	3.6% (18)	15.6% (79)
Graduate	54% (273)	18.6% (94)	72.5% (367)
Faculty	6.5% (33)	5.3% (27)	11.9% (60)
School			
Theology	0.2% (1)	0.2% (1)	0.4% (2)
College of A&S	1.0% (5)	1.0% (5)	2.0% (10)
Goizueta	3.0% (15)	4.2% (21)	7.1% (36)
Laney	19.2% (97)	7.3% (37)	26.5% (134)
Nursing	0.6% (3)	-	0.6% (3)

Oxford	12.3% (62)	3.0% (15)	15.2% (77)
Public Health	26.7% (135)	5.7% (29)	32.4% (164)
Law	7.1% (36)	4.0% (20)	11.1% (56)
Medicine	2.6% (13)	2.2% (11)	4.7% (24)
Degree			
Bachelors	13.2% (65)	4.7% (23)	17.8% (88)
Masters	28.5% (141)	8.9% (44)	37.4% (185)
MD/JD	8.3% (41)	5.1% (25)	13.4% (66)
Doctorate	21.9% (108)	9.5% (47)	31.4% (155)
Field			
Hard Science	30.2% (153)	9.7% (49)	39.9% (202)
Social Science	32.4% (164)	13.4% (68)	45.8% (232)
Humanities	9.9% (50)	4.3% (22)	14.2% (72)
Parent(s) in Hard Sc.			
Yes	36.4% (184)	11.3% (57)	47.6% (241)
No	35.8% (181)	15.8% (80)	51.6% (261)
Unknown	0.4% (2)	0.4% (2)	0.8% (4)
Which parent?			
Father	41.9% (101)	12.9% (31)	54.8% (132)
Mother	10.4% (25)	4.1% (10)	14.5% (35)
Both	24.1% (58)	6.6% (16)	30.7% (74)

Note: Mean (sd) is presented unless specifically states percentage (n).

Table 2

Descriptive analysis of the sample's behavioral characteristics

	Females (n=346)	Males (n=130)	Total (n=476)
Autistic traits	2.78 (1.84)	3.30 (1.98)	2.92 (1.89)
	Females (n=342)	Males (n=127)	Total (n=469)
Social functioning	6.26 (2.84)	6.39 (3.09)	6.29 (2.90)
	Females (n=340)	Males (n=126)	Total (n=466)
Anxiety	4.90 (4.08)	4.34 (4.40)	4.75 (4.17)

Note: Mean (sd) is presented.

Table 3

Independent-samples T-test of autistic traits by gender

	Females Mean (sd)	Males Mean (sd)	T-test
Autistic traits	2.78 (1.84)	3.30 (1.98)	2.68*

* p=.008, N=476

Table 4

Independent-samples T-test of autistic traits by field of study (hard vs. other)

	Hard science	Other fields	T-test
	Mean (sd)	Mean (sd)	
Autistic traits	3.25 (2.05)	2.70 (1.75)	3.03*

* p=.003, N=476

Table 5

Analysis of variance of autistic traits by field of study

Sourse	df	SS	MS	F	p
Between groups	2	34.530	17.265	4.891	.008
Within groups	473	1669.594	3.530		
Total	475	1704.124			

Note: N=476

Table 6

Independent-samples T-test of autistic traits by field of study (hard vs. humanities)

	Hard science	Humanities	T-test
	Mean (sd)	Mean (sd)	
Autistic traits	3.25 (2.05)	2.68 (1.68)	2.04*

* p=.043, N=255

Table 7

Independent-samples T-test of autistic traits by parental occupation (one or both parents in scientific occupation vs. non-scientists)

	Parents scientists	Parents non-scientists	T-test
	Mean (sd)	Mean (sd)	
Autistic traits	2.97 (1.87)	2.89 (1.92)	.50*

* p=.618, N=472

Table 8

Independent-samples T-test of autistic traits by parental occupation (both parents in scientific occupation vs. one)

	Both parents scientists	One parent scientist	T-test
	Mean (sd)	Mean (sd)	
Autistic traits	3.68 (1.85)	2.65 (1.80)	-3.94*

* p<.001, N=226

Table 9

Analysis of variance of autistic traits by parental occupation

Sourse	df	SS	MS	F	p
Between groups	2	52.268	26.134	7.901	.000
Within groups	223	737.573	3.308		
Total	225	789.841			

Note: N=226

Table 10

Independent-samples T-test of autistic traits by parental occupation (both parents in scientific occupation vs. mother)

	Both parents scientists	Mother scientist	T-test
	Mean (sd)	Mean (sd)	
Autistic traits	3.68 (1.85)	2.82 (1.83)	-2.209*

* p=.029, N=104

Table 11

Simple linear regression analysis summary for autistic traits predicting social functioning

Variable	B	SE(B)	β	t	Sig. (p)
Autistic traits	.450	.067	.296	6.685	.000

Note: R^2=.087

Table 12

Simple linear regression analysis summary for autistic traits predicting anxiety

Variable	B	SE(B)	β	t	Sig. (p)
Autistic traits	.562	.098	.256	5.709	.000

Note: R^2=.066

Table 13

Analysis of variance of autistic traits by affiliation status

Sourse	df	SS	MS	F	p
Between groups	2	51.520	25.760	7.373	.001
Within groups	473	1652.604	3.494		
Total	475	1704.124			

Note: N=476

Table 14

Analysis of variance of autistic traits by level of education

Sourse	df	SS	MS	F	p
Between groups	3	20.234	6.745	1.924	.125
Within groups	461	1616.390	3.506		
Total	464	1636.624			

Note: N=465

Table 15

Independent-samples T-test of autistic traits by level of education (bachelor vs. master)

	Bachelor	Master	T-test
	Mean (sd)	Mean (sd)	
Autistic traits	3.32 (1.88)	2.72 (1.85)	2.408*

* p=.017, N=255

Table 16

Simple linear regression analysis summary for age predicting autistic traits

Variable	B	SE(B)	β	t	Sig. (p)
Age	-.023	.009	-.115	-2.526	.012

Note: R^2=.013

Table 17

Analysis of variance of autistic traits by race

Sourse	df	SS	MS	F	p
Between groups	4	81.286	20.322	5.892	.000
Within groups	468	1614.270	3.449		
Total	472	1695.556			

Note: N=473

Table 18

Multiple linear regression analysis summary for socio-demographic and behavioral factors predicting autistic traits

Variable	B	SE(B)	β	t	Sig. (p)
Age	-.010	.010	-.047	-.978	.329
Gender	-.519	.200	-.119	-2.592	.010
Scientific field	-.500	.177	-.128	-2.821	.005
Social functioning	.116	.037	.177	3.103	.002
Anxiety	.063	.026	.139	2.460	.014
Race	.834	.243	.157	3.428	.001

Note: R^2=.165