Title Registration for a Systematic Review: Electronic Assistive Technology for Improving Social and Behavioral Outcomes for Individuals with Autism Spectrum Disorder (ASD)

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Submitted to the Coordinating Group of:

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| ☐ International Development | ☐ Nutrition | ☐ Social Welfare |
| ☐ Other: |

Plans to co-register:

| ☑ No | ☐ Yes | ☐ Cochrane | ☐ Other |
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TITLE OF THE REVIEW

Electronic Assistive Technology for Improving Social and Behavioral Outcomes for Individuals with Autism Spectrum Disorders (ASD)

BACKGROUND

Autism Spectrum Disorder (ASD) is considered the third most common developmental disorder, affecting approximately 1% of the population worldwide (e.g., Baron-Cohen et al., 2009). Similar to other neuro-developmental disabilities, ASD is not “curable” and therefore requires management. ASD has a range of impacts on the health, economic wellbeing, social integration, and quality of life of individuals with the disorder, and also affects families, healthcare professionals, teachers, and, potentially, the rest of the society. From an economic perspective, recent estimates in the UK, for example, have shown that the aggregate annual costs of supporting children with ASD is approximately £2.7 billion, with the cost of supporting adults in the region of £25 billion (Knapp et al., 2007). The costs throughout the life-course for an individual with high-functioning autism have been estimated to be in the region of £3.1 million, whereas £4.6 million is required for someone with low-functioning autism (Knapp et al., 2007). Interestingly, most of these costs are accounted for by hospital services, other health and social services, special education, other education support, day care provision, respite services, and pharmacological and non-pharmacological treatments (Knapp et al., 2007). As a result of these compelling impacts, there have been consistent reports within the literature identifying the critical need for further research that aims to expand and/or improve the currently available interventions to mitigate the core features of ASD (Toth, 2007).

These core features are related to severe and pervasive impairments in reciprocal social interaction skills, communication, and the presence of restricted repetitive and stereotyped patterns of behavior, interests, and activities (or lack of imagination) (American Psychiatric Association, 2000). In terms of the Electronic Assistive Technology (EAT) interventions, these have been designed and mainly focused on teaching individuals with ASD self-help skills, communication and language (expressive and receptive) skills, socially relevant behaviors, play skills, or reducing disruptive and self-stimulatory behaviors.

The Intervention

One way of addressing the aforementioned demand has been through the design and development of innovative interventions based on assistive technology. The scope of assistive technology is extensive and includes thousands of devices (Scherer, 2000). Of particular interest are the high technology devices. Indeed, advances in Information and Communication Technology, including for example, mobile phones, satellite navigation systems and the internet, have shaped our lives and have led to a number of innovative applications (Doughty et al., 2007). High technology devices can be grouped together as
electronic assistive technology (EAT), which has been defined as: “... a subset of assistive technology which comprises communication devices, environmental control systems, personal computers and the interface which permit their integration with information technology and with wheelchair control systems” (p.3 Royal College of Physicians, 2000). A non-exhaustive list of examples includes robotics, iPods, computer-aided instructions, video modeling, virtual reality, voice output communication devices, computer-play and others (e.g., Goodwin, 2008; Verdonck et al., 2011).

How the Intervention Might Work

Parents, teachers, healthcare professionals and researchers regularly report that individuals with ASD are drawn to EAT interventions for a number of reasons, such as:

- Usually, interventions based on EAT allow a presentation of a simplified social environment and then gradual increase in the complexity of social interactions (e.g., Duquette, Michaud, & Mercier, 2008; Goldsmith & LeBlanc, 2004). These are significant elements for the design of successful therapeutic programs for individuals with ASD who typically present with a deficit of social skills (Reichow et al., 2010) and often experience discomfort within non-controlled social environments (Charlop-Christy et al., 2000);

- It is common for people with ASD to respond to a restricted set of cues within an environment; a phenomenon known as stimulus overselectivity (e.g., Lovaas & Koegel, 1979; Rincover & Ducharme, 1987). Interventions based on EAT can be utilized to bring relevant cues closer together which can help people with ASD to follow respective cues and to discriminate between them. This is important to develop skills in imitative responding (e.g., Morgan & Salzberg, 1992);

- Interventions based on EAT can efficiently take advantage of the attention skills of individuals with ASD, which tend to be more sensitive towards graphical presentations. Technology can be used to display and record a wide range of examples of visual stimuli and response variations (e.g., Nally et al., 2000; Williams et al., 2002);

- Individuals with ASD exhibit difficulties in situations involving environmental change typically referred to as deficits in disruptive transition behavior (American Psychiatric Association, 2000). Interventions based on EAT can be used provide controlled responses and therefore serve as an efficient medium to present optimal, adaptive learning contexts while supporting the option to slowly and systematically increase the levels of complexity (Bolte et al., 2010; Golan & Baron-Cohen, 2006);

- The extensive use of interventions based on EAT in training may stem from the obvious shift in emphasis from language-based instruction to more visual-based instructional supports for teaching individuals with multiple disabilities and ASD (e.g., Bondy & Frost, 2001; Quill, 2000). Indeed, individuals with ASD have been reported to have a tendency to better use and learn from visual instructions which are generally provided in EAT
interventions (e.g., Brown & Mirenda, 2006; Ganz, Bourgeois, Flores, & Campos, 2008; Konstantinidis et al., 2009). Hence, technology would be particularly appropriate and motivating for these individuals (e.g., Dawson et al., 2000; Kamio & Toichi, 2000; Rao & Gagie, 2006; Shane & Albert, 2008);

Why it is Important to do the Review

Since the development of EAT for individuals with ASD has been relatively recent, a systematic review to provide the best available evidence on the research outcomes and to highlight areas where further original research is required becomes more than essential. However, to date there does not appear to exist a publication which has fully addressed this requirement. In fact, to our knowledge, there have only been two published literature reviews (neither are systematic reviews), which could potentially be considered. However, the first review published by Goldsmith et al. (2004) provides just five examples of technology introduced as a temporary instructional aid to be removed once the goal of behavior change has been met, whilst the second review by Wainer et al. (2011) deals with only a subset of the available technologies that might be employed for individuals with ASD: the use of computers for teaching social communication. The necessity for conducting a systematic review of EAT interventions is further reinforced by the fact that the European Commission has earmarked a total of € 9.1 billion for research into technology-enabled solutions for people with disabilities between 2007-2013, making it the largest research theme currently being funded (European Commission, 2010).

Moreover, the popularity of technology in the field of psychology is evidenced by the development of new journals in the area such as the Journal of Special Education Technology, the Journal of Educational Multimedia and Hypermedia and the Journal of Computer Assisted Learning. Furthermore, Autism Speaks, one of the largest international autism funding bodies, continues to support the “Innovative Technology for Autism Initiative” which promotes collaborations amongst healthcare professionals, computer scientists, and designers within the ASD community. More traditional clinical psychology journals are also recognizing the importance of technology in facilitating service delivery and, as such, are devoting special issues to the topic (e.g., Autism: The International Journal of Research and Practice). Parents and clinicians regularly report that individuals with autism are drawn to technological devices and researchers have noted the importance of devising treatments that take advantage of the fact that this population has a tendency to better use and learn from visual instructions (Goldsmith & LeBlanc, 2004; Konstantinidis et al., 2009). Last but not least, the use of technologies are becoming more mainstream because they are widely available, cost effective, and easier to use, which warrants extending and combining them to address the task of helping people with ASD.

The total number of individuals with a long-term health problem or a social disability in EU-25 is estimated to be more than 45 million citizens. Enabling people with disabilities to enjoy dignity, equal treatment, independent living and full participation in society is the main purpose of the EU’s long-term strategy for the active inclusion of people with disabilities
(European Foundation for the Improvement of Living and Working Conditions, 2010). More specifically, the European i2010 initiative on e-inclusion aims to "accelerate the effective participation of target groups at risk of exclusion and improve their quality of life" by stimulating the effective use of technology-enabled services. Technology-enabled solutions aim to help compensate for functional, mental and social deficits and promote the quality of life for people with disabilities (European Commission, 2006). Autism has a great impact on the individuals themselves, their parents/carers, the national health systems and, in essence, all of society. The proposed systematic review has the potential to positively affect consumers and draw the interest of the policymakers by dealing with an extremely 'hot'/topical issue, which is the assessment of the effectiveness of interventions using EAT for individuals with ASD and by highlighting areas where further original research is required along with assisting informing decisions of which technology interventions may be adopted.

**OBJECTIVES**

The main objective of this systematic review is to assess the effectiveness of interventions using electronic assistive technology (EAT) for individuals with autism spectrum disorders (ASD) when an objective evaluation has taken place, and to highlight areas where further original research is required.

**METHODOLOGY**

**Introduction**

It is likely that we will find a number of studies which employ controlled within-subject (or single-subject) experimental designs (e.g., multiple baseline designs). One of the important observable characteristics exhibited by people with ASD is their uneven learning ability and skill levels. Thus, personalized/individualized interventions are not uncommon and it is not unreasonable to assume that the specifics of intervention programs will be different for different people and must be sensitive to each person's needs (Anderson & Romanczyk, 1999). Hence, research questions that pertain to the evaluation of the effectiveness of individually tailored treatments for individuals diagnosed with ASD typically are addressed by methodologies, such as single-subject designs, that are particularly tailored to address these types of ideographic questions. This is the main reason for having been extensively mentioned in the literature that single-subject studies play a critical role in bringing a treatment from initial conceptualization to implementation in daily practice (Schlosser & Sigafous, 2008). Specifically, within the literature relevant to autism, intervention studies rarely use a group-comparison design. For example, the selective review by Matson et al. (2007) addressing social skill treatment studies in children with ASD revealed that more than 90% of the 79 papers reviewed adopted within-subject designs. In addition, the relatively low prevalence of ASD makes random assignment of participants to the groups difficult. Furthermore, assigning individuals with ASD to the control group may violate their needs for early intervention and raise ethical concerns.
Nevertheless, apart from single-subject design studies, all other studies which may have used randomized controlled trials (RCTs) with blinded assessment of outcome, control clinical trials (CCTs), controlled before and after studies (CBA) or interrupted time series (ITS) will also be included.

**Inclusion Criteria**

**Study Designs**

The following study designs will be eligible for inclusion in the systematic review.

1. *Randomized Controlled Trials & Controlled Clinical Trials (RCTs & CCTs)*

2. *Controlled Before and After (CBA) studies*

3. *Interrupted Time Series (ITSs) studies*

4. *Single-Subject Experimental studies*

**Participants**

Individuals with a primary diagnosis of ASD (autism, Asperger’s syndrome, high-functioning autism or Pervasive Developmental Disorder: Not Otherwise Specified - PDD:NOS) according to the Diagnostic and Statistical Manual of Mental Disorders, 4th edition, text revision (American Psychiatric Association, 2000), or ICD-10 (WHO, 2007). No further inclusion criteria for participants shall be applied.

**Interventions**

The most predominant EAT interventions in the treatment of individuals with ASD will be included in this review such as robotics, iPods, computer-based interventions, video modeling, virtual reality, and voice output communication devices. These might have been deployed in any environment (e.g., home, school, clinical settings etc.) with the aim of promoting any skills within any domain and sub-domain of development (e.g., language and communication, adaptive and self-care, social, play etc.) or eliminating disruptive and self-stimulatory behaviors (e.g., self-injury, physical aggression, verbal aggression, non-compliance, disruption of the environment, inappropriate vocalizations, stereotypes) usually exhibited by individuals within this condition.

Interventions that evaluate a combination of treatment approaches in addition to the EAT will not be included. The control interventions, whenever applicable, may either be 'care as usual', or non-EAT interventions (including interventions that use non electronic devices). Further, careful consideration and reference to the degree of parent/carer support with the technology during evaluation as well as possible training approach adopted will also be reported.
Outcomes

As stated above in the ‘Background’ section, EAT interventions have been designed to address the core features of individuals with autism and particularly, they have mainly been focused on the promotion of self-help skills, language (expressive and receptive) and communication skills, socially relevant skills, play skills or on the elimination of disruptive and self-stimulatory behaviors in individuals with ASD. Consequently, the outcomes of this review will be related to - exactly - these areas of development and they will be analyzed and measured in respect to the selected research methodology in any reviewed study. Examples of particular behaviors/skills to be included in any of the aforementioned areas of development are provided in Appendix A at the end of this form. Adverse effects of the EAT interventions for individuals with ASD and their parents/carers, teachers and other health care professionals if measured by qualitative means or specific scales (e.g., Family Impact of Assistive Technology Scale; Ryan et al., 2007) will also be reported.

Search Strategy

We will search the Ovid MEDLINE, PsycINFO, ERIC, and Web of Science databases with the keywords: autism or autistic or better autis* in combination with a range of keywords attributed to EAT such as robotics, iPods, computer-based interventions, video modeling, virtual reality and voice output communication devices. Only papers published between 1994 and 2012 and in English will be collected. The reason for setting limitation to 1994 is because the diagnostic criteria as reported in the DSM (Diagnostic and Statistical Manual of Mental Disorders) and ICD (International Statistical Classification of Diseases and Related Health Problems) have become more consistent after DSM-IV was published in 1994.

Method of Data Extraction and Synthesis

Study Quality and Risk of Bias

The study design for each eligible study will be evaluated for quality or risk of bias. Because risk of bias differs for different study designs, it will be evaluated separately for the different research designs included using a scheme that takes into account the following information.

Typically, criteria for randomized controlled trials and controlled clinical trials include the following:

a) the unit of allocation (selection of the participants in the current proposal) was made by an institution, team or professional and any random process is described explicitly;

b) follow-up of professionals and of patients or episodes of care occurred, which means that outcome measures were obtained for 80-100% of subjects;

c) blinded assessment of primary outcome(s) was carried out or the outcome variables were objective (e.g., use of standardized tests etc.);
d) baseline measurement (i.e., the performance or patient outcomes were measured prior to the intervention, and no substantial differences were present across study groups) was conducted;

e) primary outcome measure(s) were reliable in terms that 90% agreement or kappa greater than or equal to 0.8 between two or more raters was achieved or that the outcome was obtained from some automated system (e.g., drug levels as assessed by a standardized test); and

f) allocation was made by community, institution or practice and it was unlikely that the control received the intervention (contamination issue) (Higgins & Green, 2011).

Typically, criteria for controlled before and after (CBA) studies include the following:

a) the unit of allocation (selection of the participants in the current proposal) was made by an institution, team or professional and any random process is described explicitly;

b) baseline measurement (i.e., the performance or patient outcomes were measured prior to the intervention, and no substantial differences were present across study groups) was conducted;

c) there were not any differences between study and control providers, which means that characteristics of study and control providers were clearly reported and indicated as similar;

d) blinded assessment of primary outcome(s) was carried out or the outcome variables were objective (e.g., use of standardized tests etc.);

e) primary outcome measure(s) were reliable in terms that 90% agreement or kappa greater than or equal to 0.8 between two or more raters was achieved or that the outcome was obtained from some automated system (e.g., drug levels as assessed by a standardized test); and

f) follow-up of patients occurred in terms that outcome measures were obtained for 80-100% of patients allocated to groups or for patients who entered the study (Higgins & Green, 2011).

Typically, criteria for interrupted time series (ITSs) studies include the following:

a) the intervention should be independent of other changes over time;

b) data were analyzed appropriately (e.g., ARIMA models or time series regression models were used to analyze the data and serial correlation was adjusted/tested);
c) rationale for the number of points was stated or sample size calculation was performed;

d) explanation for the shape of the intervention effect was specified;

e) intervention itself was unlikely to affect data collection (e.g., sources and methods of data collection were the same before and after the intervention);

f) blinded assessment of primary outcome(s) was carried out or the outcome variables were objective (e.g., use of standardized tests etc.);

g) primary outcome measure(s) were reliable in terms that 90% agreement or kappa greater than or equal to 0.8 between two or more raters was achieved or that the outcome was obtained from some automated system (e.g., drug levels as assessed by a standardized test); and

h) data set covered 80-100% of total number of participants or episodes of care in the study (Higgins & Green, 2011).

The quality criteria for the inclusion of single-subject designs will be based on the work of Horner et al. (2005), who presented several criteria that would indicate the appropriate use of a single-subject design for the identification of empirically supported treatments. It is worth mentioning that these criteria are supported by a number of funding organizations such as the National Center for the Dissemination of Disability Research (NCDDR; 2011), and they include the following:

a) participants and the process of their selection were described with sufficient detail to allow other researchers to select similar participants;

b) critical features of the physical setting were described with sufficient precision to allow for replication;

c) the dependent variable was sufficiently operationalised and measured repeatedly using sufficient assessment conditions to allow for identification of performance patterns prior to intervention and comparison of performance patterns across conditions/phases (level, trend, variability);

d) the dependent variable was assessed for consistency through interobserver agreement;

e) the dependent variable was selected for its social significance;

f) the independent variable was defined with replicable precision;
g) the fidelity of the independent variable implementation was documented if, for example, the implementation of all components of the independent variable was not carried out by the primary researcher;

h) the description of the baseline and intervention conditions was sufficiently precise to permit replication; and

i) the performance during the baseline condition was compared with the performance during intervention.

Data collection and subsequent critical assessment of single-subject studies will be carried out through the use of meta-analysis as it has been clearly suggested in the literature (e.g., Banda & Therrien, 2008; Ganz et al., 2011; Kavale, 2001; Marquis et al., 2000; Parker et al., 2007; Scruggs & Mastropieri, 2001). There are, however, some challenges with quantification and synthesis of single-subject studies. These challenges are due to the specific features of these studies, for example, the various scales used in different studies, the auto-correlation, and trend in the data (Jenson et al., 2007). The first step towards the integration of data across studies is the standardization of the raw data from the dependent variables from different studies, which is quite likely to have been measured on different scales (Raudenbush & Bryk, 2002; Van den Noortgate & Onghena, 2003). A number of traditional statistical methods have been suggested to provide such standardized scales, including percentage of non-overlapping data points (Scruggs et al., 1987), effect size calculated by dividing the mean difference between pre-treatment and post-treatment data points with the standard deviation of pre-treatment data points (Busk & Serlin, 1992), percentage of zero data (Scotti et al., 1991), and the Improvement Rate Difference (IRD; Parker et al., 2009) to name but a few. These methods, however, appear to present some problems, as indicated in a few studies (e.g., Brossart et al., 2006; Campbell, 2004; Jenson et al., 2007). Importantly, these problems can be addressed by using hierarchical linear modeling (HLM), which facilitates the reliable examination of outcomes across multiple single-subject studies (Jenson et al., 2007; Raudenbush et al., 2002; Van den Noortgate & Ongena, 2007).

More specifically, prior to the HLM analysis, data from multiple studies are transformed to a standardized metric so that the outcomes can be compared on the same scale. Furthermore, the scores of HLM are generally structured in units. For instance, the data points from the same dependent variable and the effect sizes from the same participant or the same study in units are coded and analyzed as the same category in HLM. In that way (i.e., by setting a hierarchical structure to the data), the possible dependence which may be caused by the influence of the data being at the same unit or category can be considered, examined and carefully evaluated (Van den Noortgate et al., 2007). In other words, the use of HLM permits investigators to manage the scaling and dependence problems of the score in addition to describing the variance at the same level of these units by adopting the characteristics of the units as the predictors. Significantly, the application of the HLM to the meta-analysis can
help estimate the mean and variation of effect size parameters across multiple studies and test how well different predictors can explain the variation (Raudenbush et al., 2002; Van den Noortgate et al., 2007). An excellent illustration of the use of HLM analysis can be found in a recent study by Wang et al. (2011), in which HLM was employed for the examination of the effect sizes of peer-mediated and video-modeling interventions that had adopted a within-subject research methodology to improve the social behavior for children with ASD.

Finally, there will be a subgroup analysis which potentially would include:

- Age
- Different types of ASD (autism, Asperger’s syndrome, high-functioning autism or PDD:NOS)
- Severity of ASD
- Conditions comorbid to ASD, such as fragile X syndrome, ADHD, learning disabilities (mental retardation), epilepsy or sensory integration dysfunction
- Gender
- Participant’s levels of functioning as usually measured by any of the following assessment tools: the Autism Diagnostic Observation Schedule-Generic (ADOS-G; Lord et al., 1999), the Leiter International Performance Scale-Revised (Leiter-R; Roid, & Miller, 1997), the Peabody Picture Vocabulary Scale-III (PPVT-III: Dunn, & Dunn, 1997), the Vineland Adaptive Behavior Scale (VABS-II; Sparrow et al., 2005), the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2000 - Pandolfi, Magyar, & Dill, 2009) and others
- Setting(s); experimental and/or generalization (e.g., home, school, clinical settings etc.)
- Degree of parent/carer support.
REFERENCES


**SOURCES OF SUPPORT**

**Internal funding:**
N/A

**External funding:**
N/A

**DECLARATIONS OF INTEREST**

It is declared that neither the reviewer nor the co-authors have any interests in this topic that could be perceived as conflicts of interest.
# REVIEW TEAM

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ROLES AND RESPONSIBILITIES

All members of our team should contribute in the tasks below, undertaking either an active or a supportive role. Christos Nikopoulos, however, will have the overall leadership, management and the co-ordination of the members for ensuring the timely completion of all required tasks.

- Content:
- Systematic review methods:
- Statistical analysis:
- Information retrieval:

However, it may be worth providing you with some information about each of the author in an effort to highlight their areas of expertise which are relevant to this systematic review.

Christos Nikopoulos is a lecturer at the School of Health Sciences & Social Care, Brunel University. Having gained a BSc (Hons) in occupational therapy, Christos holds a DPhil in psychology, investigating the use of video modeling as a behavioral analytic procedure in autism treatment.

He has gained international experience in working with children with autism which has resulted to numerous publications (including an authored book on autism) as well as the delivery of keynote speeches at national and international conferences. Particularly, his current research on video modeling with individuals with autism is at the forefront of research and development in this area. His research activities resulted in gaining the award of Chartered Scientist from the Science Council. He is also a scientific advisor for the Research Autism charity and guest reviewer for the Journal of Autism & Developmental Disorders, ESRC, EPSRC as well as for the Health & Social Care Research & Development Function of the Public Health Agency (HSC R&D). Due to his extensive experience in Autism Spectrum Disorders (ASD), use of video technology in the treatment of individuals with ASD, database searching, supervising research students who have carried out systematic reviews as well as in single-subject experimental methodologies he will be able to substantially contribute to all required tasks (e.g., content, methodology; statistics in relation to the aforementioned research methodologies).

Panagiota Nikopoulou-Smyrni is an Occupational Therapy lecturer at the School of Health Sciences & Social Care, Brunel University, who holds a PhD in Health Informatics. She is acting as a European Expert Evaluator for the FP7- ICT for Health Call 7 as well as a Reviewer for the Cochrane Collaboration.
Following 20 years of practice as a clinician and academic specialized in neurological and developmental disorders, Panagiota has obtained extensive experience, amongst other, in:

i) developing and implementing developmentally supportive care programs in several private schools, in early intervention centers, as a home-based occupational therapist, and in clinical settings;

ii) implementing assessment and treatment plans of school-aged children with diagnoses varied from learning disabilities to autism;

iii) incorporating information technology, adaptive programs and equipment, remediation techniques, and compensatory strategies in educational and rehabilitation settings for individuals across the life-span;

iv) supervising research students who have carried out systematic reviews.

She will be able to contribute to all required tasks (e.g., content, search strategy; select trials; extract data from trials; carry out analysis; interpret analysis).

Karola Dillenburger is Professor at the School of Education at Queens University Belfast and Director of Centre for Behaviour Analysis and of the Queen’s University Autism Research and Treatment (QUART) She co-ordinates the MScASD. Prof Dillenburger is a Clinical Psychologist (HPC) and Board Certified Behavior Analyst-Doctoral. She has written extensively in the area of ASD, intervention, education, parenting, diagnosis and psychological trauma, including 5 books and over 50 academic and practice papers. She is invited regularly to present keynote addresses at national and international conferences and has held Adjunct Professorships in USA and Germany. She has reviewed for Cochrane Collaboration, many key journals, and most major funders (e.g., ESRC, Leverhulme etc).

Prof Dillenburger will contribute leadership, editorial, managerial, and review functions.

**PRELIMINARY TIMEFRAME**

Approximate date for submission of Draft Protocol (please note this should be no longer than six months after title approval. If the protocol is not submitted by then, the review area may be opened up for other reviewers):

By the end of 2012
APPENDIX A

Examples of particular skills

Self-Help Skills:
- *Eating* (drinking from a cup, eating with a spoon or a fork, using a napkin etc.)
- *Dressing* (taking off/putting on socks, pants, trousers etc., fastening and unfastening zippers, buttons, tying shoes etc.)
- *Toileting* (requesting to use the bathroom, toileting independently etc.)
- *Hygiene* (washing hands or face, bathing etc.)

Language and Communication Skills:
- *Imitating vocalizations* (imitating sounds, words, phrases)
- *Following directions* (typically it concerns non-verbal behavior in response to spoken words such as following one-step, two-step, multiple-step directions; following directions involving objects, illustrated directions, written directions etc.)
- *Making requests* (pointing to desired items, requesting preferred items, seeking out a communicative partner, asking for help, asking for information etc.)
- *Labeling* (objects, people, places, actions, environmental sounds, emotions, colors, numbers, letters, possession etc.)
- *Conversation* (completing word associations such as animal noises or associated objects, completing songs and nursery rhymes, answering Wh-questions, answering social questions such as questions about personal information, family, school, preferences or emotions, reciprocating information etc.)

Socially Relevant Skills:
- *Orienting to social stimuli*
- *Acknowledging facial expressions*
- *Responding to another’s distress*
- *Communicating through gaze*
- *Initiating social interactions* (efforts to stop another person’s action, obtaining permission from another person to participate in an activity, acquiring objects, directing the attention of another person, gaining specific information or clarification, general initiations to engage in social contact etc.)
- *Establishing joint attention with others*
- *Using appropriate greetings*
- *Responding to conversational humor*

Play Skills:
- *Simple social games*
- *Construction play*
- *Pretend play with or without another person*
- *Simple board games*
- *Simple card games*
- *Sports and physical play*
- **Music and singing**

**Disruptive and Self-stimulatory Behaviors:**
- **Self-injury**
- **Physical aggression**
- **Verbal aggression**
- **Non-compliance (i.e., failure to follow simple verbal instructions)**
- **Disruption of the environment**
- **Inappropriate vocalizations**
- **Stereotypes**
- **Self-stimulatory behaviors**