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Examining Three Connected Concepts: Social Impairment and STEM; Broader Autism Phenotype; and Convergence Validity in Autistic Trait Screening Tools

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Abstract *— The societal cost of ASD is enormous, and the concept of broader autism phenotype (BAP) adds more weight to the situation. The recent reporting of the higher prevalence rate of ASD in India [1] (Chauhan et al., 2019) and social impairment implications suggest a serious attempt to understand this situation. Present work reports finding from a pilot study in this direction. This work examines three related concepts: 1) hypothesized connection between social impairment/autistic trait and STEM education/profession; 2) existence of broader autism phenotype, and 3) convergence validity between two most widely used autistic trait screening tool (autism spectrum quotient and social responsiveness scale). We conducted this study on 85 student participants with autism spectrum quotient, social responsiveness scale, reading Mind in the eye test, and metacognitive questionnaire. The data collection was done using a paper-pencil test, google form, and E-prime software. The results suggest the possible connection between autistic trait-STEM and BAP. However, the convergence validity between autism spectrum quotient and social responsiveness scale is not found unexpectedly. We discuss the implication, limitations, and suggestions.*

Keywords — *STEM education, Social impairment; Broader Autism Phenotype; Autistic Trait, Convergence Validity*

Introduction

Social impairment is defined as people's inability to process, store, and apply information in social situations by keeping other people in their minds. An individual faces difficulty in understanding social cues, which leads to process social information in making decisions. Social cognitive deficit or impairment is evident in unusual or inappropriate body language, gestures, and facial expressions (e.g., avoiding eye contact or using facial expressions that don't match with what one is saying), lack of interest in other people or in sharing interests or achievements, feels difficulty in approaching others or pursuing social interaction; feels detached; prefers to be alone, difficulty understanding other people's feelings, reactions and nonverbal cues, resistance to being touched, problem or failure to make friends with same age people. Researchers in the neurosciences have focused their attention on understanding how the brain gives rise to these remarkable social abilities. It is proven that social cognition exists in the human brain with a subset of general cognitive processes [2,3]. (Adolphs, 1999; Blakemore, Winston & Frith, 2004) Various aspects of social cognition have been listed below (**Table 1**):

Table 1 Showing a various important aspect of Social cognition

Important aspects of Social cognition
• Recognize the difference between self and others
• Emotional recognition of others
• Collaboration
• Sharing episodic memory
• Theory of Mind
• Perspective making
• Empathy

Further, based on these abilities, [4] Tomasello (1999) proved that human life is different from individuals who have a selective social impairment, such as Autism or after particular kinds of brain damage. Indeed, the importance of human sociability both to everyday life and the cultural differences in the world has motivated some researchers to argue that social cognition may have been one of the primary engines of human evolution. For example, Tomasello [5] has argued convincingly that what sets Homo sapiens apart from other primates is the ability that represents the Mind of beings. Based on his argument, one can predict the importance of sociability and various cognitive processes (i.e., thinking and interacting with other individuals) to human life.

In April 2008, the American Psychiatric Association's (APA) DSM-5 Task Force began work proposing revisions to the criteria for the disorders referred to in DSM-IV as Delirium, Dementia, Amnesic and Other Cognitive Disorders [5,6]. (APA, 2000, Ganguli 2011) Based on the given shreds of evidence, social cognitive impairment disorders were categorized, as shown in (**Table 2**).

Table 2 showing categorization of disorders with social cognitive impairment [5] (APA, 2000)

Psychiatric disorders	Developmental disorders	Neurodegenerative disorders	Acute brain damage
Schizophrenia	Autism spectrum disorder	Fronto-temporal dementia	Traumatic brain injury
Bipolar disorder	Fragile X syndrome	Alzheimer disease	Stroke
Antisocial personality disorder	Williams syndrome	Amyotrophic lateral sclerosis	
Major depressive disorder	Angelman syndrome	Parkinson disease	
Post-traumatic stress disorder	Prader–Willi syndrome	Huntington disease	
Social phobia	Turner syndrome	Progressive supranuclear palsy	
Anorexia nervosa	Rett syndrome	Corticobasal degeneration	
Personality disorders (for example, borderline, antisocial, narcissistic	Attention deficit hyperactivity disorder	Multiple sclerosis	
	Severe conduct disorder		
	Fetal alcohol syndrome		

A. Autism Spectrum Disorder (ASD) and Broader Autism Phenotype (BAP)

Social impairment is a marked symptom of Autism spectrum disorder (ASD). Social impairment may be the most complex and impenetrable core challenge facing children with Autism [7,8]. (Kasari, C. 2012, Wing 1981) According to the current frame of reference, social impairment is the main symptom of Autism. Majorly autism spectrum disorder (ASD) is described as impairment in three areas: social communication, social interaction, and restrictive or repetitive behavior patterns [9]. (American Psychiatric Association, 2013)

ASD's etiological studies suggested that milder but qualitatively similar behavioral characteristics are seen in the relative of ASD patients. In one way, we can say that ASD shows impairment in social functioning with various effects; it may vary from mild to severe. While on the other hand, traits of ASD are seen in the general population among non-affected people [10,11] (Baron-Cohen et al., 2001; Kanne et al., 2009) and especially prevalent among relatives of individuals with ASD. The idea that ASD traits exist in a continuum is termed Broader Autism Phenotype (BAP) [12,13]. (Bishop et al., 2004; Hurley et al., 2007) The BAP hypothesizes that none to few social deficiency symptoms are seen in the normal population. Qualitatively similar symptoms in relative of ASD patients and Autism exist at another extreme of the continuum. Several extensive population studies have shown support to BAP and reported that social impairment is continuous in epidemiologic samples, where Autism appears at negative extreme and typical developed (TD) individuals at the other end [14-16]. (Constantino & Todd, 2003; Ronald, Happe, Price, Baron-Cohen, & Plomin, 2006; Skuse et al., 2005).

ASD Prevalence

According to Shuang Qiu and colleagues' meta-analysis, in 2019 [17] for Asian countries, among 1,22,195,497, the overall prevalence rate is 0.36%, with males' ratio to females (4:1), i.e., Male 0.45% and female 0.18%. Recent Statistics of the year 2020 by the Centers for Disease Control and Prevention estimated that around 222 per 10,000 children in the United States had autism spectrum disorder, one of the world's highest prevalence rates. Autism prevalence in India is not conclusive due to the scarcity of data. The 2011 census-estimated 1.3 percent prevalence of neurodevelopment conditions. One recent systematic review and meta-analysis is done by Chauhan and colleagues [1] on epidemiological studies. They found only four studies between the periods of 2014-2017. The rural setting study showed a pooled percentage prevalence of 0.11 [95% confidence interval (CI) 0.01–0.20] in children aged 1-18 years; and four studies conducted in the urban setting showed a pooled percentage prevalence of 0.09 (95% CI 0.02–0.16) in children aged 0-15 years. Therefore, looking at prevalence rate, suggestion, and evidence for BAP, it is imperative to examine this phenomenon.

BAP associated Social Impairment in STEM

The expansion of BAP is suggested in another set of studies. These researches also conclude that ASD characteristics are seen more in males and those who study STEM disciplines. Indeed, researchers suggest that individuals with an ASD are more likely than the general population to be good at science, technology, engineering, and maths (STEM) [18-21]. (Moore 2006; Morton 2001; Ross 2006; Safer 2012) These studies suggest a path from a lack of social skills to sound science and technology skills. It has been believed that people with excellent skills in STEM show similar scores on social impairment compared with autistics. Most of them showed a score above than clinical threshold on a typical screening tool.

Such a population is also named a subclinical population [10]. (Baron-Cohen et al., 2001) The people who are near the threshold also lack social interaction level.

Indeed, there is some evidence to suggest a negative correlation between social and emotional competence and innate understanding of the physical universe. Specifically, Baron-Cohen, Wheelwright, Spong, Scahill, and Lawson (2001) hypothesized that participants with Asperger syndrome would display superior knowledge of *folk physics* (i.e., the ability to infer physical causality) and inferior knowledge of *folk psychology* (i.e., the ability to infer causality of social action).

With intelligence and prior science knowledge controlled, [10] Baron-Cohen et al. (2001) demonstrated that their sample with Asperger syndrome displayed a stronger natural sense of folk physics and a weaker understanding of folk psychology than a sample of controls. Baron-Cohen sparked this research, Wheelwright, Skinner, et al.'s (2001) findings that among a large sample of university students in England, those whose majors related to natural science and mathematics scored higher autistic traits than students majoring in the humanities and social sciences. These studies seem to suggest a preference and increased aptitude for sciences (e.g., physical, natural, and computer sciences but not social sciences), technology, engineering, or mathematics (STEM) among ASD populations. Recently, a large-scale study from the Stanford Research Institute compared the degree program choices of university students as a function of various sub-populations. Of all university students with ASD, about 36% chose a degree program relating to STEM fields, while only 22%of the total general student body chose degree programs relating to STEM fields [22]. (Wei, Yu, Shattuck, McCracken, &Blackorby, 2013)

But there is still a debate going on that the traits of Autism lying on a continuum of the population from clinical (autistic) to subclinical to (normal) typically developed. These conclusions have led to speculation and attempt to understand this autism trait in the whole population.

Rationale

In this background, it is interesting to explore the ASD and STEM relations in the Indian population and the broader autism phenotype. This work is carried out as a pilot study to examine the possibility of such interrelation.

Objective

The current study's objective is to investigate if trait autism were more common in the people in the field of science, technology, engineering, and mathematics (STEM) and the social cognitive deficit on the population continuum.

Hypothesis

H1: It is hypothesized that people in STEM areas would show significantly less social cognitive capacity than people in the Arts and Humanities areas.

H2: It is hypothesized that the clinical group will show more deficit and prediction by ASQ.

Methodology

Participants: Present study is done with student participants, and they were recruited from two government institutes of Jodhpur, Rajasthan (Western India). They were distributed in two groups based on STEM and other than STEM disciplines. We invited participation through campus flyers and word of mouth. A total of 118 participants enrolled in the study, and 85 participants completed all tasks and questionnaires.

Procedure: All the participants were recruited by the consent of the respective departments' competent authority, and informed consent was taken from the participants. All STEM participants have completed their senior secondary education with Science and Mathematics subjects. Still, students in Arts and Humanities were from diverse backgrounds (Science, Maths, and commerce subjects). All the participants took part in the study voluntarily by signing a written consent form.

Comparing people studying STEM and Arts and Humanities disciplines on social cognition is made to examine the objective. We measured social cognition through different indicators: social awareness, social cognition, social communication, social motivation, the theory of Mind as facial emotional recognition, thoughts, and tendencies associated with cognitive-emotional processes. Different psychometric tools and tasks are used to collect data on these indicators.

Measuring Tools/Task: Following psychometric tools and the task was used:

Autism Spectrum Quotient (ASQ): is the most common screening tool developed by Simon Baron-Cohen and his colleagues in 2001[10] to measure autistic traits. It comprises fifty questions and investigates whether adults of average intelligence have symptoms of Autism or one of the other autism spectrum conditions. As per the cutoff, a score above 29 to 31 shows a subclinical level, and a score above 32 indicates the possibility of an autistic trait. The reliability of the current sample is 0.67.

Social Responsiveness Scale (SRS): The Social Responsiveness developed by John Constantino in 2008 [23] is used to measure indicators: social awareness, social cognition, social communication, social motivation. As per the manual raw score of 70 and above id moderate evidence, any score above 85 is robust evidence of autistic trait. The reliability of the current sample is 0.80.

Reading Mind in the Eye Test: We used a computerized task, the "Reading the Mind in the Eyes" test (RMIE- Eyes test) by Baron and Cohen in 2001[24] for this study to measure the theory of Mind for facial emotion recognition. This task is created in E-prime software following Baron and Cohen's 2001 [26] methodology.

Meta Cognition Questionnaire (MCQ-30): developed by Wells and Cartwright-Hatton in 2004 [25], is used to

measure thoughts about cognitive-emotional processes. about worry, 2) negative beliefs about the controllability of thoughts and corresponding danger; 3) cognitive confidence; 4) negative beliefs about thoughts, need to control thoughts, and 5) cognitive self-consciousness. The reliability of the current sample is 0.80.

Analysis

Scoring was done for questionnaires and computerized tasks. All the score was analyzed statistically on SPSS platform. Frequency Analysis, T-test, ANOVA, Bonferroni post hoc, correlation, and regression analysis was performed.

Results and discussion

Section I: A total of 85 participants completed the study, and their mean age was 19.3 years (*SD* = 1.83 range = 16–25). They all attended Higher Secondary schooling without a gap in-between their education. Seventy-seven out of them were undergraduates, and 8 of them were postgraduates. As the study requires both STEM and other than STEM (Arts and Humanities) participants, a total of This scale consists of 30-item measuring 1) positive beliefs *N*= 42 participants currently in the STEM field and *N*=43 in the Arts and Humanities field were selected.

An independent sample t test was performed to find difference between groups (STEM/ Non STEM). In the mean difference analysis STEM participants showed more social awareness deficit (t=1.80, p=.074, D= 0.39), but also the reading mind in the eye (t=5.28, p=.00, D=1.147) capacity. Whereas, Non-STEM participants showed higher social cognitive problems and deficits like restrictive repetitive behaviour (t= 3.27, p= 0.002, D= 0.71), positive belief about worry (t=4.37, p=0.00, D=0.94), cognitive confidence (t= 5.28, p= .00, D=1.15), need for controlling thought (t=2.13, p=.036, D= .46), cognitive self-consciousness (t=2.05, p=.04, D=.44), general factor (t=4.14, p= .00, D= .90), social skill deficit (t=3.34, p=.00, D=.72), deficit in attention to details (t=1.89, p=.06, D= .41) and total autism quotient score (t=3.49, p=.00, D= .75). All these differences show moderate to very large effect size and therefore we question the basic premise we started with (**see Table 3**) and the graphical representation is shown in **Figure 1**.

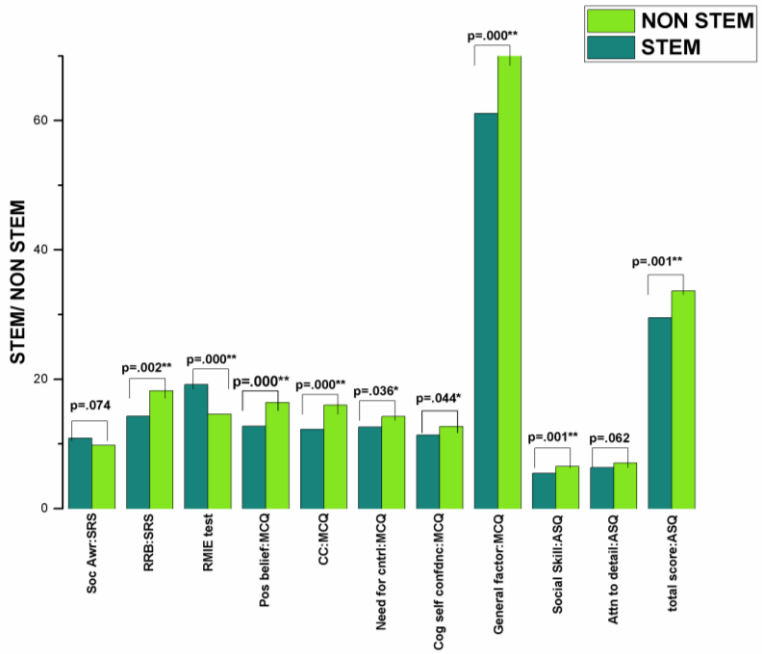

Figure 1 graphical representation is a significant difference between STEM/ Non STEM groups

As on most of the deficits and problems, the Non-STEM participant scored higher than the STEM participant. We assessed participants' cross-tabulation (**Table 4**) as per their education affiliation and group as per the Autism screening tool (Autism Spectrum Quotient). As per ASQ score all 85 participants were divided into three groups: normal (n=11); subclinical (n=35) and clinical (n=39).

It is clear from the above table that the highest percent (28.2%) of STEM participants were in the sub-clinical group. In contrast, the highest percent of Non-STEM participants (32.9%) were in the clinical group. Due to this conundrum, we cannot directly assess STEM education related to the social cognitive deficit. ***We assume this is not the absence of a relationship between the two but a societal factor.*** The choice of educational stream in India is not dependent on the student's preference but the multiple factors ranging from financial to societal pressure to opportunity availability. One possibility to handle this and check for the STEM – social cognition relation is to conduct this kind of work with professionals in the STEM area to measure people's preferences for STEM or Non-STEM.

Table 3 t-test calculation to find the difference between STEM/ Non STEM groups

Variables	Groups(N)	Mean	SD	t	p	D
Social Awareness Deficit: SRS	STEM (42)	10.8810	2.54905	1.808	.074	0.391
	NON-STEM (43)	9.7907	2.99649			
Restricted and Repetitive Behavior: SRS	STEM (42)	14.2857	5.62783	-3.276	.002	0.71
	NON-STEM (43)	18.2093	5.40968			
Reading Mind in the eye test score	STEM (42)	19.1667	4.30494	5.282	.000	1.147
	NON-STEM (43)	14.6047	3.61965			
Positive belief about worry: MCQ	STEM (42)	12.7381	3.10043	-4.376	.000	0.947
	NON-STEM (43)	16.3953	4.49412			
Cognitive Confidence on worry: MCQ	STEM (42)	12.2619	3.22384	-5.281	.000	1.145
	NON-STEM (43)	16.0000	3.30224			
Need for Controlling thought: MCQ	STEM (42)	12.5952	3.40057	-2.134	.036	0.462
	NON-STEM (43)	14.2558	3.76761			
Cognitive Self Consciousness: MCQ	STEM (42)	11.3810	2.83663	-2.045	.044	0.443
	NON-STEM (43)	12.6977	3.09789			
General Factor: MCQ	STEM (42)	61.1190	12.82566	-4.136	.000	0.896
	NON-STEM (43)	73.2093	14.10599			
Social Skill Deficit: ASQ	STEM (42)	5.4524	1.48492	-3.341	.001	0.724
	NON-STEM (43)	6.5116	1.43713			
The deficit in Attention to Details: ASQ	STEM (42)	6.3571	1.55895	-1.895	.062	0.41
	NON-STEM (43)	7.0698	1.89480			
Total score: ASQ	STEM (42)	29.5000	5.01826	-3.497	.001	0.757
	NON-STEM (43)	33.6512	5.89949			

Table 4 cross-tabulation Table among groups

STEM/NON-STEM		ASQ Group			Total
		Normal	Sub-clinical	Clinical	
STEM	Count	7	24	11	42
	% of Total	8.2%	28.2%	12.9%	49.4%
Non-STEM	Count	4	11	28	43
	% of Total	4.7%	12.9%	32.9%	50.6%
Total	Count	11	35	39	85
	% of Total	12.9%	41.2%	45.9%	100.0%

Section II

This section examines the social cognition deficit in the population continuum (BAP) with ASQ groups (**Table 5,6**), and the graphical representation is shown in **Figure 2**.

The mean difference analysis showed a significant difference in social motivation deficit (F(2,82) =3.758, p=.027), with the subclinical group showing the highest deficit. The clinical group showed maximum problems on the positive belief about worry (*F*(2,82) =3.263, p=.043), the general factor of metacognitive errors (*F*(2,82) =3.227, p=.045), especially in comparison to the normal group.

Further, we assess the prediction of social cognitive problems and deficits from the ASQ score (see **Table 7, Figure 3**).

The regression results showed a significant negative predictor of social motivation deficit and explained 4 percent variance (β= -0.21, p= 0.05). However, ASQ significantly positively predicted positive belief about worry and explained 7 percent variance (β= 0.27, p= 0.01), need for controlling worry and explained 5 percent (β= 0.23, p= 0.03) and general metacognition problem and explained 6% variance (β= 0.25, p=0.02).

These results suggest that the higher the social cognitive deficit (as per the autism spectrum quotient scale) higher the metacognitive problems associated with worry.

Table 5 analysis of variance (ANOVA) to analyze the differences among group means

Variables	Groups(N)	Sum of Squares	df	Mean Squares	F	Sig.	*ηp2*
Social Motivation: SRS	Between Groups	149.943	2	74.972	3.758	.027	0.083
	Within Groups	1635.869	82	19.950			
	Total	1785.812	84				
Positive belief about worry: MCQ	Between Groups	112.539	2	56.270	3.263	.043	0.073
	Within Groups	1414.049	82	17.244			
	Total	1526.588	84				
General Factor: MCQ	Between Groups	1328.378	2	664.189	3.227	.045	0.072
	Within Groups	16878.916	82	205.840			
	Total	18207.294	84				

Table 6 mean difference analysis using Post Hoc

Variables	Groups	Normal	Subclinical	Clinical
Social Motivation: SRS	Mean	**M=12.63**	**M=14.60**	**M=11.76**
	Normal	---	-1.963	.867
	Subclinical		---	2.830*
	Clinical			---
Positive belief about worry: MCQ	Mean	**M=12.545**	**M=13.942**	**M=15.743**
	Normal	---	-1.397	-3.198*
	Subclinical		---	-1.800
	Clinical			---
General Factor: MCQ	Mean	**M=58.090**	**M=66.571**	**M=70.410**
	Normal	---	-8.480	-12.319*
	Subclinical		---	-3.83
	Clinical			---

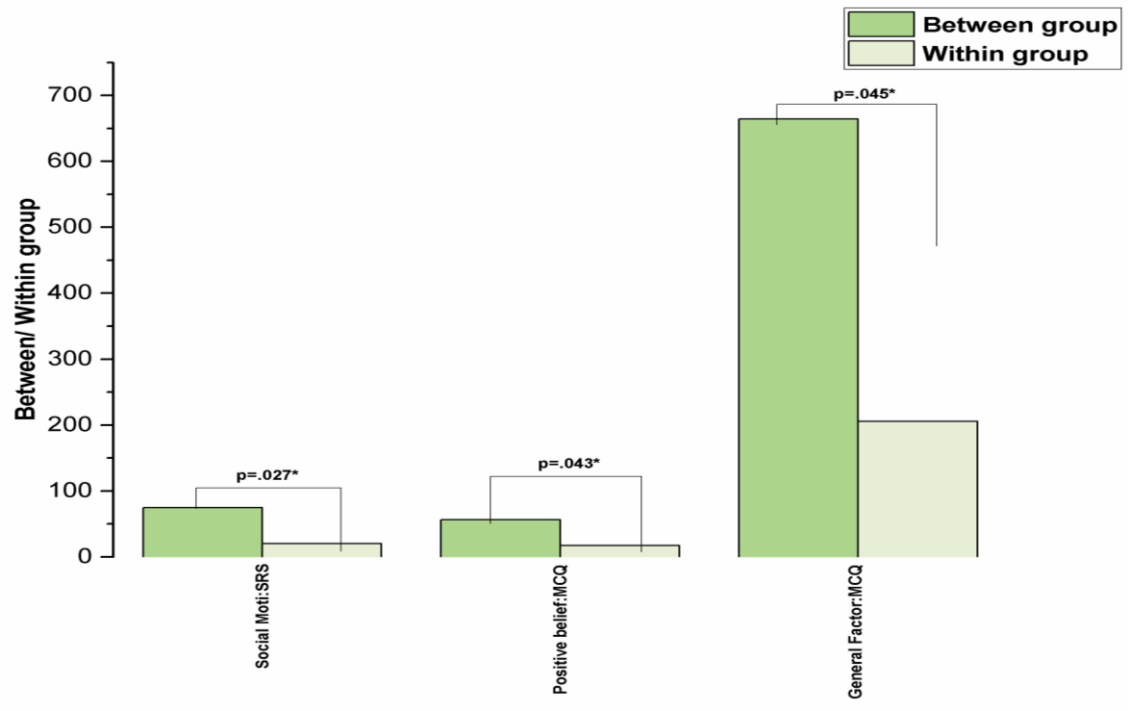

Figure 2 graphical representations are showing significant differences among group means

Table 7 showing the prediction of social cognitive variables when ASQ score is the independent variable

Variable	R^2	R^2 CHANGE	F	p	B	T	P
			Social Motivation: SRS				
ASQ	0.043	0.043	3.742	0.056	-0.208	-1.934	.056
			Positive belief about worry: MCQ				
ASQ	0.076	0.076	6.799	0.011	0.275	2.608	.011
			Need for Controlling worry: MCQ				
ASQ	0.056	0.056	4.888	0.030	0.236	2.211	.030
			General Factor: MCQ				
ASQ	0.062	0.062	5.448	0.022	0.248	2.334	.022

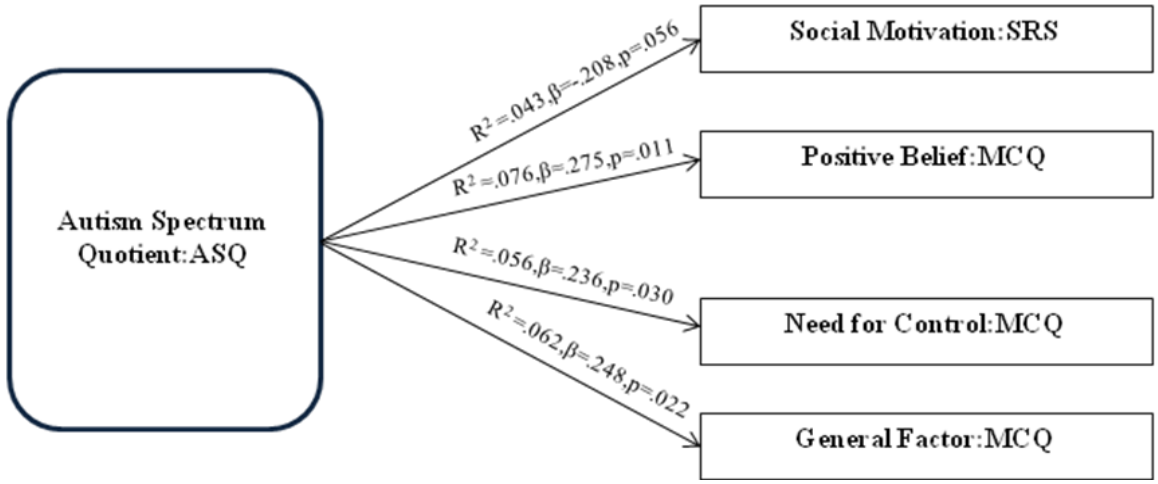

Figure 3 regression model predicting significant change for social cognitive variables

Section III

We noticed an unexpected result regarding the convergence of ASQ and SRS tools and, therefore, explored a bit more in the present pilot data. This section presents conflicting evidence for the convergent validity between these two widely used tools. The autism-spectrum quotient (ASQ) developed by Baron-Cohen and colleagues [10] is a widely accessible screening tool. Similarly, the social responsiveness scale (SRS) developed by Constantino and Gruber [23] is also a standard tool. Our previous systematic review analysis for neurofeedback applicability for autism spectrum disorder has reported SRS use in multiples selected empirical articles [26]. Both the tools are reported to have high construct and discriminate validity in the literature [27-30]. (Clark & Watson, 1995; Woodbury-Smith et al., 2005; Hoekstra et al. 2008; Booker & Starling, 2011)

We find very few studies reporting the association of ASQ and the SRS scale. Ingersoll and colleagues [31] conducted a large non-clinical study administering ASQ, SRS-A, and broad autism phenotype questionnaire. They reported a significant moderate positive correlation of r = 0.55. Armstrong and Iarocci [32] published a brief report on convergent validity between SRS and ASQ rating in high functioning ASD sample. In a recent study by Goris and colleagues [33], they examined the relationship between autistic traits and predictability. ASQ and SRS were used to measure the ASD trait, and they reported a strong positive correlation between the two, r = 0.69, p<0.001.

A positive correlation between ASQ and SRS is reported in all these studies on non-clinical to clinical populations from various countries. However, in the present work, neither in STEM – Non-STEM difference on social cognitive measures nor in social cognitive deficit as per ASQ groups' convergence is found.

As reported in the previous section, the Non-STEM group showed higher ASQ scores but not on SRS dimensions (opposite to hypothesized direction). In ASQ group analysis, a significant result is found on the social motivation dimension of SRS. But again, the subclinical group of ASQ showed a more social motivation deficit than the clinical group of ASQ. In prediction analysis also, ASQ's total score negatively predicted the social motivation deficit. All of these findings are opposite to the expected pattern. Therefore, we examined the correlation between ASQ and SRS that is shown in **Table 8**.

The results clearly show that only ASQ's communication dimension positively correlated with different dimensions and total score of SRS. No correlation is found between most of the dimensions and total SRS and ASQ scores. Also, some of the dimensions were significantly negatively correlated (**Figure 4**).

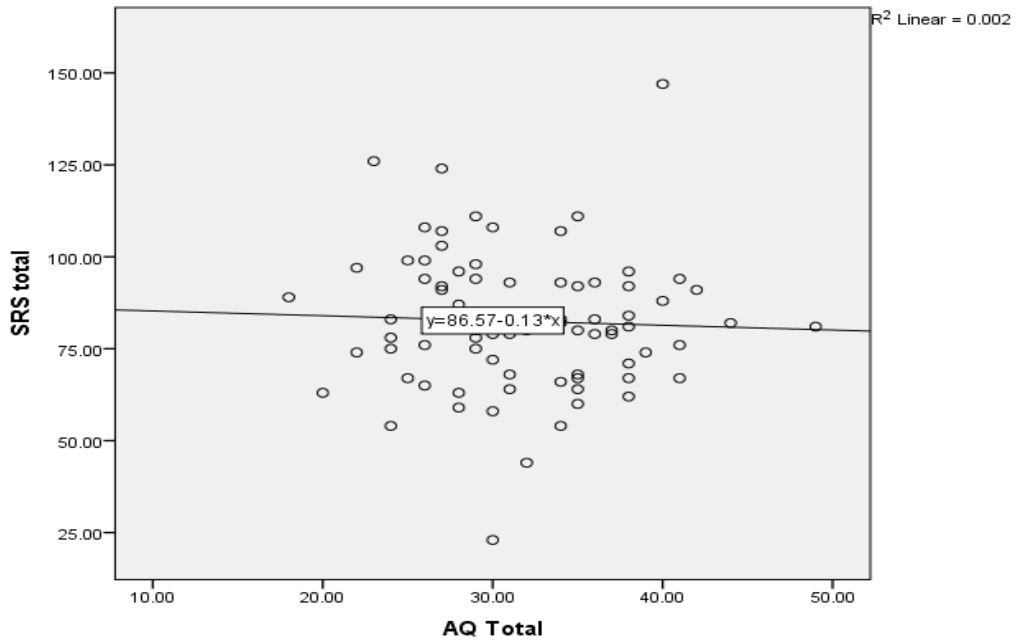

Figure 4 graphical representation of the correlation between ASQ and SRS

Table 8 correlation between ASQ and SRS variables

Variables		Social Awareness	Social Cognition	Social Communication	Social Motivation	RRB	SRS Total
Social Skill: ASQ	r	-.103	.058	-.092	-.252*	-.014	-.110
	(Sig)	(.349)	(.598)	(.401)	(.020)	(.898)	(.317)
Deficit in Attention	r	-.120	-.053	-.111	-.092	-.039	-.111
Switch: ASQ	(Sig)	(.274)	(.629)	(.314)	(.401)	(.721)	(.310)
Deficit in Attention to	r	-.084	-.090	-.185	-.290**	.035	-.170
Detail: ASQ	(Sig)	(.445)	(.413)	(.090)	(.007)	(.748)	(.119)
Deficit in	r	.190	.215*	.238*	.022	.256*	.261*
Communication: ASQ	(Sig)	(.082)	(.048)	(.028)	(.840)	(.018)	(.016)
Deficit in Imagination:	r	-.165	-.247*	-.207	-.137	-.145	-.245*
ASQ	(Sig)	(.132)	(.023)	(.057)	(.210)	(.186)	(.024)
AQ Total	r	-.095	.116	-.068	-.208	.090	-.042
	(Sig)	(.389)	(.292)	(.538)	(.056)	(.413)	(.705)

Table 9 cross-tabulation for ASQ Group * SRS group

ASQ Group * SRS Group Cross-tabulation

ASQ Group		SRS groups		
		Normal	**Susceptible**	**Strong susceptibility**
Normal	Count	3	3	5
	% within ASQ Group	27.3%	27.3%	45.5%
Sub-clinical	Count	7	6	22
	% within ASQ Group	20.0%	17.1%	62.9%
Clinical	Count	10	5	24
	% within ASQ Group	25.6%	12.8%	61.5%

Further, we examined whether convergence can be found between autism trait categorization as per ASQ and SRS (**Table 9**). In the cross-tabulation only 28% convergence can be seen (3+6+24 = 33x85/100 = 28.05%).

These findings put a question mark on the convergence validity between ASQ and SRS for the Indian population. However, this needs further examination in a bigger clinical and non-clinical population.

Conclusion

The present work provides three initial indications. First, there is a connection between STEM education/profession and autistic trait, but it needs more exploration with the inclusion of assessment of societal factors. Second, the autism spectrum quotient group show significant social cognition and related metacognitive deficit. Thirdly and most importantly, there is a need to examine the appropriateness and convergence of ASD trait measure tools on the Indian population.

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