Understimulation of Cerebellum in Asperger’s Syndrome: A Personal Perspective

Jay D. Paul

I
The object of this Memorandum (report preparation and completion time: 22 hours 12 minutes 13 seconds) is to fulfill the requirements of collaborative psychotherapy in accordance with the instructions communicated by Dr M. Ahmed to Jay D. Paul (hereinafter referred to as “J.D.P.”) during the session of August 14. In that session, Dr Ahmed informed J.D.P. that “recent research has identified [how] weakness in [the] Cerebellum as [sic] related to poor sensory-motor functioning and how Cerebellum-related sensorimotor stimulation is related to reasoning and thinking skills above and beyond what the Cerebrum does.” Dr Ahmed then proceeded to ask J.D.P. if he might conduct research into “recent studies or work on [the] Cerebellum,” so as to improve our (Dr Ahmed’s and J.D.P.’s) collaborative understanding of J.D.P.’s “different ability levels”; J.D.P. agreed to this request. Pursuant to both the general information and the general instructions thus communicated, J.D.P. shall discuss in this Memorandum the specific data that he has obtained with regard to the following: (1) the basic structure and function of the cerebellum, (2) the grounds for the view that the cerebellum is involved in advanced functions, (3) the supposition that abnormalities of the cerebellum may be positively related to impairments in both basic and advanced cerebellum-related skills and behaviors, (4) the possible relationship of cerebellar functionality to the phenomenology of Asperger’s syndrome, and (5) the implications that may be drawn out from a confirmation of the relationship between cerebellar dysfunctionality and Asperger’s syndrome, for J.D.P. (who has been diagnosed with Asperger’s syndrome, but whose cerebellum has yet to be examined via technical means as to its structural and functional normality or abnormality).

II
The cerebellum is a fist-sized structure located at the lower back of the brain or, more precisely, in the posterior cranial fossa behind the brainstem. As the cerebrum (the largest and uppermost section of the brain) is divided into a left hemisphere and a right hemisphere, so also is the cerebellum. From a functional standpoint, the cerebellum has traditionally been viewed as limited to the role of coordinating voluntary muscular activity, albeit viewed as crucial in this role. This traditional view has undergone substantive revisions in recent years, however, such that the cerebellum is now generally regarded as a facilitator of the workings of both motor and nonmotor regions of the brain. Researchers have found extensive connections between the cerebellum and the frontal associative areas of the cerebral cortex that fall well outside the classical sensory–motor circuit. This finding may seem less surprising when juxtaposed to the observation that the cerebellum is connected to the cerebral cortex by some 40 million nerve fibers (by way of comparison, the optic tract is connected to the cerebral cortex by 1 million nerve fibers). A distinction should, perhaps, be made here between motor functions and sensory functions, for some researchers challenge the consensus that the cerebellum is associated with both motor control and sensory integration, postulating instead that the cerebellum is principally associated with sensory integration.

Within the context of the conception of the cerebellum as a structure whose role is limited to the facilitation of sensorimotor functions, a recent theory posits that the cerebellum establishes the internal conditions requisite to the performance of sequences of tasks by other parts of the brain. This theory proposes that, by virtue of the establishment of these internal conditions, motor tasks become automated via practice and hence do not require that the individual attend consciously to the details of these tasks. This phenomenon of cerebellar automation would seem to imply that the conscious part of the brain is thereby made available for the control and coordination of tasks above and beyond sensorimotor tasks. These tasks fall into the domains of cognitive, linguistic, emotional, and social behavior. If cerebellar functionality is, in fact, positively related to both sensorimotor functionality and higher-order (cognitive, linguistic, emotional, social) functionality, then it should follow that cerebellar dysfunctionality is positively related to impairments in the sensorimotor and higher-order domains. A 2007 study cited by Gowen and Miall seems to confirm this general supposition by providing unprecedented quantitative evidence of a positive...
relationship between cerebellar abnormalities and motor skills dysfunction in non-neurotypical individuals. Prior to this study, only qualitative and indirect evidence could be procured through various tests as to abnormal cerebellar motor control in individuals with autism, Asperger’s syndrome, and schizophrenia.4

Exploration of the role of cerebellar abnormalities in the pathogenesis of Asperger’s syndrome is especially intriguing. It was only in the fourth edition of the American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders that the condition first described by Hans Asperger in a German-language research paper in 1944 received a discrete clinical identification and diagnostic profile.4 Significantly, the diagnostic criteria for Asperger’s syndrome (or Asperger’s disorder), as enumerated in the DSM-IV, do not include motor skills impairment (or “motor clumsiness”) as a criterion but rather are restricted to the criteria of (1) gross impairment in social interaction and (2) narrowly circumscribed interests (in conjunction with an absence of any delay in language development).5 The DSM-IV, notwithstanding, studies have revealed motor coordination problems in 50%–90% of children and adults with Asperger’s syndrome.6 More specifically, these problems have been noted in gross motor skills, fine motor skills, locomotion, timing of movement, balance, manual dexterity, handwriting, and inability to follow others’ rhythms.6

Two recent studies,3 in particular, have explored the relationship of brain (including cerebellar) structure to motor and sensorimotor impairments in persons with Asperger’s syndrome. The aforementioned 2007 study that did not confine itself to the examination of the phenomenon of motor impairments in Asperger’s subjects but included an examination of these impairments in autistic, schizophrenic, and dyslexic subjects, as well, found that subjects with an Autistic Spectrum Disorder demonstrated impairment in movement preparation but not in movement execution. Overall, subjects with an Autistic Spectrum Disorder demonstrated impairments in visually guided movements, prediction and coordination, balance, and timing; those subjects with the specific Autistic Spectrum Disorder of Asperger’s syndrome committed more absolute errors on synchronization task than did the subjects in the control group but were comparable to the subjects in the control group in their performance of a continuation task. It is noteworthy that neither the subjects with depression nor the subjects with bipolar disorder showed signs of cerebellum-related motor dysfunction; only those subjects with Autistic Spectrum Disorder, schizophrenia, or dyslexia showed these signs.

In the 2002 study,7 which concentrated exclusively on individuals with Asperger’s syndrome, the central question investigated was whether anatomical abnormalities of the brain are associated with the impairment of “sensorimotor gating.” Prior studies supported the consensus that alterations in the frontostriatal regions of the brain are associated with impaired sensorimotor gating in individuals with obsessive–compulsive disorder, Huntington’s disease, Tourette’s disorder, and schizophrenia; the investigators in the 2002 study sought to establish whether or not such an association also holds true for individuals with Asperger’s syndrome. Such an investigation is germane to our discussion in view of the fact that the frontostrial regions are closely linked to the cerebellum. The investigators arrived at several noteworthy anatomic findings: (1) the brains of the subjects in the control group varied (in volume) inversely with age, whereas the brains of the subjects with Asperger’s syndrome did not; (2) there was no correlation between age and the volume of gray matter in the Asperger’s subjects; (3) deficits in gray matter were discovered in the Asperger’s subjects in no fewer than 3 distinct regions, viz., (a) from the basal ganglia to the thalamus and ventral striatum, (b) within the medial frontal lobe and cingulate, and (c) in the cerebellum; (4) deficits in white matter were found in the brains of the Asperger’s subjects, preponderantly in the left hemisphere; (5) excesses of white matter were found in the brains of the Asperger’s subjects, primarily around the basal ganglia; (6) there were no significant differences in bulk regional brain volume between the brains of the Asperger’s subjects and the brains of the subjects in the control group.

III

The implications of scientific evidence of a positive relationship between abnormalities of the cerebellum and some of the behavioral abnormalities present in Asperger’s syndrome may now be drawn out and viewed specifically in the light of certain behavioral abnormalities and ability-level discrepancies as reported by J.D.P. (or as observed in J.D.P. by others). Before addressing the particular case of J.D.P.’s behavioral presentation, however, several observations gleaned from the literature on Asperger’s syndrome should be noted. An expert on Asperger’s syndrome has noted, on the basis of extensive clinical involvement with Asperger’s patients, motor clumsiness in individuals with Asperger’s and alludes to earlier studies that found a relationship between cerebellar abnormalities and techniques that revealed that the cerebellum of an individual with Asperger’s syndrome to be smaller than normal.6

A commentator4 on Asperger’s syndrome has argued for the connection between cerebellum-related developmental delays and poor balance, poor hand–eye coordination, poor spatial awareness, and motor clumsiness; moreover, the same commentator claims that individuals with Asperger’s syndrome are unable to access efficiently their frontal cortices or prefrontal lobes and, as a result, must learn socially appropriate behaviors by rate (i.e., on the basis of memory). There is a general accepted notion that a key difference exists in ability levels between
Asperger’s individuals and autistic (ie, those with classical” autism) individuals: the former typically score higher in intelligence tests on Verbal IQ than they do on Performance IQ, whereas the latter typically score higher in intelligence tests on Performance IQ than they do on Verbal IQ. A study by Cederlund and Gillberg supports this notion that Asperger’s syndrome is or entails a nonverbal learning disability (where Verbal IQ is more than 15 points higher that Performance IQ), as they found a high rate (51% of such disability) in Asperger’s subjects.

A student researcher concurs on this point and even adds that individuals with Asperger’s syndrome can be distinguished from those with high functioning autism by both the Verbal IQ/Performance IQ inversion and the full-scale IQ, which she claims is higher in Asperger’s individuals than in individuals with high functioning autism.

Many, if not all, of the above suppositions by experts and commentators on Asperger’s syndrome—suppositions now substantiated by the data obtained from the rigorous 2002 and 2007 studies—are consonant with at least 2 ability-level discrepancies manifested by J.D.P. Firstly, J.D.P.’s Verbal IQ score exceeded his Performance IQ score by fully 37 points, as measured by the Wechsler Adult Intelligence Scale-Revised (WAIS-R), in 1990 (age: 16 years); this difference more than meets the operational definition of nonverbal learning disability noted above (viz., that there be at least a 15-point difference in favor of Verbal IQ). Secondly, J.D.P.’s motor skills have evidenced signs of significant impairment from an early age to the present time in such tasks as the tying of shoelaces, throwing and catching a ball, manipulating physical objects, tying a necktie, and assembling particular units to form a general apparatus (eg, unassembled furniture purchased at a store).

Of lesser clarity are the implications of the above research findings and commentaries for J.D.P.’s linguistic, emotional, and social behaviors. Though much of the literature on Asperger’s syndrome does, in fact, note widely observed peculiarities in these domains (eg, Asperger’s individuals use language on an extremely literal basis; they are both hyposensitive and hypersensitive to various environmental stimuli, such as light and sound; they are deficient in their ability to engage in reciprocal social interactions), the specific relationship of cerebellar abnormality to peculiar linguistic, emotional, and social behaviors is difficult to deduce from the limited sample of findings that serve as the basis of this report. Of prima facie plausibility, however, are the following suppositions: (1) the structure of the cerebellum of J.D.P. may in cerebellar structure be associated with a dissimilarity in cerebellar functioning and (2) this dissimilarity in cerebellar functioning may account, to at least some extent, for the dissimilarities between the sensorimotor, cognitive, linguistic, emotional, and social behaviors typically manifested by J.D.P. and those typically manifested by individuals who do not have Asperger’s syndrome.

*This is a posthumous writing of Jay D. Paul (J.D.P.), who had a high level of intelligence and academic attainments (Summa Cum Laude graduate of Rhode Island College, and he was pursuing a Master’s degree at the time of his “accidental death”). J.D.P. had multiple psychiatric diagnoses: schizoaffective disorder, obsessive-compulsive disorder, and more recently Asperger’s syndrome. J.D.P. prepared this document in the context of psychotherapy with Mohiuddin Ahmed (using Mind Stimulation Therapy techniques. See Mind Stimulation Therapy: Cognitive Intervention for Persons with Schizophrenia by Mohiuddin Ahmed and Charles Boivert, 2013). J.D.P. has had severe obsessive-compulsive symptoms, and he also had to deal with the tormenting experience of “hearing voices,” in spite of being on medication treatment for years, as described in his recently published article in Schizophrenia Bulletin (The Vacuum of the Mind: A Self-Report on the Phenomenology of Autistic, Obsessive-Compulsive, and Depressive Comorbidity). Taken together, these 2 writings of J.D.P. support the notion that many persons with “serious mental illness” may have the capacity to objectively describe their clinical conditions and may show considerable insights and understanding of their psychological problems. As such, therapy strategies may need to focus above and beyond the traditional therapy approach of “developing insight and understanding” and need to focus into strategies of self-control and self-regulation in the presence of emotional arousal or perceived stress experiences. This will require a system of care that appreciates and stimulates the “intact capacity for adaptive thinking,” which many people with “serious mental illness” may possess, but not readily explored or evident to clinicians, and that does not excessively focus on the long-entrenched “irrational habits” or “illogical thinking and beliefs” that the persons may present, as they may be difficult to “dislodge” and do not appear to respond positively to current psychiatric intervention that is available. More research in medication practice as well as identifying optimal therapeutic support services, in conjunction with optimal family and milieu support, is needed to best serve people like J.D.P. The article is being submitted by Mohiuddin Ahmed (with very minor editing of J.D.P.’s writings, primarily involving shortening the article as per editorial request by deleting some sentences, and substituting a new reference for the incorrect one cited for ref. 8) with the consent of J.D.P.’s parents, Dr Biswa Paul and Anjali Paul, who are extremely grateful that J.D.P.’s writings and knowledge are being appreciated by the psychiatric community even after his death.

References


