

Asperger's Syndrome and Skin Vibration Sessions: A Theoretical Model

Athanasios Tsatsaris* and Domenikos Steven

Ierion Corporation, USA

Abstract: In the last decades, Asperger's Syndrome (AS) has received extensive investigation by many researchers worldwide. It belongs to Autism Spectrum Disorders (ASD) domain, and is characterized by a variety of symptoms including intrinsic social attitude and relative preservation of linguistic and cognitive development. So far, the exact cause is unknown but current evidence indicate that, genetic factor to be an important one in the evolution of AS, while many others environmental agents are considered to contribute, as well. All these co-factors seem to affect the final structure and connectivity of the brain resulting in neural circuits malfunction. In this research, we assume an additional mechanism that may be implicated in AS: the AS's person might have sustained a specific "sentimental stress" produced by his environment unwittingly, and has triggered the progression of the syndrome. It is proposed that the creation of "suitable-music-like" skin vibration sessions may stimulate Thalamus multi-connective neural system so as to harmonize the action of biochemical neurotransmitters implicated in AS.

Keywords: Asperger's syndrome, thalamus, skin vibration, sentimental stress theory.

I. INTRODUCTION

Asperger's Syndrome (AS) is an autism spectrum disorder (ASD) that usually exhibits symptoms such as: deficit in social interaction and non verbal communication skills, limited empathy, clumsiness, monotonic behavioral patterns and relative preservation of linguistic and cognitive development [1]. Many aspects of AS are still under investigation; it is unclear if it belongs to high-functioning autism [2].

Regarding Social Interaction deficits the following should be highlighted: first, lack of empathy, impaired emotional reciprocity and impaired non-verbal behaviors affect significantly the interpersonal relationships; secondly, social awkwardness and selective mutism disturbs AS's social status; and last but not least monotonic behavioral patterns like narrow areas of interest with shallow cognitive infrastructure and/or adherence to rigid stereotyped form the social "intrinsic" personality of people with AS.

In case of developmental linguistic skills, it is worth being mentioned that no extraordinary abnormalities have been recorded so far. Yet, the use of language is often atypical: limited intonated speech, boring monologues, marked verbosity, poor prosody, tangential-circumstantial speech and echolalia [3].

In most cases, AS's symptoms comprises as well, motor deficits, sleep disturbances, and sensory perception deviations. Motor deficits, mainly include the

delay in acquisition of common motor skills. Sleep disturbances are characterized by nocturnal and early morning awakenings [4]. Sensory perception deviations, describe the commonly excellent auditory and visual perception, the problematic proprioception, and alexithymia [5].

The aforementioned manifestations of AS offer a detailed description of it, while current scientific research has raised some important explanative theories as well [6-8]. Although, none of them support a thorough, satisfactory and scientifically completed mechanism of AS [9, 10].

In this study, it is proposed an additional theory for AS, alongside with the Asperger Therapeutic Vibration Sessions (ASVT). It is hypothesized that among other mechanisms, AS may be triggered at a certain developmental brain stage by a kind of Sentimental Stress, induced by the environment unwittingly (i.e family or social interpersonal attitudes, exposure to infrasonic waves or to electromagnetic waves of certain spectrum).

II. MATERIAL AND METHODS

It is worth being mentioned, that significant vibration factors are: the point of application, the frequency, the acceleration and the duration of the vibration. The body of a sitting person perceiving a variety of different frequencies during vertical vibrations, responds as follows: 3-4Hz-strong resonance in the cervical vertebra; 4Hz-high resonance of the lumbar vertebrae; 5Hz-high resonance in the shoulder girdle; 20-30Hz-high resonance between the head and the shoulders;

*Address correspondence to this author at the 20 Jellioe Road, Watford, WD 18 6QE, UK; Mob: 07570312180; E-mail: athanasiotsatsaris@yahoo.com

60-90Hz-resonance in the eyeballs and 100-200Hz-resonance in the maxilla.

Over the last decades, Body vibration Therapy (BVT), has been used for a wide spectrum of medical issues, such as diabetic peripheral neuropathy [11, 12], orthopedic issues [13, 14], manipulation of lean mass in elderly people [15] etc.

Recurrent thalamic-cortical resonance constitute, an oscillatory phenomenon of neural activity between the Thalamus and various Cortical regions of the brain [16]. Thalamic cells receive both sensory input from the body and feedback signals from the brain; virtually, these cells integrate the multiple input by adapting their oscillatory properties in response to various depolarization triggering. On the other hand, the cortical cells provide feed-back to the thalamus through links to dendrites, of this particular thalamic-cortical loop. Different cortical regions may be synchronized to one another through thalamic-cortical oscillations. Gamma range oscillations (20-50Hz) are mainly correlated with active thinking and cognition, while Alpha range oscillations (8-12Hz) appear to be related to the focus ones' attention [17]. Disturbance on thalamic-cortical oscillations may derange the usual operation of the brain (i.e. Parkinson's Disease, neuropathic pain).

Researchers have proved experimentally that whole body vibration performed in rats, affect the secretion of biogenic amines. In detail, Noradrenalin (NA) depletion in Hypothalamus, have been recorded, depending on the applied acceleration (i.e. for 5G a 57% reduction of NA). Of note, alterations in frequency did not statistically affected the aforementioned depletion, while smaller decrease appeared in Hippocampus. Furthermore, Dopamine (DA) concentrations were hardly affected by the applied vibration frequency or acceleration in the whole brain. Yet, DA tended to decrease in Striatum and increase in Cortex. Likewise, Serotonin (5-HT) appeared to be influenced more by vibration acceleration than by frequency. 5-HT concentrations were increased in the two brain regions, that is to say, in Hypothalamus and Cerebellum [18].

Brain operation in AS is characterized by "particular" neural function in various Cortical and Sub-cortical areas of Central Nervous System. Based on the previous evidence, this study, postulates that among other mechanisms people who demonstrate this syndrome have sustained at a certain developmental stage a "kind" of sentimental stress (i.e. emotional

stress, infrasonic stress, visual stress). This "neural injury", is not easy to detect but results in partly, selective malfunction of the brain. It is introduced, the AS Vibration Therapy (ASVT), which is consisted by whole Body Vibration Sessions both for two groups children and adults. Each group will follow a specific vibration algorithm adapted to its needs. In designing the vibration algorithms special consideration has been given to the intrinsic factors of the vibration: frequency (F), amplitude (A), duration (D) and pattern (P). Regarding the used vibrating platform it is proposed the Linear system, which produces z-movement [19]. Also, it should be highlighted that the sessions that are outlined below are subject to adaptation according to the persons' specific needs and response.

First, the F-values have been chosen so as to be consecutive terms of Fibonacci sequence [20]. The Fibonacci numbers are defined by the recurrent relation: $F(N) = F(N-1) + F(N-2)$, with seeded values $F(0) = 0$, $F(1) = 1$, Range [3,34Hz], $N=1,2,3\dots$

Secondly, the A-values are determined by the formulae: $A(l) = A(l-1) + \Phi^{-1}$, with $\Phi=1.618$ being the Golden ratio and $A(0) = 1\text{mm}$, initial amplitude value. While the boundary conditions are: Children Group is $A(l) \leq 2.5\text{mm}$ and for Adult Group is $A(l) \leq 3.5\text{mm}$, $l=1,2,3\dots$

Thirdly, D-values are defined for children Group to be 1st boutx30sec, 2nd boutx50sec and 3rd boutx80sec, whereas for Adult Group are 1st boutx50sec, 2nd boutx80sec and 3rd boutx130sec.

Fourthly, P-value is 3 sessions per week for both Groups. Combining the previous definitions the displacement oscillatory function can be written as: $Y(l,t) = A(l) \cdot \sin(2\pi F \cdot t)$, t-sec.

III. RESULTS

In the context of ASVT sessions, we hypothesize that AS people are divided into two Groups: Group 1 includes children less than 12 years of age and Group 2 for greater age. The following tables illustrate the main characteristics applied for an ASVT session; frequency (F), amplitude (A), duration (D) and pattern (P). It must be clarified that the next sessions represent rather an introductory management tool than a definitive scheme therapy. The Tables 1, 2, 3 illustrate the 1st, 2nd and 3rd session respectively of Group 1 for the 1st week.

Table 1: Group 1 ASVT Algorithm of 1st Session-1st Week

F(Hz)	A(mm)	D(sec)	P-session
3	1	30	1
3	1.618	50	1
3	2.236	80	1
3	1	30	1
3	1.618	50	1
3	2.236	80	1
3	1	30	1
3	1.618	50	1
3	2.236	80	1

Table 2: Group 1 ASVT Algorithm of 2nd Session-1st Week

F(Hz)	A(mm)	D(sec)	P-session
5	1	30	2
5	1.618	50	2
5	2.236	80	2
5	1	30	2
5	1.618	50	2
5	2.236	80	2
5	1	30	2
5	1.618	50	2
5	2.236	80	2

Table 3: Group 1 ASVT Algorithm of 3rd Session-1st Week

F(Hz)	A(mm)	D(sec)	P-session
8	1	30	3
8	1.618	50	3
8	2.236	80	3
8	1	30	3
8	1.618	50	3
8	2.236	80	3
8	1	30	3
8	1.618	50	3
8	2.236	80	3

The consecutive sessions are applied according to the person's clinical response and tolerance, for values within the boundary conditions.

Accordingly, for larger age the sessions take the form of Tables 4, 5, 6 which illustrate the 1st, 2nd and 3rd session respectively of Group 2 for the 1st week.

Table 4: Group 2 ASVT Algorithm of 1st Session-1st Week

F(Hz)	A(mm)	D(sec)	P-session
3	1	50	1
3	1.618	80	1
3	2.236	130	1
3	1	50	1
3	1.618	80	1
3	2.236	130	1
3	1	50	1
3	1.618	80	1
3	2.236	130	1
3	1	50	1
3	1.618	80	1
3	2.236	130	1

Table 5: Group 2 ASVT Algorithm of 2nd Session-1st Week

F(Hz)	A(mm)	D(sec)	P-session
5	1	50	2
5	1.618	80	2
5	2.236	130	2
5	1	50	2
5	1.618	80	2
5	2.236	130	2
5	1	50	2
5	1.618	80	2
5	2.236	130	2
5	1	50	2
5	1.618	80	2
5	2.236	130	2

Table 6: Group 2 ASVT Algorithm of 3rd Session-1st Week

F(Hz)	A(mm)	D(sec)	P-session
8	1	50	3
8	1.618	80	3
8	2.236	130	3
8	1	50	3
8	1.618	80	3
8	2.236	130	3
8	1	50	3
8	1.618	80	3
8	2.236	130	3
8	1	50	3
8	1.618	80	3
8	2.236	130	3

Similarly to the previous algorithm, the consecutive sessions are applied according to the person's tolerance and response, with values specified by the boundary conditions.

IV. DISCUSSION

Over the last decades, AS has received extensive scientific research worldwide. Yet, the exact culprit of this autism spectrum disorder is still unknown. The classic symptoms are difficulties in social interaction and non verbal communication skills, monotonic behavioral patterns and interests, no significant delay in cognitive development and language, alexithymia, clumsiness, sensory issues [20, 21] etc. Also, a variety of theories have been proposed for AS such as Mind Theory, Mirror Neuron System Theory, Under-connectivity Theory, Genetic Theory etc.

In this study, it is proposed another mechanism that may also be implicated in AS: The Asperger Sentimental Stress Theory (ASST). In detail, it is postulated that the person has sustained a certain portion of sentimental stress during his developmental course. This kind of stress could be attributed to: infrasonic waves that might have affected the fetus or baby, visual or no-visual (infrared or ultraviolet) radiation that could have also participated in sentimental stress, external vigorous skin-perceiving stimuli and sentimental stressing environmental patterns. It is advocated that by applying whole body vibration sessions (ASVT), of special characteristics, the AS symptoms may be improved and people with AS could operate more effectively in their environment either personal or social.

The ASVT aims primarily to produce skin signals that travels through the spinal cord, reaching the thalamus and the respective cortical regions *via* the thalamic-cortical pathways. The vibrating factors of these signals have been chosen so as to enable thalamic-cortical resonance with view to harmonize the specific neuronal areas responsible for AS manifestations. In this context, it is worth being mentioned that the main vibrating factors are following the Fibonacci sequence terms or having equivalent values of golden ratio. Entities which have been verified extensively to be involved in biological systems. The potential intervention pathway includes neuronal channel-mediated current creation that activates sub-functioning areas alongside with a balanced neurotransmitter secretion.

Although, ASVT is a theoretical approach that needs clinical verification, there are current research evidence which support the beneficial effect of whole body vibration therapy on a variety of neuromuscular disorders[14, 15, 19, 22, 23]. Of note, its application is very easy to take place in current scientific settings and its effectiveness could be evaluated during the course sessions. Also, this method is subjected to changes according to tolerance and improvement of tested person. Moreover, herein the algorithms have kept the F constant while the other parameters are changing. This approach may be altered in such a way that the A may be kept constant (or the D) and the F is being subjected to fluctuation and vice versa. All these possibilities may result in producing vibration music-like thalamic-cortical resonance sessions[17].

To recapitulate, both the Theory of Sentimental stress and the whole body vibration sessions are postulated to add in scientific investigation of AS some aspects that so far, have not been approached by previous studies. Undoubtedly, clinical research is imperative so as to delineate the effective margins of ASVT.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest included in this study.

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GLOSSARY

AS	=	Asperger's Syndrome
ASD	=	Autism Spectrum Disorder
ASVT	=	AS Vibration Therapy
ASST	=	AS Sentimental Theory
NA	=	Noradrenaline

DA = Dopamine

5-HT = Serotonin

BVT = Body Vibration Therapy

F = Frequency

A = Amplitude

D = Duration

P = Pattern

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