

Brief Report: Is Cognitive Rehabilitation Needed in Verbal Adults with Autism? Insights from Initial Enrollment in a Trial of Cognitive Enhancement Therapy

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Abstract Cognitive rehabilitation is an emerging set of potentially effective interventions for the treatment of autism spectrum disorder, yet the applicability of these approaches for “high functioning” adults who have normative levels of intelligence remains unexplored. This study examined the initial cognitive performance characteristics of 40 verbal adults with autism enrolled in a pilot trial of Cognitive Enhancement Therapy to investigate the need for cognitive rehabilitation in this population. Results revealed marked and broad deficits across neurocognitive and social-cognitive domains, despite above-average IQ. Areas of greatest impairment included processing speed, cognitive flexibility, and emotion perception and management. These findings indicate the need for comprehensive interventions designed to enhance cognition among verbal adults with autism who have intact intellectual functioning.

Keywords Cognition · Social cognition · Neurocognition · Cognitive rehabilitation · Adults

Autism spectrum disorder (ASD) is a family of persistent neurodevelopmental conditions that emerge early and continue to present many challenges to affected individuals in adulthood (Kanner 1971). Despite growing recognition of the continued need for treatment and other supports in adults with ASD, intervention research has been largely focused on early childhood (Kasari and Lawton 2010). Remarkably few empirically supported treatments are available for verbal adults with these conditions who do not have a comorbid intellectual disability. Longitudinal studies of “high functioning” individuals with autism have shown consistent and persistent disability across educational, social, and vocational domains, despite supposedly intact verbal and intellectual abilities (Howlin 2000), indicating a significant need for effective treatments for these functional disabilities.

As the neurobiological basis of autism is becoming increasingly clear (Abrahams and Geschwind 2008; Minshew and Williams 2007), attention has been focused on remediating the core brain deficits that underlie social and non-social cognitive dysfunction in ASD. Impairments in information processing are considerable in these conditions and place significant limitations on adaptive function. A group of treatment approaches known as cognitive rehabilitation have emerged in other disorders that may be potentially effective non-pharmacologic interventions for core information processing deficits in adults with ASD. Although cognitive rehabilitation approaches vary widely in their scope and targets, most use progressive computer-based exercises that are designed to enhance specific domains of cognitive function (e.g. attention, memory). For

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the past several decades, cognitive rehabilitation has been used with considerable success in a wide variety of brain disorders, such as traumatic brain injury (Ben-Yishay et al. 1985), stroke (Cicerone et al. 2005), Alzheimer's disease (Sitzer et al. 2006), and schizophrenia (Wykes et al. 2011).

One particularly promising cognitive rehabilitation intervention for verbal adults with ASD is Cognitive Enhancement Therapy (CET; Hogarty and Greenwald 2006), which was originally developed for individuals with schizophrenia (Hogarty et al. 2004; Eack et al. 2010). CET is a developmental approach designed to remediate social and non-social cognitive deficits through the integration of computer-based neurocognitive training with a group-based social-cognitive curriculum focused on the achievement of key adult social-cognitive milestones (e.g. perspective-taking, social context appraisal). CET may be uniquely relevant for individuals with ASD, in that it is the only cognitive rehabilitation intervention that takes a comprehensive approach to integrating social-cognitive and neurocognitive rehabilitation into a single treatment to address the broad array of social and non-social information processing deficits experienced by this population.

Targeting broad brain-based cognitive deficits using cognitive rehabilitation in verbal adults with ASD is novel and promising. However, many verbal adults with ASD present with average or even above-average intellectual functioning, which has led some to raise important questions regarding the need for cognitive rehabilitation, particularly neurocognitive training, in this population. This investigation presents the baseline cognitive characteristics of verbal adults with ASD enrolled in an initial trial of CET. While this trial is ongoing and treatment data will be forthcoming, the enrollment characteristics of this study afforded the unique opportunity to examine the degree to which adults with high functioning ASD have specific cognitive impairments that could indicate a need for cognitive rehabilitation. It was hypothesized that despite average or above-average intelligence scores, verbal individuals with ASD would demonstrate broad and pervasive deficits in social and non-social cognition that would indicate the need for a comprehensive cognitive rehabilitation approach to address these functionally disabling impairments.

Method

Participants

Participants consisted of 40 verbal adults with ASD recruited for a pilot trial of Cognitive Enhancement Therapy. Eligibility criteria for the study included a diagnosis of

autism or ASD using the Autism Diagnostic Observation Schedule (ADOS; Lord et al. 2000), age 16–45, IQ ≥ 80 assessed by the Wechsler Abbreviated Scale of Intelligence (Wechsler 1999), ability to speak and read English, the presence of significant social and cognitive disability based on the Cognitive Styles and Social Cognition Eligibility Interview (Hogarty et al. 2004), and the absence of significant substance use problems within the past 3 months. The Cognitive Styles and Social Cognition Eligibility Interview is a structured interview developed specifically for trials of CET (Hogarty et al. 2004), which is designed to elicit information from participants on the degree to which they experience social and cognitive disability that could represent meaningful targets for treatment. Of the over 100 participants screened, none were excluded because they failed to demonstrate significant cognitive and social disability during this interview. Participants were excluded primarily due to lack of willingness to enroll in an experimental treatment trial (39 %), IQ < 80 (13 %), and the absence of a research diagnosis of ASD (12 %). Sample characteristics are presented in Table 1. Participants were young, most were male, and the sample was predominantly Caucasian. Over half of the participants met ADOS criteria for autism, with the remaining meeting criteria for ASD. While most participants had attended some college, less than half were employed and only 6 (15 %) were living independent of family.

Measures

A comprehensive battery of neuropsychological tests and performance-based assessments of social cognition was used to characterize the degree of cognitive disability experienced by verbal adults with ASD. Neurocognitive assessments included the NIMH-recommended MATRICS Consensus Cognitive Battery, which was designed to provide a broad assessment of cognitive function for use in clinical trials of cognitive enhancement interventions in patients with schizophrenia (Green et al. 2004). This battery consists of a package of standardized neuropsychological tests for assessing processing speed, attention, verbal and non-verbal working memory, verbal learning, visual learning, problem-solving, and social cognition. The MATRICS battery was originally developed for patients with schizophrenia, and while the cognitive domains it covers are highly relevant to ASD, its assessment of cognitive flexibility and social cognition is minimal. As such, the Wisconsin Card Sorting Test was also utilized to assess cognitive flexibility (Heaton et al. 1993), and social-cognitive assessments were greatly expanded.

Social cognition was assessed using the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT; Mayer et al.

Table 1 Demographic, cognitive, and clinical characteristics of verbal adults with autism spectrum disorders

| | M/N | SD/% | Range | | V | Normative difference <i>d</i> ^a |
|--|--------|-------|-------|--------|-----|---|
| | | | Low | High | | |
| Demographic | | | | | | |
| Age | 25.20 | 5.82 | 16.00 | 44.00 | .23 | – |
| Male | 36 | 90 % | – | – | – | – |
| White | 34 | 85 % | – | – | – | – |
| Attended some college | 28 | 70 % | – | – | – | – |
| Employed | 16 | 40 % | – | – | – | – |
| Clinical | | | | | | |
| ADOS diagnosis | | | | | | |
| Autism | 23 | 57 % | – | – | – | – |
| Autism spectrum | 17 | 42 % | – | – | – | – |
| IQ | 113.22 | 15.47 | 80.00 | 157.00 | .14 | .87 |
| Verbal IQ | 112.88 | 13.39 | 82.00 | 138.00 | .12 | .91 |
| Performance IQ | 108.65 | 14.61 | 76.00 | 137.00 | .13 | .58 |
| Cognitive | | | | | | |
| Neurocognition (percentile) | | | | | | |
| Overall composite | 34.79 | 26.76 | .00 | 81.60 | .77 | –.60 |
| Processing Speed | 38.58 | 31.89 | .00 | 97.10 | .83 | –.46 |
| Vigilance | 46.79 | 31.24 | .30 | 95.60 | .67 | –.16 |
| Working memory | 38.02 | 31.08 | .00 | 99.90 | .82 | –.37 |
| Verbal learning | 46.76 | 29.71 | 1.10 | 94.50 | .64 | –.12 |
| Visual learning | 37.57 | 28.23 | 1.10 | 90.30 | .75 | –.45 |
| Problem solving | 45.71 | 30.71 | 1.40 | 93.30 | .67 | –.16 |
| Cognitive flexibility | | | | | | |
| WCST—perseverative errors | 14.90 | 9.49 | 4.00 | 41.00 | .64 | –.54 |
| WCST—non-perseverative errors | 14.50 | 9.67 | 2.00 | 37.00 | .67 | –.46 |
| Social cognition | | | | | | |
| Emotional intelligence ^b | 93.44 | 19.06 | 9.55 | 116.57 | .20 | –.38 |
| Emotion facilitation | 94.12 | 20.65 | 1.46 | 124.28 | .22 | –.33 |
| Emotion understanding | 92.60 | 16.33 | 24.04 | 117.96 | .18 | –.47 |
| Emotion management | 89.78 | 12.73 | 41.55 | 110.14 | .14 | –.73 |
| Facial emotion perception ^c | 30.82 | 4.19 | 19.00 | 37.00 | .14 | –.75 |
| Vocational impairment ^d | 3.90 | .67 | 3.00 | 5.00 | .17 | – |

ADOS Autism Diagnostic Observation Schedule, WCST Wisconsin Card Sorting Test

^a Effect sizes are based upon comparisons with normative test values

^b Scores are standardized with a mean (*SD*) of 100 (15)

^c Emotion perception accuracy scores range from 0 to 40

^d Impairment was rated on a 5-point scale (1 = rare, 2 = mild, 3 = moderate, 4 = severe, 5 = very severe) using the Cognitive Styles and Social Cognition Eligibility Interview

2003). The measure is computerized and performance-based, in that it requires participants to solve emotional problems, rather than relying on self-report about emotional understanding and capacity. A series of 141 items across 8 distinct tasks assess emotion perception, facilitation, understanding, and management. Answers are scored based on consensus norms, and domain scores are scaled with a mean (*SD*) of 100 (15) based on a large normative

sample. Previous research has documented the reliability and validity of the MSCEIT in healthy (Mayer et al. 2003) and psychiatric samples (Eack et al. 2010a). All components of the MSCEIT were utilized in this research, with the exception of the emotion perception branch. Facial emotion perception was more comprehensively assessed using the Penn Emotion Recognition Test-40 (Kohler et al. 2003), which asks participants to choose the appropriate

emotional label associated with 40 emotional (happy, sad, angry, and fearful) and non-emotional (neutral) facial stimuli. Previous research has established the reliability and validity of this measure, as well as the neural pathways involved in its completion in non-ASD samples (Carter et al. 2009).

Procedures

Participants were recruited for a study of CET from local organizations, support groups, and research registries. Individuals were enrolled who met study criteria and were willing to commit to two 1.5-hour treatment sessions per week for 18 months. Upon recruitment, participants were assessed for ASD using the Autism Diagnostic Observation Schedule by trained reliable research interviewers experienced with autism who were members of the Subject Assessment Core of the NIH-funded University of Pittsburgh Autism Center of Excellence. All diagnostic interviews were videotaped, reviewed, and verified by a doctoral-level research psychologist, and IQ eligibility assessments were conducted by trained research associates. Eligibility interviews to establish the degree of social and cognitive disability were completed by master's- and doctoral-level clinicians, with final ratings assigned based upon consensus meetings using all available interview and screening data. After determining eligibility, participants were assessed using the aforementioned measures of neurocognition and social cognition by a trained neuropsychological tester who was supervised by a licensed clinical psychologist. This study was approved and reviewed annually by the University of Pittsburgh Institutional Review Board, and all individuals provided written informed consent prior to participation.

Results

Clinical and cognitive characteristics of ASD participants are presented in Table 1. Full scale IQ scores were within or above normative ranges (range 80–157) for the sample. Despite mean intelligence scores for sample in the above-average range, performance on tests of neurocognition and social cognition were substantially impaired. Overall neurocognitive performance was below the 35th percentile, and ranged from a low of 0 % to a high of 81.60 %, with considerable heterogeneity in ability across domains. Nearly half (45 %) of the sample performed below the 25th percentile for neurocognitive functioning, with the most marked impairments observed in speed of processing, cognitive flexibility, working memory, and visual learning. All but four participants demonstrated moderate ($\geq .50$ SD) or greater deficits in at least one neurocognitive domain on the MATRICS battery, and most (75 %) displayed

impairments in multiple domains. With regard to social cognition, participants also displayed substantial impairments in overall emotional intelligence, particularly emotion understanding and management. In addition, significant impairments in facial emotion perception were observed. On average, full scale IQ scores accounted for only 14.9 % (range 0–51 %) of the variance in performance on these cognitive domains, and no significant differences in level of impairment were observed in any domain between those meeting ADOS criteria for autism compared to ASD (all $p > .172$).

The functional consequences of this vast array of cognitive impairment were clear, as all individuals demonstrated at least moderate vocational impairment based on the Cognitive Styles and Social Cognition Eligibility Interview (Hogarty et al. 2004) that was completed during eligibility screening. Evidence also suggested that poorer performance on the overall neurocognitive composite was significantly associated with the severity of ASD symptomatology on ADOS domain scores regarding reciprocal social interaction ($r_s = -.40$, $p = .010$) and stereotypic behavior and restricted interests ($r_s = -.33$, $p = .039$), as well as greater social-cognitive impairment as assessed using the MSCEIT ($r_s = .50$, $p = .001$). Taken together, these findings indicate significant cognitive disability among verbal adults with ASD.

Discussion

The development of effective interventions designed to address core cognitive deficits in adults with ASD is an area of great need. Neurocognitive and social-cognitive impairments have a significant impact on social, vocational, and academic functioning and quality of life. Cognitive rehabilitation interventions, and CET in particular, offer significant promise for remediating the broad social and non-social cognitive impairments associated with ASD. However, questions have been raised regarding their applicability to high functioning verbal adults, especially those with normal IQ scores. This study sought to examine the nature and degree of cognitive deficits experienced by high functioning adults with autism, in an effort to elucidate the relevance of applying cognitive rehabilitative interventions to this population. The initial cognitive characterization of a sample of 40 verbal adults enrolled in a pilot trial of CET revealed that despite above-average intellectual functioning, marked cognitive impairments were observed across every domain, with considerable heterogeneity in performance. All but four participants demonstrated at least medium-sized impairments in neurocognition, with most exhibiting impairments in multiple domains. Social-cognitive deficits were equally prominent, and related to degree of non-social

cognitive impairment. These deficits were almost universally unappreciated as issues by treating clinicians who had previously seen participants.

Several limitations should be noted and the implications of this research should be considered in the context of these limitations. The sample size of this characterization study was modest, although purposely reflective of those seeking cognitive rehabilitation. Further, the predominance of Caucasian males also limits the generalizability of these findings to women and minority groups. Finally, the absence of a matched sample of healthy control individuals precludes definitive conclusions regarding the magnitude of performance impairments, although all cognitive measures employed have been rigorously normed with large samples from the general population. Despite these limitations, the results of this research have important implications for the treatment needs of verbal adults with ASD. The results suggest the presence of substantial cognitive disability that could be easily overlooked when using standardized intelligence testing. The absence of a general intellectual disability and the presence of developed formal speech did not spare such individuals from significant cognitive and functional impairment, and the significant degree of cognitive impairment in the sample indicates the need for targeted intervention approaches designed to address these deficits in social and non-social cognition. CET was originally designed to address similar cognitive deficits in patients with schizophrenia through the integration of computer-based neurocognitive training in attention, memory, and problem-solving with a structured small-group social-cognitive treatment curriculum (Hogarty and Greenwald 2006). The treatment has demonstrated considerable success in remediating social and non-social cognitive impairments, as well as adaptive function (Hogarty et al. 2004; Eack et al. 2010). The results of an adaptation and application of this comprehensive cognitive rehabilitation approach in verbal adults with ASD is eagerly anticipated and expected to demonstrate the feasibility of targeting cognitive impairments in this population using cognitive rehabilitation.

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