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Assistive Technology for Promoting Adaptive Skills of Children with Autism Spectrum Disorders: A Literature Overview

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Abstract

Individuals with autism spectrum disorders are commonly described with emotional, intellectual, communicative and social impairments. They are frequently isolated and passive with few opportunities of positive and constructive interaction with the outside world. Accordingly, they may exhibit withdrawal, stereotypic and challenge behaviors. The aforementioned conditions might seriously hamper their social image and status, with negative consequences on their quality of life. One way to overcome this issue is the use of assistive technology aimed at promoting adaptive skills, self-determination and active role towards the environment by participants involved. The first goal of this paper is to provide an overview of the empirical evidences available in the last fifteen years (i.e. 2000-2015, that is the time period with the wide production of such studies). Overall, 33 studies were selected, involving 184 participants. The second objective of the overview is to emphasize strengths and weakness of such evidences. Finally, clinical, psychological and rehabilitative implications of the findings were discussed and practical guidelines within this topic area as future research perspectives were outlined.

Keywords

Assistive technology, Autism spectrum disorders, Adaptive skills, Quality of life, Indices of happiness, Social validation

Introduction

Assistive Technology (AT) defines and includes any device, equipment or piece that promotes new skills, increases existing (i.e. adaptive) behaviors, or reduces the negative consequences of disabilities on daily functioning [1,2].The adopted technology may be sophisticated (i.e. high tech) or simply (i.e. low tech). For instance, a child may be exposed to a complex computer-based program aimed at enhancing his/her request and choice opportunities or could exchange pictures or cards for communicative purposes [3,4]. Irrespective of its complexity, AT is focused on the improvement of independence and self-determination of participants involved, with beneficial effects on their quality of life [5,6]. That is, based upon learning principles (i.e. causal association between a behavioral response and environmental consequences), AT promotes the positive practice of such principles [3].

Children with autism spectrum disorders (ASD) may be considered as privileged recipients of an AT-based program, due to their difficulties emerging from their pathologies and their learning incapacities associated with their symptoms and behavioral features [7,8]. For example, one may envisage an alternative and augmentative communication (AAC)-based intervention through a speech-generating device (SGD) or self-management of instruction cues for promoting functional activities and decreasing stereotypic behaviors [9,10]. Additionally, AT may be viewed as useful for temperate many of the common obstacles arising from developmental disabilities (DD), motor impairments and challenge behaviors such as aggression or self-injury [11,12].

The first objective of this paper is to provide an overview of the empirical evidences available in the last fifteen years (i.e. 2000-2015, as time period with a large production of such evidences) involving AT-based programs for education, research and practice towards individuals with ASD. The second goal of the paper is to emphasize strengths and weakness of the reviewed studies. Finally, the paper guides practitioners and researchers pointing out the effectiveness of AT for improving the quality of life of children with ASD.

Method

A computerized search was carried out within electronic database such as Scopus, Medline, Psych Info, and ERIC using the following keywords: (a) autism spectrum disorders, (b) intellectual disabilities, (c) developmental disabilities, (d) assistive technology, (e) communication impairments, (f) adaptive behaviors, (g) stereotypic behaviour, (h) aggression, (i) quality of life, (j) indices of happiness, and (k) self-determination. A manual search was additionally performed as supplement and research completion. Including criteria concerned: (a) empirical studies (i.e. research articles), (b) at least one participant who was between 3 and 19 years old (i.e. child or adolescent), (c) the English language of the article, and (d) an AT-based intervention program. Excluding criteria were: (a) systematic

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review paper, book chapter, conference papers and/or meta-analysis, (b) assessing studies without intervention protocol, (c) only adults as participants involved, and (d) participants with Rett syndrome, as their inclusion would exceed the goal of this paper. Accordingly, thirty-three studies were included in the review, involving 184 participants. Specifically, three main domains were considered, namely: (a) communication skills, (b) social and emotional skills, and (c) adaptive and living skills. For each domain, the reviewed studies were examined in terms of the number of participants involved and their ages, AT devices used and/or procedures adopted targeted behaviors and outcomes. A synoptic tab summarizing the included studies will be available. Regardless of the number of the studies retained for each domain, two illustrative evidences will be discussed for every area, for practical reasons.

Overview

AT for communication purposes

Individuals with ASD may exhibit a large range of communication impairments [13,14]. For example, they may present a significant poor speech repertoire, repetitive language (e.g. people with Asperger syndrome), gaze avoidance, withdrawal, disorientation, and echolalia. These conditions may widely interfere with daily life, preventing those individuals towards real forms of integration [15,16]. In fact, deficits in communication may impede their inclusion within educational and community settings, with deleterious consequences for their quality of life [17]. Consequently, AT-based programs are centred to improve their communicative potentials as basic forms of AAC [18]. In fact, AAC-aided systems rely either on high technology-devices such as computers, tablets, I-pad, SGD, or on low-technology strategies such as PECS [18,19]. Since the selected technological solution may significantly influence the person's success, it should be always rigorously individualized, as to ensure the participant with a profitable way to constructively communicate with the outside world [20,21]. Overall, 11 studies were retained within this section, with 126 participants involved (Table 1).

For instance, Copple, Koul, Banda and Frye [22] proposed to three preschool children with autism spectrum disorders a SGD following a video-modelling intervention and a generalization phase to request a preferred object to social partners. The study was carried out according to a multiple baseline design across participants. During the intervention phase all participants were provided with a video showing two adults who requested a preferred item using a SGD. Results emphasized that all participants learned to use the SGD and successfully generalized their learning capacities across partners and objects. The study pointed out that the AT-based program was helpful in improving communication skills of participants involved.

Sigafoos, O'Reilly, Seely-York and Edrisinha [31] taught to two non verbal adolescents diagnosed with ASD, 16 and 12 years old respectively, to use a VOCA to request access to preferred items. A least-to-most prompting procedure was assessed for enabling participants to locate their AT-device. The study was carried out through a delayed multiple-baseline across subjects design. Results showed that both students learned to locate their VOCA once the procedure was implemented. Thus, both participants correctly used their AT-device for requesting preferred objects. Authors concluded that teaching VOCA location skills may be helpful and may constitute an essential element in AAC interventions for participants with ASD.

AT for Social Skills

According to diagnostic criteria [33], ASD include deficit in social skills (e.g. lack of eye contact, poor peers relationships, low joint attention, failure in social and emotional reciprocity). Bauminger and Kasari [25] compared a group of 22 high functioning ASD children with a group of 19 typically developed children to assess their capacity of establish friendship and be aware of loneliness. Data showed that within the experimental group (i.e. children with ASD) levels of friendship were significantly lower compared to those of the control group, in terms of stability and security. Furthermore, reduced feelings of lonely were observed in the experimental group. Results suggested that social deficits and emotional difficulties might cause isolation and social anxiety, which are dominant among ASD individuals [34,35].

Accordingly with the above, AT-based interventions are aimed at improving social relationships and functioning within ASD population [36]. That is, AT programs are essentially computer-based instructions (CBI) which may be at least partially faded and/or eliminated, once social skills have been learned [37,38]. For instance, Hopkins et al. [39] exposed 49 ASD children to a computer-based program finalized to promote eye contact, acquire the ability of discriminating and recognizing facial emotions and expressions.

Table 1: Synoptic representation of the reviewed studies on communication.

Studies 2015	Participants	Range Age	AT	Targeted Behaviors	Outcomes
Copple et al. [22]	3	3.5-5	SGD	Request and Choice	Three positive
Couper et al. [23]	9	4-9	SGD	Manual Signs	Five positive
Kasari et al. [24]	61	5-8	SGD	Communicative Skills	Sixty one positive
Flores et al. [25]	5	6-10	I - Pad and Cards	Communicative Skills	Two negative
Ganz et al. [26]	2	4-5	Verbal modelling and PECS	Verbal Requests	Two negative
Yoder & Liberman [27]	36	1.5-5	PECS and Pre - linguistic milieu teaching	Coordinated Attention	Thirty six positive
Franco et al. [28]	1	7	SGD	Vocal Utterances	One positive
Ganz et al. [29]	3	6-9	PECS	Requests Words	Three positive
Son et al. [30]	3	4-5	PECS and VOCA	Requesting Behaviour	Three positive
Sigafoos et al. [31]	2	12-16	SGD	Requests Behaviour	One negative
Sigafoos et al. [32]	1	12	SGD	Request Objects	One positive

Table 2: Synoptic representation of the reviewed studies on social skills.

Studies	Participants	Range Age	AT	Targeted Behaviors	Outcomes
Ganz et al. [40]	1	5	Tablet	Photos identification	One positive
Axe and Evans [41]	3	5	Video Modelling	Facial Recognition	One negative
Trottier et al. [42]	2	11	SGD	Communicative acts	Two positive
Charlop et al. [43]	3	7-11	Video Modelling	Social Verbalizations	Three positive
Sancho et al. [44]	2	5	Video Modelling	Verbalizations	One negative
Tetreault and Lerman [45]	3	5-8	Video Modelling	Eye Contact	One negative
Wichnick et al. [46]	3	5-7	VOCA	Response to peer	Three positive
Lacava et al. [47]	8	8-11	CBI	Emotions Recognition	Eight positive
MacDuff et al. [48]	3	3-5	Audio Script	Joint Attention	Three positive
Maione and Mirenda [49]	1	5	Video Modelling with feedback	Social Initiations	One positive
Shabani et al. [50]	3	6-7	Vibrating Paper	Verbal Initiations	Three positive

Subsequently the implementation of the intervention, the children significantly improved their performances by increasing their capacities of identifying facial expressions and emotions. Moreover, they all augmented their social skills with peers. Overall, 11 studies were selected within section, with 32 participants involved (Table 2).

Ganz, Hong, Goodwyn, Kite and Gilliland [40] exposed a pre-schooled aged boy with autism to a tablet-based program aimed at promoting receptive identification of photos through an AAC system with voice output. The tablet prompted the participant and provided a vocal feedback for the response correctness during intervention phases. A multiple baseline single-case experimental design across vocabulary words was implemented. Results showed a mild improvement for two of three vocabulary words selected.

Shabani et al. [50] carried out a study with three boys diagnosed with autism who were exposed to a vibrating paper-based program for enhancing their social initiations with other children during a play and for acquiring responding capacities to social interactions with peers. The vibrating paper was activated by a therapist once a social initiation and/or a social interaction were observed. Participants were previously taught to use such technology for their constructive engagement in social initiations/interactions. A reversal design was implemented. Results emphasized that all participants significantly increased their performance during intervention phases compared to baselines. Moreover, for all of them the use of the technology seemed to be purposeful.

AT for adaptive and daily skills

A third relevant issue for ASD individuals is represented by adaptive and daily skills. That is, on-task behaviour and/or constructive engagement for dressing, time and/or money management, recreational skills are essential for the independent functioning of a person within daily settings (e.g. home, school, community) [51]. Furthermore, self-determination might be increased and isolation reduced by acquiring adaptive behaviours. Children with ASD often fail to learn the adaptive skills needed for an independent life and consequently rely on caregivers [52]. Overall, 11 studies were selected within this section with 26 participants involved (Table 3).

For example, Lee et al. [54] implemented a comparison between an I-Pad and an intervention delivered by a therapist for promoting the on-task behaviour and reducing the challenge behaviour through an alternating treatments design for two children with ASD. Results emphasized that the I-Pad was effective and useful if compared to the intervention mediated by the therapist. In fact, its use was associated with increased on-task behaviour and a reduced challenge behaviour for both participants involved.

Stasolla, Damiani and Caffò [57] exposed two high functioning boys diagnosed with ASD to a comparison between a computer-based intervention and a traditional task (i.e. based upon paper and pencil), for promoting constructive engagement and decreasing stereotypic behaviour. The study was carried out through a multi-elements baseline design. Results pointed out that both participants increased their constructive engagement and reduced stereotypic behaviours during intervention phases. Moreover, both preferred the computer-based intervention instead of the traditional program.

Discussion

The reviewed studies summarized the use of AT devices and programs for improving communication, social and adaptive skills of children with ASD. The outcomes were largely positive, although some failures occurred (i.e. 7.6%). Thus, AT-based interventions were effective and successful by increasing self-determination and independence of participants involved in daily contexts, with positive consequences on their quality of life. Thus, by promoting their active role, AT-based interventions significantly facilitated the inclusion of children with ASD with beneficial effects on their social image, desirability and status. Data of this overview were supported by previous findings [64,65], allowing to put forward the following considerations.

With regard to the first group (i.e., communication skills), the literature available outlined that AT-based interventions were useful as it increased the opportunity of requesting preferred items, ignoring non-preferred and/or neutral activities, beginning conversational interactions. Despite the aforementioned outcomes, it seems that AT has been focused, at least up today, to what may be considered the beginning of communication abilities. Assessing the complexity of AT and its potential, the extension of such interventions should be addressed at more structured, articulated communication possibilities, as to enable participants with ASD with more sophisticated communications. For example, one may envisage technological solutions ensuring individuals with ASD to the literacy process, and/or to independently access to phone calls opportunities [66,67]. Else, one may argue that next to the familiar partners considered among the reviewed studies, is undoubtedly necessary to generalize the findings to unfamiliar partners, considering natural settings, added to home, educational and medical contexts [68]. Moreover, it may be interesting to deal with communities members' perceptions through social validation assessments [69,70].The latter extension may represent an important clinical issue for future research within this topic area [71].

With regard to the second issue (i.e. social skills), one may argue that AT-based treatments were successfully applied to a considerable range of social/emotional skills, including recognizing emotions and/or facial expressions, promoting joint attention and eye contact. Although the examined areas within this topic deal with a relevant number of problems exhibited by children with ASD, the existing literature within this specific framework is still limited. For instance, one may envisage the use of AT for extending the knowledge and the identification/recognition of other social emotions such as shame, proud and/or towards the empathy process [72]. Additionally, one may argue that the use of AT devices and/or procedures should be extended as well. That is, high-technology-based solutions such as smart-phones, I-Pod, virtual reality and/or robots might be further investigated [73].

With regard to the third category (i.e. adaptive/daily skills), the AT-based interventions emphasized the enhancement of relevant abilities, including complete functional activities and decreasing ritual, stereotypic and/or challenge behaviours accordingly [74]. Its application, however, appears still limited with respect to the adopted solutions, although broadly applicable in daily life domains. Thus,

Table 3: Synoptic representation of the reviewed studies for adaptive and daily skills.

Studies	Participants	Range Age	AT	Targeted Behaviors	Outcomes
Burckley et al. [53]	1	19	I - Pad	Independence	One positive
Lee et al. [54]	2	6-7	I - Pad	On - task and challenge behaviours	Two positive
Vandermeer et al. [55]	3	4	I - Pad	On - task behaviour	Two negative
Stasolla et al. [56]	3	8.4-10.2	Microswitches	Adaptive and challenge behaviours	Three positive
Stasolla et al. [57]	2	7-8	Laptop	Constructive engagement and stereotypic behaviour	Two positive
Bereznak et al. [58]	3	15-18	I - Phone	Task - Analysis correctness	Three positive
Rosenberg et al. [59]	3	3-5	Video - Modelling	Task - Analysis correctness	Three positive
Van Laarhoven et al. [60]	2	13-14	Picture and Video Prompts	Task - Analysis correctness	Two positive
Ayres et al. [61]	3	7-9	CBI	Task - Analysis correctness	Three positive
Hutcherson et al. [62]	1	16	CBI	Correct responses	One positive
Shipley - Benamou et al. [63]	3	5-6	Video - Modelling	Task - Analysis correctness	Three positive

the AT used should be further extended to new emerging portable options, as to continuously transfer its use from an environment to the other [75].

Irrespective of the domain where it has been used (i.e. for communicative, social and/or adaptive goals), a relevant clinical concern is to determine whether and when AT is requested and/or required. Furthermore, it is recommended to select and consequently adopt the most effective and/or efficient AT solution, considering the following issues: (a) participant's characteristics, (b) environment availability, and (c) human and economical resources [76,77]. According to the aforementioned issues, it can be argued that one should carefully examine the following variables: (a) participant's motor impairments, (b) participant's alertness/vigilance, (c) participant's impulsiveness, (d) participant's skills, (e) motivational components, (f) environment's demands, and/or (g) parents and care givers expectations [78]. Additionally, the participant's preferences seem to play a crucial role for the decision-making process concerning the most suitable AT solution that should be selected [79]. Moreover, preferences of the families and/or caregivers should be analyzed, as to provide the best individualized AT-based option for each participant exposed to such interventions [80].

Conclusion

The general conclusion emerging from this literature overview presents AT as a great value resource and a relevant way for ensuring children with ASD and/or developmental disabilities to positively and constructively interacting with the surround and outside world, playing an active role and enhancing self-determination. The reviewed studies provide a general picture added to some illustrative examples for readers dealing with those individuals. That is, professionals interested with children exhibiting ASD may find some significant and useful support and consequently reduce their burden. However, caution is undoubtedly needed. In fact, beside the small number of studies/participants retained (i.e., thirty-three studies including 184 participants), one should also examine the suitability of the adopted AT solutions within a plausible rehabilitative program. For example, one may argue that children with ASD frequently need systematic instructions and intensive treatments rather than the mere provision of an AT solution. In light of above, new research perspectives in this area should deal with the following topics: (a) new and further extension and/or updating of AT options to new participants with ASD, (b) envisage more generalization, maintenance, follow-up phases in order to assess the consolidation of learning by participants involved, (c) carry out preference check phases, (d) conduct social validation procedure involving students, teachers, parents and caregivers as external raters, and (e) eventually integrating alternating and systematically different AT strategies within a unique experimental research design [81,82].

References

1. Matson JL, Goldin RL (2013) Comorbidity and autism: Trends, topics and future directions. Research in Autism Spectrum Disorders 7: 1228-1233.
2. Matson JL, Boisjoli JA (2008) Strategies for assessing Asperger's syndrome: A critical review of data based methods. Research in Autism Spectrum Disorders 2: 237-248.
3. Felce D, Perry J (1995) Quality of life: its definition and measurement. Res Dev Disabil 16: 51-74.
4. Scheeren AM, Geurts HM (2015) Research on community integration in autism spectrum disorder: Recommendations from research on psychosis. Research in Autism Spectrum Disorders 17: 1-12.
5. Cottenceau H, Roux S, Blanc R, Lenoir P, Bonnet-Brilhault F, et al. (2012) Quality of life of adolescents with autism spectrum disorders: Comparison to adolescents with diabetes. Eur Child Adolesc Psychiatry 21: 289-296.
6. Hampshire PK, Butera GD, Dustin TJ (2014) Promoting Homework Independence for Students with Autism Spectrum Disorders. Intervention in School and Clinic 49: 290-297.
7. Carter EW, Lane KL, Cooney M, Weir K, Moss CK, et al. (2013) Self-determination among transition-age youth with autism or intellectual disability: Parent perspectives. Research and Practice for Persons with Severe Disabilities 38: 129-138.
8. Lancioni GE, Singh NN, O'reilly MF, Sigafoos J, Oliva D, et al. (2014) Persons with multiple disabilities exercise a complex response scheme to counter incorrect head and shoulder positions via a microswitch-aided program. Journal of Intellectual and Developmental Disability 39: 363-369.
9. Lancioni GE, Singh NN, O'Reilly MF, Sigafoos J, Alberti G, et al. (2014) Microswitch-aided programs to support physical exercise or adequate ambulation in persons with multiple disabilities. Res Dev Disabil 35: 2190-2198.
10. Lancioni GE, Bellini D, Oliva D, Singh NN, O'Reilly MF, et al. (2014) New camera-based microswitch technology to monitor small head and mouth responses of children with multiple disabilities. Dev Neurorehabil 17: 193-199.
11. Lancioni GE, Singh NN, O'Reilly MF, Sigafoos J, Oliva D, et al. (2013) Further evaluation of a telephone technology for enabling persons with multiple disabilities and lack of speech to make phone contacts with socially relevant partners. Res Dev Disabil 34: 4178-4183.
12. Lancioni GE, Singh NN, O'Reilly MF, Sigafoos J, Oliva D, et al. (2013) Persons with multiple disabilities increase adaptive responding and control inadequate posture or behavior through programs based on microswitch-cluster technology. Res Dev Disabil 34: 3411-3420.
13. Lancioni GE, Bellini D, Oliva D, Singh NN, O'Reilly MF, et al. (2010) Camera-based microswitch technology for eyelid and mouth responses of persons with profound multiple disabilities: two case studies. Res Dev Disabil 31: 1509-1514.
14. Lancioni GE, O'Reilly MF, Singh NN, Sigafoos J, Didden R, et al. (2009) Persons with multiple disabilities accessing stimulation and requesting social contact via microswitch and VOCA devices: New research evaluation and social validation. Res Dev Disabil 30: 1084-1094.
15. Lancioni GE, Singh NN, O'Reilly MF, Sigafoos J, Oliva D, et al. (2007) Promoting foot-leg movements in children with multiple disabilities through the use of support devices and technology for regulating contingent stimulation. Cogn Process 8: 279-283.
16. Pinder-Amaker S (2014) Identifying the unmet needs of college students on the autism spectrum. Harv Rev Psychiatry 22: 125-137.
17. Lee GK, Carter EW (2012) Preparing Transition-Age Students with High-Functioning Autism Spectrum Disorders for Meaningful Work. Psychology in the Schools 49: 988-1000.
18. Brown HK, Ouellette-Kuntz H, Hunter D, Kelley E, Cobigo V, et al. (2011) Beyond an autism diagnosis: children's functional independence and parents' unmet needs. J Autism Dev Disord 41: 1291-1302.
19. Watkins N, Sparling E (2014) The Effectiveness of the Snug Vest on Stereotypic Behaviors in Children Diagnosed With an Autism Spectrum Disorder. Behav Modif 38: 412-427.
20. Matson JL, Jang J (2014) Treating aggression in persons with autism spectrum disorders: a review. Res Dev Disabil 35: 3386-3391.
21. Lancioni GE, Singh NN, O'Reilly MF, Oliva D, Basili G (2005) An overview of research on increasing indices of happiness of people with severe/profound intellectual and multiple disabilities. Disabil Rehabil 27: 83-93.
22. Copple K, Koul R, Banda D, Frye E (2015) An examination of the effectiveness of video modelling intervention using a speech-generating device in preschool children at risk for autism. Dev Neurorehabil 18: 104-112.
23. Couper L, Van Der Meer L, Schäfer MCM, Mckenzie E, Mclay L, et al. (2014) Comparing acquisition of and preference for manual signs, picture exchange, and speech-generating devices in nine children with autism spectrum disorder. Dev Neurorehabil 17: 99-109.
24. Kasari C, Kaiser A, Goods K, Nietfeld J, Mathy P, et al. (2014) Communication interventions for minimally verbal children with autism: A sequential multiple assignment randomized trial. J Am Acad Child Adolesc Psychiatry 53: 635-646.
25. Flores M, Musgrove K, Renner S, Hinton V, Strozier S, et al. (2012) A comparison of communication using the apple ipad and a picture-based system. AAC Augmentative Altern Commun 28: 74-84.
26. Ganz JB, Lashley E, Rispoli MJ (2010) Non-responsiveness to intervention: Children with autism spectrum disorders who do not rapidly respond to communication interventions. Dev Neurorehabilitation 13: 399-407.
27. Yoder PJ, Lieberman RG (2010) Brief report: Randomized test of the efficacy of picture exchange communication system on highly generalized picture exchanges in children with ASD. J Autism Dev Disord 40: 629-632.
28. Franco JH, Lang RL, O'Reilly MF, Chan JM, Sigafoos J, et al. (2009) Functional analysis and treatment of inappropriate vocalizations using a speech-generating device for a child with autism. Focus Autism Other Dev Disabil 24: 146-155.
29. Ganz JB, Parker R, Benson J (2009) Impact of the picture exchange communication system: Effects on communication and collateral effects on maladaptive behaviors picture exchange communication and maladaptive behaviors. AAC Augmentative Altern Commun 25: 250-261.

30. Son SH, Sigafoos J, O'Reilly M, Lancioni GE (2006) Comparing two types of augmentative and alternative communication systems for children with autism. Pediatr Rehabil 9: 389-395.

31. Sigafoos J, O'Reilly M, Seely-York S, Edrisinha C (2004) Teaching students with developmental disabilities to locate their AAC device. Res Dev Disabil 25: 371-383.

32. Sigafoos J, O'Reilly MF, Seely-York S, Weru J, Son SH, et al. (2004) Transferring AAC intervention to the home. Disabil Rehabil 26: 1330-1334.

33. American Psychiatric Association. Diagnostic and statistical manual of mental disorders 2013. Arlington, VA: American Psychiatric Publishing.

34. Gelbar NW, Smith I, Reichow B (2014) Systematic review of articles describing experience and supports of individuals with autism enrolled in college and university programs. J Autism Dev Disord 44: 2593-2601.

35. Devine DP (2014) Self-injurious behaviour in autistic children: A neuro-developmental theory of social and environmental isolation. Psychopharmacology 231: 979-997.

36. van der Meer L, Achmadi D, Cooijmans M, Didden R, Lancioni GE, et al. (2014) An iPad-Based Intervention for Teaching Picture and Word Matching to a Student with ASD and Severe Communication Impairment. Journal of Developmental and Physical Disabilities 27: 67-78.

37. van der Meer L, Kagohara D, Roche L, Sutherland D, Balandin S, et al. (2013) Teaching multi-step requesting and social communication to two children with autism spectrum disorders with three AAC options. Augment Altern Commun 29: 222-234.

38. Roche L, Sigafoos J, Lancioni GE, O'Reilly MF, van der Meer L, et al. (2014) Comparing Tangible Symbols, Picture Exchange, and a Direct Selection Response for Enabling Two Boys with Developmental Disabilities to Access Preferred Stimuli. J Dev Phys Disabil 26: 249-261.

39. Hopkins IM, Gower MW, Perez TA, Smith DS, Amthor FR, et al. (2011) Avatar assistant: Improving social skills in students with an asd through a computer-based intervention. J Autism Dev Disord 41: 1543-1555.

40. Ganz JB, Hong ER, Goodwyn F, Kite E, Gilliland W (2015) Impact of PECS tablet computer app on receptive identification of pictures given a verbal stimulus. Dev Neurorehabilitation 18: 82-87.

41. Axe JB, Evans CJ (2012) Using video modeling to teach children with PDD-NOS to respond to facial expressions. Res Autism Spectr Disord 6: 1176-1185.

42. Trottier N, Kamp L, Mirenda P (2011) Effects of peer-mediated instruction to teach use of speech-generating devices to students with autism in social game routines. AAC Augmentative Altern Commun 27: 26-39.

43. Charlop MH, Dennis B, Carpenter MH, Greenberg AL (2010) Teaching socially expressive behaviors to children with autism through video modeling. Educ Treat Child 33: 371-393.

44. Sancho K, Sidener TM, Reeve SA, Sidener DW (2010) Two variations of video modeling interventions for teaching play skills to children with autism. Educ Treat Child 33: 421-442.

45. Tetreault AS, Lerman DC (2010) Teaching social skills to children with autism using point-of-view video modeling. Educ Treat Child 33: 395-419.

46. Wichnick AM, Vener SM, Pyrtek M, Poulson CL (2010) The effect of a script-fading procedure on responses to peer initiations among young children with autism. Res Autism Spectr Disord 4: 290-299.

47. LaCava PG, Golan O, Baron-Cohen S, Myles BS (2007) Using assistive technology to teach emotion recognition to students with asperger syndrome a pilot study. Remedial Spec Educ 28: 174-181.

48. MacDuff JL, Ledo R, McClannahan LE, Krantz PJ (2007) Using scripts and script-fading procedures to promote bids for joint attention by young children with autism. Res Autism Spectr Disord 1: 281-290.

49. Maione L, Mirenda P (2006) Effects of video modeling and video feedback on peer-directed social language skills of a child with autism. J Posit Behav Interventions 8: 106-118.

50. Shabani DB, Katz RC, Wilder DA, Beauchamp K, Taylor CR, et al. (2002) Increasing social initiations in children with autism: effects of a tactile prompt. J Appl Behav Anal 35: 79-83.

51. Zwaigenbaum L, Bryson S, Rogers T, Roberts W, Brian J, et al. (2005) Behavioral manifestations of autism in the first year of life. Int J Dev Neurosci 23: 143-152.

52. Lancioni GE, Singh NN (2014) Assistive Technologies for people with diverse abilities. Springer, New York.

53. Burckley E, Tincani M, Guld Fisher A (2015) An iPad™-based picture and video activity schedule increases community shopping skills of a young adult with autism spectrum disorder and intellectual disability. Dev Neurorehabil 18: 131-136.

54. Lee A, Lang R, Davenport K, Moore M, Rispoli M, et al. (2015) Comparison of therapist implemented and iPad-assisted interventions for children with autism. Dev Neurorehabil 18: 97-103.

55. Vandermeer J, Beamish W, Milford T, Lang W (2015) iPad-presented social stories for young children with autism. Dev Neurorehabil 18: 75-81.

56. Stasolla F, Perilli V, Damiani R, Caffò AO, Di Leone A, et al. (2014) A microswitch-cluster program to enhance object manipulation and to reduce hand mouthing by three boys with autism spectrum disorders and intellectual disabilities. Res Autism Spectr Disord 8: 1071-1078.

57. Stasolla F, Damiani R, Caffò AO (2014) Promoting constructive engagement by two boys with autism spectrum disorders and high functioning through behavioral interventions. Res Autism Spectr Disord 8: 376-380.

58. Bereznak S, Ayres KM, Mechling LC, Alexander JL (2012) Video self-prompting and mobile technology to increase daily living and vocational independence for students with autism spectrum disorders. J Dev Phys Disabil 24: 269-285.

59. Rosenberg NE, Schwartz IS, Davis CA (2010) Evaluating the utility of commercial videotapes for teaching hand washing to children with autism. Educ Treat Child 33: 443-455.

60. Van Laarhoven T, Kraus E, Karpman K, Nizzi R, Valentino J (2010) A comparison of picture and video prompts to teach daily living skills to individuals with autism. Focus Autism Other Dev Disabil 25: 195-208.

61. Ayres KM, Maguire A, McClimon D (2009) Acquisition and generalization of chained tasks taught with computer based video instruction to children with autism. Educ Train Dev Disabil 44: 493-508.

62. Hutcherson K, Langone J, Ayres K, Clees T (2004) Computer assisted instruction to teach item selection in grocery stores: An assessment of acquisition and generalization. J Spec Educ Techn 19: 33-42.

63. Shipley-Benamou R, Lutzker JR, Taubman M (2002) Teaching daily skills to children with autism through instructional video modelling. J Pos Beh Interv 4: 165-177.

64. Lancioni GE, Sigafoos J, O'Reilly MF, Singh NN (2012) Assistive Technology. Interventions for Individuals with Severe/Profound and Multiple Disabilities. Springer, New York.

65. Schlosser RW1, Koul RK (2015) Speech Output Technologies in Interventions for Individuals with Autism Spectrum Disorders: A Scoping Review. Augment Altern Commun 31: 285-309.

66. Lancioni GE, Singh NN, O'Reilly MF, Sigafoos J, Oliva D, et al. (2013) Further evaluation of a telephone technology for enabling persons with multiple disabilities and lack of speech to make phone contacts with socially relevant partners. Res Dev Disabil 34: 4178-483.

67. Stasolla F, De Pace C (2014) Assistive technology to promote leisure and constructive engagement by two boys emerged from a minimal conscious state. NeuroRehabilitation 35: 253-259.

68. Ninci J, Lang R, Davenport K, Lee A, Garner J, et al. (2013) An analysis of the generalization and maintenance of eye contact taught during play. Dev Neurorehabil 16: 301-307.

69. Stasolla F, Caffò AO, Damiani R, Perilli V, Di Leone A, et al. (2015) Assistive technology-based programs to promote communication and leisure activities by three children emerged from a minimal conscious state. Cognitive Processing 16: 69-78.

70. Stasolla F, Damiani R, Perilli V, D'Amico F, Caffò AO, et al. (2015) Computer and microswitch-based programs to improve academic activities by six children with cerebral palsy. Res Dev Disabil 45-46: 1-13.

71. O'Reilly M, Aguilar J, Fragale C, Lang R, Edrisinha C, et al. (2012) Effects of a motivating operation manipulation on the maintenance of mands. J Appl Behav Anal 45: 443-447.

72. Lambert-Brown BL, McDonald NM, Mattson WI, Martin KB, Ibañez LV, et al. (2015) Positive emotional engagement and autism risk. Dev Psychol 51: 848-855.

73. Vernon TW, Koegel RL, Dauterman H, Stolen K (2012) An early social engagement intervention for young children with autism and their parents. J Autism Dev Disord 42: 2702-2717.

74. Duncan AW, Bishop SL (2015) Understanding the gap between cognitive abilities and daily living skills in adolescents with autism spectrum disorders with average intelligence. Autism 19: 64-72.

75. Besio S (2004) Using assistive technologies to facilitate play by children with motor impairments: A methodological proposal. Technology and Disability 16: 119-130.

76. Jefferds AN, Beyene NM, Upadhyay N, Shoker P, Pearlman JL, et al. (2010) Current State of Mobility Technology Provision in Less-Resourced Countries. Phys Med Rehabil Clin N Am 21: 221-242.

77. Ben-Avie M, Newton D, Reichow B (2014) Using handheld applications to improve the transitions of students with autism spectrum disorders. In: Innovative Technologies to Benefit Children on the Autism Spectrum. 105-124.

78. Myles BS, Rogers J (2014) Addressing executive function using assistive technology to increase access to the 21st century skills. In: Innovative Technologies to Benefit Children on the Autism Spectrum. 20-34.

79. Alcantud F, Coret J, Alonso Y, Jiménez E (2013) Assistive Technologies and Autism Spectrum Disorders. In: Disability Informatics and Web Accessibility for Motor Limitations. 263-93.

80. Spence-Cochran K, Pearl C (2012) Assistive technology to support people with autism spectrum disorders. In: Educating Students with Autism Spectrum Disorders: Research-Based Principles and Practices. 295-311.

81. Tsui KM, Feil-Seifer DJ, Matarić MJ, Yanco HA (2009) Performance evaluation methods for assistive robotic technology In: Performance Evaluation and Benchmarking of Intelligent Systems. 41-66.

82. http://robotics.cs.uml.edu/fileadmin/content/publications/2009/SpringerChapter-tsui-fseifer-mataric-yanco.pdf.

83. Campbell JE, Mears KM (2009) Habilitative treatments for children with ASDs: Speech and occupational therapy, assistive technology In: The Autism Spectrum: Scientific Foundations and Treatment. Internet. 217-38.