

Children with communication disorders: possible applications of information technology and hypergravity to improve their development

Panagiotis D. Bamidis¹, Chrysoula Papadeli-Kourtidou², Christos Papadelis^{1,2},
Magda Hitoglou-Antoniadis³

¹*Lab of Medical Informatics, Medical School, Aristotle University of Thessaloniki, Thessaloniki, Greece*

²*Greek Aerospace Medical Association and Space Research, Thessaloniki, Greece*

³*Lab of Speech and Communication Disorders, A' ENT Clinic, ACHEPA Hospital, Medical School, Aristotle University of Thessaloniki, Thessaloniki, Greece*

ABSTRACT: Autism, the most severe form of communication disorders in children, is a multi-factorial disease that appears during the first 30 months of age and is attributed to brain dysfunction. As there is currently no treatment or prevention available, early diagnosis and primary intervention contributes to the improvement of the developmental process (communication, cognitive performance, social interaction, behavioural skills, and behavioural problems) and target to the adaptation to the environment. Nowadays, specific educational programs and psychotherapeutic methods are used worldwide and, recently, efforts are made to support learning through the use of computers.

In this paper, a few ideas are presented for Information Technology (IT) and space medicine projects aiming to provide specific interventions to support autistic children in developing their potential and learning new skills. A new intervention method that uses ideas from hypergravity (enhancement of gravity cues on Earth) and space research is used to enhance the sensory capabilities of autistics in the environment of a special needs school. The use of computer based software and virtual environments are suggested to be utilised as both additional cues but also as evaluation strategies for the assessment of hypergravity results. The latter interventions are coupled with a home based care and educational program to facilitate physiological recordings of the autistics, and further promote the learning environment at home by incorporating the parents in the educational process in order to better fuse theory and practice in a familiar living environment, thereby assisting and starting to empower these disabled citizens to increase their autonomy and play some role in the society.

Key Words: Autism, Space medicine, Health informatics, Home care, Education, Educational technology, Children psychiatry.

1. INTRODUCTION

Autism, the most severe form of communication disorders in children, is a multi-factorial disease that develops during the first 30 months of age and is attributed to brain dysfunction¹. Biological and environmental factors mainly induce the manifestation since there is a genetic predisposition. The prevalence of autism and diffuse developmental disorders in general is higher than blindness, Down syndrome, juvenile diabetes and is about the same as deafness (ranging from 2:1000 of mere autism) and up to

6:1000 when accompanied by other disorders. Boys are more prone to the disease 4:1, while girls present more severe forms of it. The cause of autism is still mainly (90%) unknown today.

All children have difficulties in processing sensory information and impairment in motion

As there is currently no treatment (medications are administered mainly for the epileptic crisis (30%) and some severe behavioural disorders) or prevention available, early diagnosis and primary intervention contribute to the improvement of the develop-

mental process (communication, cognitive performance, social interaction, behavioural skills, and behavioural problems) and target to the adaptation to the environment. All those are accomplished through educational programs and psychotherapeutic methods like: T.E.A.C.C.H. (Treatment and Education of Autistic and related Communications Handicapped Children), behavioural approaches like A.B.A. (Applied Behavioural Analysis), and T.E.D. (Therapie d' Echanges et du Devellopement), sensory integration, communication support etc².

The causes of sensory modulation problems or the inability of the nervous system to continually and accurately register sensory information are not well known. Similar problems are seen in children with other medical disorders, i.e. cerebral palsy, attention deficit disorders, fragile X etc. The problem in this case is that the child's nervous system is not modulating the sensory input successfully and is not responding to the sensory information appropriately. Increasing gravity could modify or alter the child's perception prior to responding³. Combining the latter with support of learning through the use of computers might actually be quite beneficial.

Thus, the aim of this paper is to discuss the possibility of combining apparently different technologies and research disciplines in exploring the potential of new interventions in children with communication disorders. This is done in the next few sections by investigating the state of the art in each area, and then outlining and designing the specific components of the combined approach mentioned above. The latter is done with the perspective of a research project that could facilitate such an approach. The challenges and methodological treatments of such a project are then discussed.

2. STATE OF THE ART

2.1 *The case for space medicine*

Here on earth, although surrounded by gravity we are negligent in using gravity as it was intended, to maintain the level of health that is appropriate to living in 1G⁴. So gravity would be beneficial for long bed rest, neuromuscular diseases, prevention of osteoporosis, prevention of orthostatic intolerance and vestibular disorders. These changes in lifestyle or pathologies

caused by various types of injury can benefit as well from artificial gravity, equivalent to or in fact greater than 1G in much the same way as we are now considering for astronauts in space.

Enhancement of gravity cues on Earth, the state known as hypergravity, depends on the principle that the faster any mass moves, the heavier it becomes. Jump up and down on a weighing machine and the needle will swing wildly, reaching far beyond the line that indicates your normal weight. Riding a bicycle, speeding in a fast car, riding a roller coaster, flying in an airplane, whizzing downhill on a sled or being strapped to a centrifuge can all provide the stimulation of hypergravity. Rocking chairs are objects we usually associate with the elderly, just as we associate cradles with babies. There may be good physiological reasons why human beings at either end of the age spectrum enjoy the motion of rocking. It might be a way to increase sensory perception and brain blood flow⁵.

Everything we do is based, to some extent, on our ability to process sensory information. The information we receive from seeing, hearing, touching, tasting, and smelling as well as the information we receive from our muscles, tendons, and joints (proprioception) and information about gravity (vestibular) is sensory information. Our brains also use sensory information to modulate our alertness. This modulation allows us to maintain an appropriate level of alertness to meet the demands of the day.

Some children, particularly those who have cognitive impairments, do not process sensory information in a way that is comparable to the majority of their peers. These differences of difficulties may affect the way children behave and learn.

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The ability of the brain to learn from experience and to adapt to new environments is recognized to be

profound. This ability, called «neural plasticity», depends directly on properties of neurons (nerve cells) that permit them to change in dimension, sprout new parts called spines, change the shape and/or size of existing parts, and to generate, alter, or delete synapses. In (SLS-1) experiments, Ross⁶ demonstrated the plasticity of the sensory connections in the gravity sensors in a model mammalian system and proved that exposure to the altered gravity of the space has a profound effect on communication sites between the sensory cells and the nerve fibres ending on them⁶.

A malfunctioning brain such may require hypergravity, a higher intensity of gravity stimulus, before a child's brain becomes programmed to respond to direction and acceleration and eventually learn to sense normally. This would mean that rehabilitation exercises in children with such sensory problems as those encountered in autism should be more effective if done in the upright position in a way that the body may experience some load, even if the child had to be supported by a harness. Alternatively, the movement therapy could be simply attempted using a trampoline, which in addition does not alter the natural environment and the cultural and social setting of the child's routine cosmos. However, this has never been attempted to our knowledge.

2.2 Communication in autism

Effective human communication and interaction require understanding of words, tone of voice, facial expression, posture, gaze, gesture and context⁷. Children at the age of 2 months of age can perceive and respond to emotional signals⁸. By the age of 3 years most children use various emotion terms in their vocabulary, and can distinguish happy, angry and scared faces from each other and differentiate the causes and consequences of these emotions⁹. Difficulties with understanding emotion are widely acknowledged as a key feature of autism and appear in the diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders (DSM IV) and International Classification of Diseases (ICD-10). Some even argue that a lack of emotional understanding is the primary deficit in autistic spectrum disorders^{10,11}. The difficulties children with autism have in understanding concepts, assumptions, and communicative intentions and in developing representational thought are all associ-

ated with impairment in theory of mind^{12,13} (ToM). ToM relates to the ability to «predict relationships». Celani et al.¹⁴ interpret the research to indicate that people with autism have good perceptual strategies and can observe emotional cues, but may lack a holistic understanding of emotion and its meaning. Emotion recognition on facial expression photographs has also been shown to correlate with the theory of mind task performance¹⁵.

Effective behavioural treatments have been shown to reduce some of the secondary problems associated with autism, but social and communicative abnormalities have so far proved more resistant to intervention¹⁶. Traditional teaching, which involves a social interaction between student and teacher, may confound the information and make it more difficult to learn¹⁷. The key features of successful interventions appear to be repetition of the task with feedback, making the tasks enjoyable to complete, and breaking the task down into a sequence of small steps, beginning with simpler skills that are learnt earlier in normal development¹⁶.

2.3 The case for Computer Interventions

Computer interventions appear to be particularly appropriate for people with autistic spectrum disorders for several reasons^{9,18,19}. It is acknowledged that there is a need for intensive one-to-one instruction in children with autism and computer-based instruction may be a way to provide some of this²⁰. In several studies, children with autism showed more enthusiasm for computer use than toys, as well as increased learning motivation. The important question is therefore not whether computer-based teaching is better than one-to-one personal instruction, but how to optimize the use of computers, in addition to personal instruction, given teacher time is limited and expensive. Finally, there seems to be a lack of computer programs written specifically for people with autism, particularly those relevant to emotional understanding and primitive daily/routine concept support.

Virtual environments (VEs) are a specific kind of computer-based task, and seem to offer great potential for people with autism²¹. Perhaps the most important advantage is that users can role-play in an environment designed to mimic specific social situations. The growing sophistication of VEs means that

tasks and skills can be practised in increasingly realistic settings. This offers the potential for improved generalization of social skills between training and real-world environments²², as well as the possibility of encouraging mental simulation of events, which may aid social «problem solving»²¹. However, such interventions have never been tried in association with «hypergravity exercises» to create a more comfortable environment and induce «fun».

2.4 The case for e-Health technology

Furthermore, the last decade has witnessed the development of e-Health systems for personalised health management targeting citizens, patients at health risks and patients enrolled in open care or home care for monitoring, treatment or follow up²³. The developments so far show promises for certain group categories, and in addition, could support developments in health care organs and systems. With the social and financial costs of chronic illness constantly increasing as the population ages in all developed countries and effective treatment forestall mortality, self-management initiatives facilitating the process of care in home are continuously emerging. Overall, electronic monitoring at home promises cost effective health services and a new sense of realism in reaching a diagnosis/treatment plan. Home care applications turn the chronic patient into an active participant in the health delivery system, thereby enhancing the quality of health services²⁴. Patients can access the system through a variety of communication technologies (automatic Call Centre via a regular phone, WAP (Wireless Application Protocol) via a mobile/WAP phone, Web via a Web browser) in order to provide measurements related to their health condition (using microdevices). The case managers (e.g. clinicians) on the other side can access the system through similar technological means in order to monitor the home cared patients, review the measurements sent in by the patients, receive messages from their patients, or send personalised messages back to them²⁵.

Despite the fact that in the case of autistic people (especially children) one cannot argue about the practice of self health-care management, it is nevertheless an enabling technological solution that could be utilised in complement with carers'/specialist educators' home visits in order to generate new sources

of health data and facilitate both better intervention assessments and pivotal clinical research on autism.

3. SOME THOUGHTS ON MERGING THE ABOVE INTO A PROJECT

3.1 Possible Project objectives

The overall objective of such a project would be to gain an understanding of approaching autistics and improve the quality of their life, as well as the life of their families' by providing a combined intervention on autistics' learning and daily activity support using research ideas from space medicine research, child psychology, computer assisted learning and e-Health. It is envisaged that such a project will actually improve the sensory communication channels of the autistics, thereby improving their overall quality of life. Autistic children will be safely prompted (and properly educated) to experience hypergravity by jumping on a trampoline. They will also be co-designers to create appropriate software tools that engage them reasonably well in interacting with a web based environment, but they will most importantly have the chance to interact with a system capable of storing their personal interaction behaviour history and being capable of intelligently modifying its content, interface and output in order to further engage to their communication. Finally, such a project should be able to provide the chance to store data of physiological/organic parameters, as well as behavioural events and effects/results of home based interventions on a personal history record, thereby providing a test bed for future scientific (autism related) variable associations and hypothesis testing.

3.2 Possible Project Components

The aim of such a project would be to design, build, and validate an interactive daily support environment for the autistics. The environment should be attempted both at a special school and at home (see methodology section below), and should be comprised of:

- (i) a simple but safe hypergravity simulator in the form of a trampoline, that will be used to stimulate the gravity sensor of the autistics;
- (ii) a suite of IT and Virtual Reality (VR) software products specially designed and used to further stimulate the autistics, enhance and support their ev-

eryday training, but also provide an assessment tool of the hypergravity efficacy;

(iii) a combined hardware and software component to be used at the home of autistics, that extends and integrates their school engagement with home living and allows for an holistic intervention evaluation.

3.3 Possible Project Challenges

The above aims give rise to a number of challenges.

3.3.1 Research Methodology Challenges

Challenge 1: How to involve autistic children in the design of the components. All stages of research and development on both the software and the hardware components/environment from specification to conclusion should be subject to the design input, feedback reaction and evaluation of the autistic children. In other words the autistics should be allowed to become «co-designers of the software» - in computer science and information systems research terms, a special modification of the spiral model of software development should be followed through the use of special prototypes that will form the basis for collecting feedback, but also gradual training.

Challenge 2: How to involve autistic children in the selection process. The availability of early trampoline prototypes and their use by autistic children should be able to guide the clinical selection process which will result in the clinical trial target group. Only those children that seem to respond (i.e. seem to «have fun») in the hypergravity exercises and fit within the history/clinical characteristics set by the child psychiatrists should enter the target group.

Challenge 3: How to initiate an organic research dimension of the autistic disorders spectrum by associating the physiological monitoring parameters (and medical examinations) with the child's own evolution development data and behavioural events and/or achievements. This may easily be accomplished with the incorporation of the home monitoring and intervention part.

3.3.2 Technical Research Challenges

Challenge 1: How to properly design and manufacture a trampoline set that will simulate hypergravity and will be electrically manipulated to allow for the

safe and technically stable hypergravity oscillations of the autistic children. To meet this objective, there is a need to collaborate with space research partners, as well as, external consultants and engineers.

Challenge 2: How to best develop a web based software environment that will mimic daily life routine activities in the areas of play, food and hygiene, and allow for multimodal interactions through the use of specific input/output devices (e.g. special mice, touch screens, etc), interaction strategies (animations, seek/hide interface options, ask question - reply request tasks, etc), as well as the use of desktop virtual environments with numerous navigation knobs/qualities (interaction by clicking/touching/verbally replying, enabling choice selection and associated reward, time dimension comprehension/perception with altering virtual lighting conditions).

Challenge 3: How to develop a web based software environment that will facilitate emotional understanding for the autistic children, and teach them to recognise and predict emotions in other. To take actions along this line, a review of all commercially and publicly available software needs to be conducted, but development should be especially co-ordinated so as to take into account educational, medical, cultural, and social needs of the specific target group. The approach should be equipped with flexibility knobs that will allow for the easily transfer of the environment in other settings and perhaps under different handicap conditions. The last couple of challenges obviously demand the multidisciplinary collaboration between software/industrial, learning specialists and pedagogy experts.

Challenge 4: How to develop a home care system that will extend the school learning environment at home, will activate on-site family training/education and will allow for seamless and transparent recordings of physiological parameters, behavioural events, training scores on the child's own health record. This challenge is rendered possible through the use of internet availability and ADSL (Asynchronous Digital Subscriber Loop) connection of the target houses, the software availability through the web, the creation of a purpose built electronic health of the autistics, and the availability of physiological/vital parameter recording microdevices, suitably packaged into an easy

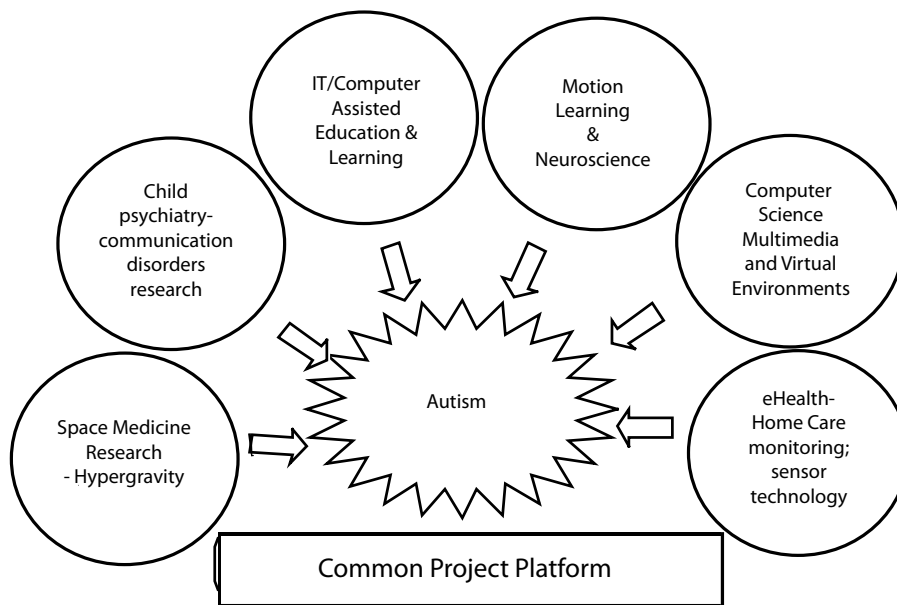


Figure 1. Disciplines and research domains involved in the possible project.

to carry suitcase, and capable of remote transmission of parameters.

Challenge 5: How to allow for video recordings of the interventions and subsequent proper autistic context based analysis and event/ontology based storage of image sequences. This should be carefully thought and taken into account so as to facilitate further research on motion learning in autism and easy future extension and/or transfer to other handicaps.

3.3.3 Scientific/Pedagogo-Psychiatric Challenges

Challenge 1: How to test and holistically evaluate the efficacy of the combined hypergravity and software based intervention through the use of simple and easy to use and adapt contemporary technologies.

Challenge 2: How to support, promote and enhance the development of autistic children and increase their autonomy through a combined multi-disciplinary intervention set, provided as early in age as possibly achievable. In extension, how to prevent behavioural problems that are encountered or deteriorated as the autistic children grow older.

Challenge 3: How to provide a technologically simple but radical intervention that allows for the best possible inclusion of autistic children (inclusion in terms of family, school, inter-personal communication, society).

Challenge 4: How to improve the quality of life of

the autistic children and their families and form the core of a school and home based training program for both families and autism professionals.

Challenge 5: How to promote research that will possibly lead to an improved understanding of brain function in autism and its best possible improvement through the combination of pharmacological, psycho-educational, and contemporary technological media.

A final word must be said here in order to correctly contextualise these challenges or possible project objectives. Any such project does not lead to the production of a therapy for autistic syndromes in the literal strong sense of «therapy» as being an attempt at cure. However, one should expect that in as far as previously untold expressions and behaviours are released and shared and the sensory channels are enhanced then the outcome of using the environment of such a project should be «therapeutic» in the weaker sense, of being both enjoyable and leading to a sense of well-being, for the autistics and their families.

4. THE WAY FORWARD:

A MULTI-DISCIPLINARY APPROACH

Apparently, the above project brings together six (6) different research domains/disciplines, namely, space medicine research, child psychiatry, e-learning and IT based/computer assisted education and learning, motion learning and neuroscience, computer science

with emphasis on multimedia and virtual environments and eHealth - Home Care monitoring and sensor applications (Figure 1).

Methodologically, interventions may be realised in three (3) different stages:

- (a) (special) school environment (IT and other educational interventions)
- (b) family, home based environment (note that these are high exclusion risk families); (IT, educational and home care interventions)
- (c) (special) school environment (after hypergravity interventions).

The above stages may be exploded into a number of core development phases:

Phase 0: Preparation. Literature review, technology review, market research, manufacture of trampoline, software development, web based and virtual environment creation, preparation of home care kit. Testing of components and their integration.

Phase 1: Target group clinical selection. Only children that seem to «enjoy» the trampoline should be considered at this pilot project. Evaluation according to international diagnostic criteria for autism: DSM IV, CARS (Children Autism Rating Scale), application of AAPEP (test d' evaluation de ses possibilités personnelles et de ses intérêts) for the level of development/evolution (kid's abilities scale).

Phase 2: Education/Training. (i) training of the trainers/educators utilising, where possible, unemployed scientists of relevant disciplines and home carers.

(ii) training of the parents/family (theory and PC practice).

(iii) educating/training of the trainees (autistics) in the various components. Teaching will be based on Schopler's theories²⁶, and will include ideas for both guided and self initiated learning.

(iv) progress evaluation.

(v) training and evaluation with the use of video.

Phase 3: Research. This phase should expand to cover research in all underlying disciplines seen in Figure 1. With reference to autism research should evaluate and/or answer the following research questions: (i) what is the ideal creation/attention time of an autistic child?

(ii) how many errors occur in the course of intervention application?

(iii) what are those characteristics of autistic children and their families that prosper gradual development, progress, happiness, well being?

Phase 4: Overall evaluation and Integration fine tuning. In this phase, the project should be rigorously evaluated in all aspects and by all participants (internal) as well as various field experts (external). Recommendations and fine tuning of pitfalls will allow for the release of reference guidelines for further outcomes exploitation.

5. DISCUSSION AND CONCLUSIONS

Autism is a «spectrum disorder» that is diagnosed at the behavioural level according to a triad of impairments in communication, socialization and imagination²⁷. Early behavioural methodologies for teaching social skills to (usually) pre-school children with autism focused on the application of operant conditioning principles²⁸. These interventions were often very effective in teaching children new behaviours or skills, but suffered from a lack of generalization in terms of transferring learned behaviours to new tasks or contexts (for discussions of the approach, see Miranda & Donnellan²⁹).

One of the main paradigms for teaching people with autism about mental states is to embody a mental state (i.e. a belief) with a tangible counterpart in reality (e.g. a photograph). For example, the protagonist's belief that the chocolate is in the drawer is shown directly as a photograph of some chocolate in the drawer. Computer interventions appear to be particularly appropriate for the above approach and research has shown that people with autistic spectrum disorders are more inclined to participate to such intervention for several good reasons^{18,19}.

Artificial gravity has long been proposed as a means of holistically maintaining the entire human organism and avoiding all of micro gravity's adverse health effects. Yet it has not been implemented, in part due to concerns with system complexity and cost in mass and energy. In this context, the project ideas listed here entail a simplistic but gradual and conventional approach to the problem of autism. However, in order to demonstrate that gravity is not only a load

acting locally and continuously on the body limbs, but is also used by higher levels of the nervous system as a dynamic orienting reference for the elaboration of the motor act, several pilot recordings («experiments») should be done (e.g. with digital media) both in 1G and artificial hypergravity conditions.

Furthermore, tele-home health care (tHHC) which provides communication options between the medical professional and patient when hands-on care is not required, is particularly innovative in this sphere. For example, tHHC interventions are currently used to collect vital sign data remotely (e.g. ECG, blood pressure, oxygen saturation, heart and breath sounds), verify compliance with medicine regimes, improve diet compliance, and assess mental or emotional status²³; but the above have never been tried or been exploited in the context of a syndrome such as autism.

Last but not least, special emphasis should be played on the design and development of the scenarios for the development of the software cases, for example, expression of emotions, time conception, choice/selection expression.

With the social and financial costs of chronic illness and/or incurable syndromes constantly increasing in all developed countries and effective treatment forestall mortality, self-management initiatives facilitating the process of care in the home are emerging as a good alternative.

There is definitely a need for research to assess various interventions and to provide rigorous scientific testing of their effectiveness. Studies developing new treatments (e.g., behavioural, cognitive-behavioural) and studies validating, refining and comparing approaches to the treatment of autism and autism spectrum disorders, as well as studies that analyze and define the critical features of effective intervention, including physical environments, parent-child and sibling-child relationship factors, and peer-child interactions seem to be scientifically and socially demanded.

List of abbreviations

A.A.P.E.P. test d' evaluation de ses possibilités personnelles et de ses intérêts

A.B.A. Applied Behavioural Analysis

ADSL Asynchronous Digital Subscriber Loop

C.A.R.S. Children Autism Rating Scale

DSM IV Diagnostic and Statistical Manual of Mental Disorders

ICD-10 International Classification of Diseases

IT Information Technology

SLS Space Life Sciences

T.E.A.C.C.H. Treatment and Education of Autistic and related Communications Handicapped Children

T.E.D. Therapie d' Echanges et du Developpement

tHHC tele-home health care

ToM theory of mind

VEs Virtual environments

VR Virtual Reality

WAP Wireless Application Protocol

Παιδιά με διαταραχές επικοινωνίας: εφαρμογές σύγχρονης τεχνολογίας πληροφορικής και υπερβαρύτητας στη βελτίωση της εξέλιξής τους

Παναγιώτης Δ. Μπαμίδης¹, Χρυσούλα Παπαδέλη-Κουρτίδου²,
Χρήστος Παπαδέλης^{1,2}, Μάγδα Χίτογλου-Αντωνιάδου³

¹Εργαστήριο Ιατρικής Πληροφορικής, Ιατρική Σχολή, Α.Π.Θ.

²Ελληνική Εταιρεία Αεροδιαστημικής Ιατρικής & Διαστημικών Ερευνών

³Εργαστήριο Διαταραχών Λόγου & Επικοινωνίας, Α' ΩΡΑ Κλινική, ΑΧΕΠΑ, Ιατρική Σχολή, Α.Π.Θ.

ΠΕΡΙΛΗΨΗ: Ο αυτισμός, η σοβαρότερη μορφή διαταραχών επικοινωνίας στα παιδιά, είναι μια πολυ-παραγοντική νόσος που εμφανίζεται κατά τη διάρκεια των πρώτων 30 μηνών της ηλικίας και αποδίδεται σε δυσλειτουργία εγκεφάλου. Δεδομένου ότι δεν υπάρχει προς το παρόν καμία θεραπεία ή πρόληψη διαθέσιμη, η έγκαιρη διάγνωση και η σωστή πρόωπη παρέμβαση συμβάλλουν στη βελτίωση της αναπτυξιακής διαδικασίας (επικοινωνία, γνωστική απόδοση, κοινωνική αλληλεπίδραση, δεξιότητες συμπεριφοράς, και προβλήματα συμπεριφοράς) και στοχεύουν στην προσαρμογή στο περιβάλλον. Σήμερα, ειδικά εκπαιδευτικά προγράμματα και ψυχοθεραπευτικές μέθοδοι χρησιμοποιούνται παγκοσμίως και πρόσφατα γίνεται προσπάθεια για την υποστήριξη της εκμάθησης μέσω της χρήσης των υπολογιστών.

Στο άρθρο αυτό, παρουσιάζονται και τεκμηριώνονται μερικές ιδέες για την εφαρμογή προγραμμάτων Τεχνολογιών Πληροφορικής και Επικοινωνιών αλλά και Διαστημικής Ιατρικής, με στόχο την παροχή συγκεκριμένων παρεμβάσεων υποστήριξης των αυτιστικών παιδιών για τη βελτίωση/ανάπτυξη της ικανότητάς τους και την εκμάθηση νέων δεξιοτήτων. Μια νέα μέθοδος παρέμβασης που χρησιμοποιεί ιδέες από την υπερβαρύτητα (εμπλουτισμός των συνθημάτων βαρύτητας στη γη) και τη διαστημική έρευνα χρησιμοποιείται για να ενισχύσει τις αισθητηριακές ικανότητες του αυτιστικού στο περιβάλλον ενός ειδικού σχολείου. Η χρήση κατάλληλου λογισμικού, και μάλιστα τα εικονικά περιβάλλοντα, προτείνονται για να χρησιμοποιηθούν και ως δύο πρόσθετα εργαλεία αλλά και ως στρατηγικές για την αξιολόγηση των αποτελεσμάτων της υπερβαρύτητας. Οι τελευταίες παρεμβάσεις συνδέονται με την προοπτική σύγχρονων μορφών φροντίδας υγείας, όπως η κατ' οίκον φροντίδα, και ένα ειδικό εκπαιδευτικό πρόγραμμα, για να καταστούν δυνατές οι καταγραφές φυσιολογικών παραμέτρων των αυτιστικών αλλά να προωθηθεί το μαθησιακό περιβάλλον και στο σπίτι, ως επέκταση του ειδικού σχολείου. Η τελευταία περίπτωση παρέχει το πλεονέκτημα της ενσωμάτωσης και των γονέων στην εκπαιδευτική διαδικασία, προκειμένου να συντηχθούν καλύτερα η θεωρία και η πρακτική σε ένα γνωστό περιβάλλον διαβίωσης. Με αυτό τον τρόπο γίνεται η ενίσχυση της ποιότητας ζωής πολιτών (παιδιών) με ειδικές ανάγκες και αυξάνεται η αυτονομία τους, παρέχοντας έτσι την πιθανότητα βελτίωσης της εξέλιξής τους, με απώτερο στόχο να δοθεί και στα άτομα αυτά η δυνατότητα να αρχίσουν να διαδραματίζουν κάποιο ρόλο στην κοινωνία μελλοντικά.

Λέξεις Κλειδιά: Αυτισμός, Αεροδιαστημική ιατρική, Ιατρική πληροφορική, Εκπαίδευση, Τεχνολογίες εκπαίδευσης, Παιδοψυχιατρική.

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