Development of Robot-enhanced Therapy for Children with Autism Spectrum Disorders

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DREAM

Development of Robot-enhanced Therapy for Children with Autism Spectrum Disorders

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D7.1 Robot Ethics Manual

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Responsible Person: **Kathleen Richardson**

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Dissemination Level		
PU	Public	**PU**
PP	Restricted to other programme participants (including the Commission Service)	
RE	Restricted to a group specified by the consortium (including the Commission Service)	
CO	Confidential, only for members of the consortium (including the Commission Service)	

Contents

Executive Summary

Deliverable D7.1 in DREAM project [Development of Robot-enhanced Therapy (RET) for Children with Autism Spectrum Disorders] is developed in order to conceive a Robot Ethics Manual, which will be used by project partners for guidance in the process of enhancing the technological tools for assisting children with autism spectrum disorders (ASD) The manual features all relevant legislation on good practice when working with children, working with children with special needs and developing safe robots for human use.

This deliverable is important as it will integrate the ethical practices of the technical and social aspects of robot design and robot-enhanced therapy. The Robot Ethics Manual is based on activities in WP1 (Clinical Framework), and deliverables 1.1 (Intervention Definition), 1.2 (Robot Behaviour Specification) and 1.3 (Child Behaviour Specification) and also on WP3 (Systems Engineering) and deliverables 3.1 (System Architecture), 3.2 (Software Engineering Standards) and 3.3 (Quality Assurance Procedures). This manual outlines existing legislation and professional practice that can be useful in designing and developing the technological tools for robot-enhanced therapy and draws on national and international codes of conduct for human-robot interactions.

Deliverable 7.1 is included in Task.7.1 Ethics Coordination Activity led by DMU and developed with input from HIS, VUB, UBB, PLYM, PORT and ALD partners during M1-M12. Task 7.1 includes also the development of an Ethics Committee. The Ethics Committee is composed of experts in the field of Robotics, Autism and Ethics and will act as the external reference point for all ethics activity and coordination. The Ethics Coordination Activity contributed to producing this Ethics Manual for use through all stages of the project.

Robot Ethics is WP6 of DREAM and is developed in conjunction with input from HIS, VUB, UBB, PLYM, PORT and ALD partners during M1-M12 and implies: a. ethics coordination activity; b. ethics committee; c. ethics manual.

Principal Contributors

Paul Baxter, University of Plymouth
Tony Belpaeme, University of Plymouth
Erik Billing, University of Skövde
Mark Coeckelbergh, De Montfort University
Daniel David, Babes-Bolyai University
Cristina Pop, Babes-Bolyai University
Kathleen Richardson, De Montfort University
Serge Thill, University of Skövde
Bram Vanderborght, Vrije Universiteit Brussel
David Vernon, University of Skövde
Tom Ziemke, University of Skövde

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I. Autism spectrum disorder – general features

Autism Spectrum Disorder (ASD) is characterized by characterized by widespread abnormalities in social interactions and communication, as well as severely restricted interests and highly repetitive behaviour (American Psychiatric Association, 2013). These core symptoms emerge early and persist in development and most individuals with ASD require professional care throughout their lives (Howlin, Goode, Hutton, & Rutter, 2004; Mordre et al., 2012). The diagnostic criteria for ASD included in the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5) (American Psychiatric Association, 2013), refer to Autism Spectrum Disorder as a single diagnosis category. More specific, the criteria refers to deficits into two categories: (1) Social Communication domain and (2) Restricted, repetitive patterns of behavior, interests, or activities. In terms of assessment and diagnostic process, ASD children are identified based on the behavioral phenotype, *Autism Diagnostic Interview-Revised* (ADI-R) (Lord, Rutter, & Le Couteur, 1994) and *The Autism Diagnostic Observation Schedule* (ADOS) (Lord, Rutter, Goode et. al., 1989) being used by researchers and academic centers as golden standards (D1.1:David et al., 2014).

Currently, no biological marker is identified and causal mechanisms are not well understood and/or integrated into a rigorous etiopatogenetic theory, although several hypotheses have been advanced. For example, *Empathizing-Systemizing (E-S) Theory* of psychological sex differences, proposed by Baron-Cohen, (e.g., Baron-Cohen, 2009; Baron-Cohen, Knickmeyer, & Belmonte, 2005), which states that human males have stronger systemizing tendencies (i.e., analyzing a system in terms of the rules that govern it, in order to predict its behavior) compared to females, who exhibit stronger empathizing tendencies (i.e., the drive to identify another's mental states and to respond to them appropriately)(D1.1:David et al., 2014).

Several theories try to explain why children with autism prefer to interact with technological tools. One of them, the Theory of Mind (TOM) (Baron-Cohen, 1997) explains that children with autism tend to have difficulties in identifying the mental states of others (e.g., beliefs, desires, intentions, imagination, emotions) that may cause some difficulties in interacting with others (Baron-Cohen (1997). Consequently, it can be very hard for them to understand social human-human interactions and thus, they prefer technological tools in order to simplify their interactions and make it more predictable.

II. Robot-enhanced psychotherapy

Taking into account that some autism specialists propose that ASD patients tend to learn more from interaction with technology rather than from the interaction with human beings, robots might have the potential to be used in ASD therapies as mediators between human models and ASD patients (see David, Matu, & David, 2014). The choice for a robot-mediated approach to psychological intervention for ASD children is justified by several advantages: 1) Children with ASD are more responsive to feedback, when administered via technology rather than a human (Ozonoff, 1995); 2) The anthropomorphic embodiment of the robot offers human like social cues, while keeping at the same time object-like simplicity; 3) Robots can be programmed to gradually increase the complexity

of the tasks, by solely presenting relevant information; moreover, information can be repeated in the same format, without trainer fatigue; 4) Robots are predictable and, therefore, controllable, enable errors to be made safely and give possibilities to train a wide range of social and communication behaviours to prepare for real life exposition (D1.1: David et al., 2014).

In our studies we will use the Robo-Mediator approach (David, Matu & David, 2014), in this role the robot acts as an intermediary for the therapist and it enables faster and better gains from the therapeutic intervention as compared to the classical condition (therapist – child interaction). However, other studies have also shown the benefits of other nonhuman agents such as puppets (Trimingham 2010) and dogs (Solomon 2010). The robot acts as a necessary component in the process and without it the learning progress will be slower and maybe the treatment would attain poorer results. In our specific tasks, children with ASD might have a greater performance when it comes to abilities like: imitation, joint attention and turn taking when using the robot compared to standard interventions.

The core motivation for DREAM [Development of Robot-enhanced Therapy (RET) for Children with Autism Spectrum Disorders] is that technology helps significantly with therapeutic interventions in ASD. The clinical application of the DREAM project aims to investigate how children with ASD behave and how they perform when interacting with the Nao robot, compared to a human partner in an imitation task, joint attention task, and turn taking. These next generation RET systems will be able to (a) make therapy more effective, efficient, and less expensive, freeing up human resources (b) facilitate repeatable, consistent child-specific interventions, and (c) provide the therapist with reliable data for long-term quantitative diagnostic analysis.

III. Ethics in research – according to American Psychological Association's (APA) Ethical Principles of Psychologists and Code of Conduct

The American Psychological Association's (APA) Ethical Principles of Psychologists and Code of Conduct is intended to provide guidance for psychologists and standards of professional conduct that can be applied only to psychologists' activities that are part of their scientific, educational or professional roles as psychologists. These activities shall be distinguished from the purely private conduct of psychologists, which is not within the purview of the Ethics Code. The ethical principles cover issues which may be of interest for our project, such as: rights and confidentiality of research participants, informed consent to research, recording and data retention and sharing.

3.1 Rights and confidentiality of research participants: psychologists have a primary obligation and take reasonable precautions to protect confidential information obtained through or stored in any medium, recognizing that the extent and limits of confidentiality may be regulated by law or established by institutional rules or professional or scientific relationship. APA manual state that, that regardless of field, the authors are required to certify that they have followed these standards as a precondition of conducting their studies and publishing their articles in APA journals. For example “when researchers use case studies to describe their research, they are prohibited from disclosing confidential, personally identifiable information concerning their patients, individual or organizational

clients, students, research participants, or other recipients of their services" (APA Ethics Code Standard 4.07, Use of Confidential Information for Didactic or Other Purposes). Subject details should be omitted only if they are not essential to the phenomenon described. Subject privacy, however, should never be sacrificed for clinical or scientific accuracy. Cases that cannot adequately disguise identifiable subject information should not be submitted for publication." (APA Manual Publication, pp. 16).

3.2 Informed consent to research: "When obtaining informed consent as required in Standard 3.10, Informed Consent, psychologists inform participants about a. the purpose of the research, expected duration and procedures; b. their right to decline to participate and to withdraw from the research once participation has begun; c. the foreseeable consequences of declining or withdrawing; d. reasonably foreseeable factors that may be expected to influence their willingness to participate such as potential risks, discomfort or adverse effects; d. any prospective research benefits; e. limits of confidentiality; f. incentives for participation; and g. whom to contact for questions about the research and research participants' rights" (APA Manual Publication, pp. 234).

When conducting studies that involve use of experimental treatments it is necessary to clarify to participants the following: "a. the experimental nature of the treatment; b. the services that will or will not be available to the control group(s) if appropriate; c. the means by which assignment to treatment and control groups will be made; d. available treatment alternatives if an individual does not wish to participate in the research or wishes to withdraw once a study has begun; and e. compensation for or monetary costs of participating including, if appropriate, whether reimbursement from the participant or a third-party payer will be sought" (APA Manual Publication, pp. 234).

3.3 Recording: before recording the voices or images of individuals to whom they provide services, psychologists obtain permission from all such persons or their legal representatives. (See also Standards 8.03, Informed Consent for Recording Voices and Images in Research; 8.05, Dispensing with Informed Consent for Research; and 8.07, Deception in Research.)

3.4 Data retention and sharing: authors are expected to keep their raw data for a minimum of five years after publication of the research. "Other information related to the research (e.g., instructions, treatment manuals, software, details of procedures) should be kept for the same period; such information is necessary if others are to attempt replication and should be provided to qualified researchers on request. Before sharing data, delete any personally identifiable information or code that would make it possible to reestablish a link to an individual participant's identity. In addition to protecting the confidentiality of research participants, special proprietary or other concerns of the investigator or sponsor of the research sometimes must be addressed as well". (APA Manual Publication, pp.12).

IV. Public attitudes toward using robots

There were several attempts of measuring public attitudes toward robots. One of the most concluding is represented by the Special Eurobarometer published in 2012, which includes a section called "public attitudes toward robots" which investigates people beliefs regarding the use of robots in different contexts. The results of this survey are presented

below (Special Eurobarometer, pp. 382 -383): "EU citizens also have well-defined views about the areas where robots should be banned. Views are most emphatic when it comes to the care of children, elderly people and people with disabilities, 60% of EU citizens saying that this is an area where robots should be banned. There is also considerable opposition to the use of robots in the other more 'human' areas included in the survey: 34% of respondents believe robots should be banned in education, 27% are against the use of robots in healthcare and 20% oppose their use for leisure purposes. Less than ten percent oppose the use of robots in any of the other areas. Overall, ten percent of respondents spontaneously said that robots should not be banned in any of the areas listed."

These findings/attitudes may influence the use of social robots in different domains, such as children with disabilities elderly, etc. When it comes to the specific uses of robots for children with autism a different and more favorable pattern emerged. A recent survey (Coeckelbergh et al., under review) conducted by the DREAM team found that parents of children with autism responded favorable when they were asked 'are social robots in healthcare and for therapy for children with autism acceptable?'. Considering the discrepancy between the two surveys further investigations regarding the attitudes toward using robots with children with disabilities are required.

V. Legislation Safeguarding and Protecting Children

The DREAM team will follow European and International protocols of working with children with disabilities when conducting their studies with ASD children. The team will adhere to the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) which highlights that at all times persons with disabilities should be treated with care and respect. This concerns mostly the process of recruitment of the participants and the assistance provided during the experiments to persons with disabilities and their families. The British Psychological Society has provided good practice guidance for psychologists working with children and young people, which includes drawing on any specific national and international legislation regarding the Rights of Children. The project will abide by the UN Convention on the Rights of Child (http://www.unicef.org.uk/UNICEFs-Work/UN-Convention). The Convention compresses 54 articles that establish the body of all children's civil and political rights, as well as their economic, social and cultural rights. Of particular importance are the following articles:

5.1 The Rights of Children: central to our research are Article 3 (best interests of the child), Article 23 (children with disabilities) and *Article 41 (respect for better national standards)*.

Article 3 (best interests of the child): "The best interests of the child must be a top priority in all actions concerning children". Specifically, in our case we define the best interests as the child with ASD must at all times be a respected participant in the experiments that will be conducted in the DREAM project. The experiments conducted in this project involve a novel technology with a group of children that may show increased levels of distress. The psychologists and researchers responsible for conducting the experiments will develop some specific strategies in order to avoid increased level of stress in children. For example, a phase of 'habituation' for the child to the robot will be introduced before starting the targeted tasks. Following previous experiments where the

robot Probo was used, a similar format will be implemented (Pop., et al., 2012). These experiments took place in the clinical therapy room of the Autism Transylvania Association. The habituation phase lasted about 10 minutes and consisted in some enjoyable play activities which were promoted by the therapist between the child and the robot. Moreover we recommend the child should be allowed to leave the experiments if he/she shows an increased level of distress. And also we propose that all cases in which the child is disinterested in the robot to be accounted for in the results.

Article 23 (children with disability) "A child with a disability has the right to live a full and decent life in conditions that promote dignity, independence and an active role in the community. Governments must do all they can to provide free care and assistance to children with disability". Children are entitled to secure protection regardless of their abilities or disabilities and Article 23 of the UN Convention makes a priority that children with disability be respected at all times. As the children in the DREAM experiments are children with complex needs, special provisions need to be considered during the project to allow the child and their families to disengage with the project at any point. We propose that parents and caregivers have the opportunity to engage with the researchers and ask feedback regarding their child performance.

Article 41 (respect for better national standards) If the laws of a particular country protect children better than the articles of the Convention, then those laws must be followed. The DREAM team is a European wide project with four partner countries: Belgium, France, Romania, Sweden and the United Kingdom. The experimental parts of the project will be carried out by researchers from the Department of Clinical Psychology and Psychotherapy, Cluj-Napoca, Romania. In this manual we have outlined current legislation regarding the Rights of Children and the Rights of Children with Disabilities in reference to Romania. However, we advise that if partners intend to carry out experimental procedures using the robot NAO or other robots for robot-enhanced therapy national legislation to be consulted. In the United Kingdom for example, all adults working in close proximity to children have to undergo a Disclosure and Barring Service (DBS) check. It is up to the DREAM team to inform the Ethics Committee if any experiments are planned to take place other than in Romania so that national legislation for the protection of children can be consulted.

5.2 The Rights of Children with Disabilities: in Romania the project team will abide by the Country Report on Romania for the Study on member States' Policies for Children with Disabilities (http://www.europarl.europa.eu) and specific legislation in the children with disabilities be consulted before any experiments are carried out in the respective states. Moreover the psychologists who will implement the experiments will abide the Code of Conduct developed by National Board of Psychologists. Families need to provide full consent for their child to participate in any experiments.

5.3 Autism Advocacy: the ethics of DREAM will take into account social narratives of disability and difference and autism advocacy (Gibilisco 2011). The social model of disability and difference offers alternative explanations to the normative models of mental health, disability and difference, and are important viewpoints to understand human difference (Ochs and Solomon 2010, Grinker 2009). One such group is the Autistic

Self Advocacy Network (ASAN), a US based non-profit organisation seeking to do the following: 'ASAN believes that the goal of autism advocacy should be a world in which Autistic people enjoy the same access, rights, and opportunities as all other citizens. We work to empower Autistic people across the world to take control of our own lives and the future of our common community, and seek to organize the Autistic community to ensure our voices are heard in the national conversation about us' (Autistic Self Advocacy Network Website accessed January 2015).

VI. Legislation Safeguarding Humans Interacting with Robots

The robots used and developed in the DREAM project will follow international protocols on human safety. The experimental platforms developed in labs will conform to the International Standards of Health and Safety such as the EU Safety Requirements for Collaborative Robots and Applications (2014). Aldebaran Robotics provides a Best Practice document as guidelines to be followed by users of NAO. NAO Best Practice policy document must include further safety protocols for use by non-engineering professionals in psychotherapeutic contexts for children with autism.

6.1 European Guidance on Robot technologies: the Ethics Manual highlights the importance of International, European and National conventions on the protection and safeguarding of children, with additional guarantees for protection ensured by legislation protecting and safeguarding children with disabilities.

Robot Ethics is a related field of Machine Ethics that examines the specific ethical issues raised by new technologies (Lin, Abney and Bekey 2012). Machine ethics explores the applied uses of machines, especially in contexts that might depend on an advanced degree of judgment and sensitivity such as in a war or a medical situation (Anderson and Anderson 2011). Machine ethics is now emerging as a new subject area about how to incorporate ethical principles into the technology of machines as part of their functioning practices, so that the machines are able to carry out ethical acts in the applied domains in which they are situated. Robot Ethics will be discussed in detail in Deliverable D7.2 (Human-Robot Interaction) and D7.3 (Implementation of ethical constraints in the self-monitoring subsystem).

6.2 Legal codes regarding the safe testing of robots with humans: our team will refer to the recommended and the mandatory standards of all software developed in WP4, WP5, and WP6 (Deliverable D3.2 Software Engineering Standards pg. 23). The standards will include: GNU Coding Standards, Java Code Convention, C++ Coding Standard, The EPFL BIRG and Coding Standards, and the Doxygen User Manual (ibid). In addition the robots will be subject to rigorous tests enshrined in the codes of the *CE mark,* a mandatory conformity marking for certain products sold within the European Economic Area (EEA) since 1985 (Council Directive CE). In particular, CE directives 88/378/EEC (safety of toys) and 73/23/EEC (electrical equipment designed for use within certain voltage limits) are particularly relevant to the DREAM project and will be adhered to at all times.

VII. Data Protection and Privacy

As we are working with children's data, it is crucial that no images or personal details compromise the safety, dignity and security of the child. This should be a priority in the design of healthcare and assistive technologies (Coeckelbergh, 2010). Working within the current legislative framework is fundamental to all aspects of the work. This will ensure that children with autism are protected during all stages of the project.

The DREAM team will abide by European and national legislation of data protection and privacy. The DREAM team will develop the robot specifications of NAO to include the recording of visual, audio and sensory data that can be later accessed by the psychotherapist for analysis. The same material will also be circulated to the engineering and software partners for analysis and improvement of the hardware and software systems. As a result the child's data will be accessible to four member states: Romania, Sweden, Belgium, France and the United Kingdom. We propose a safe system for data transmission between the partners to be established that is protected via an encryption password system. We advise a very secure transference of the clinical information that the robot will collect as part of its activities in the *supervised autonomous* mode. We indicate the most relevant laws for data protection and privacy.

7.1 Data Protection: there are several documents regarding the way data should be protected, as it follows:

- The European Convention for the Protection of Human Rights and Fundamental Freedoms. Directive 2001/20/EC of the European Parliament and of the Council of 4 April 2001 on the approximation of the laws, regulations and administrative provisions of the Member States relating to the implementation of good clinical practice in the conduct of clinical trials on medicinal products for human use.
- Data Protection Directive (95/46/EC) of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data. This directive specifies a number of confidentiality and security safeguards for this and other interactive on-line services.
- Council Directive 83/570/EEC of 26 October 1983 amending Directives 65/65/EEC75/318/EEC and 75/319/EEC on the approximation laid down by law, regulation or administrative action relating to proprietary medicinal products.
- The Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects (art I.3 and I.4 related to the careful assessment of risks to the subject), and all articles of section III Nontherapeutic clinical research, related to the obligation for patients' informed consent and right to withdraw as well as to the safeguard of patient's dignity and personal integrity.
- The Data Protection Act (1988) and Data Protection Amendment (2003), Directive 2002/58/EC on Privacy and Electronic Communications (amending Directive 97/66/EC), regulating personal information protection across the telecommunications sector; ISO 13482:2014 for Robots and robotic devices - Safety requirements for personal care robots.

7.2 Privacy: is a core principle of the European Union. Communication and information technologies have reshaped many crucial principles and issues of privacy for citizens of Europe. We propose to follow the guidelines of the European Union (EU) and the Council of Europe (CoE) for the need to protect private data in digital formats.

With the entry into force of the Treaty of Lisbon in December 2009, the Charter of Fundamental Rights of the EU became legally binding, and with this the right to the protection of personal data was elevated to the status of a separate fundamental right. A better understanding of Council of Europe Convention 108 and EU instruments, which paved the way for data protection in Europe, as well as of the CJEU and ECtHR case law, is crucial for the protection of this fundamental right (Handbook on European data protection law pg. 3).

In our activities during the project we will follow the 'Council of Europe Convention 108: "Convention 108 applies to all data processing carried out by both the private and public sector, such as data processing by the judiciary and law enforcement authorities. It protects personal data, and seeks, at the same time, to regulate the transborder flow of personal data. As regards the collection and processing of personal data, the principles laid down in the convention concern, in particular, fair and lawful collection and automatic processing of data, stored for specified legitimate purposes and not for use for ends incompatible with these purposes nor kept for longer than is necessary. They also concern the quality of the data, in particular that they must be adequate, relevant and not excessive (proportionality) as well as accurate".

The DREAM team will follow relevant guidelines on the length of time that personal data can be held and propose a plan for the destruction of said data if appropriate. The personal data of participants combined with visual and audio data present the team with a crucial data strategy. Data used for experimental purposes will be secured for the duration of the project. The data can continue to be used beyond the project if the identifying features of the participants are anonymised. Therefore, study participants (caregivers of children with autism) must give explicit consent for any public use of the visual, audio or personal data. Ethics clearance will be required for all experimental stages of the project. As Robot-enhanced therapy is a new procedure of therapeutic investigation, extra considerations will be included in the long-term data protection and privacy.

7.3 Consent forms must be prepared giving precise description of the project, the intended goals and the use of data. Parents and caregivers of children with autism can withdraw their children at any point during the study with no personal ramifications to their entitlements for healthcare provision. A parent and/or caregiver are to be provided with the details of the Ethics Committee and can email the secretary at the committee at any time through the duration of the project. Special funds will be made available for translation if necessary. The Ethics Committee will act as an independent ombudsman to families and can be contacted at any point throughout the project if there are any issues or concerns regarding the nature of the experiments. Only correspondence directly relating to the project can be entered into with parents and or caregivers of children with autism.

VIII. Health and Safety

Robots are specialized technological equipment that must meet with recognized international, European and national standards of health and safety. The electrical parts of the system must be securely sealed behind a safe body, and any threats to the health of the child or adults removed. We offer to follow the health and safety guidelines proposed by Aldebaran robotics Best Practice Guide and other relevant legislation.

8.1 Procedures for operating robots: Aldebaran presents *a Best Practice Guide* for the safe use of NAO. We propose that all users of Aldebaran robots undergo a training procedure which includes the following:

- A Safe Area recommended at 60cm/25inch in all directions around NAO (this will be moderated specifically to the needs of the DREAM project – see below).
- Technical Operating Instructions for NAO (Aldebaran propose When turned off, the best position is to have NAO lying down on his back, with no cable plugged.)
- Precautions: take all necessary precautions to ensure that NAO will not be directly or indirectly damaged by its surroundings. Do not exert strong forces on NAO and protect it from falls. Do not make NAO walk on thick carpets or rugs, mattresses, clothes. NAO will move about properly if the floor is flat, hard and smooth. Do not block its sensors or introduce foreign objects into its body. Do not use NAO outdoors.
- Handling: if you need to handle or move NAO, it is best to hold it with both hands by the waist/torso. Do not pull it by the arms, legs or head.
- Water: do not expose NAO to any form of water as permanent damage may occur. In particular, if NAO switches from a cold environment to a warm one, condensation may occur on its surface or inside. In that case, let NAO dry before turning it on.
- Temperature: NAO is designed to function between 10 and 35 °C (50-95 F). Humidity: NAO is designed to function within 10% to 90% relative humidity.
- Electrical shock: do not attempt to disassemble or modify NAO, as this can cause malfunction/damage or result in electrical shock.
- Children and pets: do not let children or pets interact with NAO unsupervised.
- Storage: when not intending to use NAO for a long time, remove the battery and store it in a dry location, at temperatures between 0 and 45 °C (32- 113 F). Be aware that during storage, the battery will be subject to discharge. Also bear in mind that the charge capacity of the battery will decrease in time.
- Transport: the robot must always be transported in its original packing or in a specific suitcase sold by Aldebaran Robotics. Any other packing may damage the robot and void the warranty.
- Battery handling: do not expose the battery to temperatures above 45 °C (113°F). Protect the battery terminals from dust or foreign objects.
- Cleaning: clean NAO and charger with a soft, dry cloth only. Do not use solvents.
- Do not oil NAO's joints or other movable parts.
- Lithium-ion rechargeable batteries are recyclable. You can help preserve our environment by returning your used rechargeable battery to the collection and recycling location nearest you.

- For information regarding the AC adapter, please refer to the manual provided separately.

8.1.1 Safety

- Periodically examine the AC adapter for conditions that may result in the risk of fire, electric shock, or injury to persons (such as damage to the cords, blades, housing). In the event of such conditions, the AC adapter should not be used until properly replaced.
- The robot must be used only with the recommended AC adapter and battery. Use of another type of adapter and/or battery may result in malfunction and voids the warranty.
- If the external flexible cable or cord is damaged, it must be replaced or repaired only by the manufacturer, an authorized service agent or a similar qualified person in order to avoid a hazard.
- All material for fastening or packing purposes is not part of the robot and should be disregarded for children's safety.
- Do not handle damaged or leaking lithium ion batteries.
- There is a risk of explosion if the battery is incorrectly replaced. Replace only with an Aldebaran battery. Discard used batteries according to the manufacturer's instructions.
- The battery pack used in this device may present a fire or chemical burn hazard if mistreated. Do not disassemble heat above 60 °C (140 °F) or incinerate. Dispose of used battery promptly. Keep away from children. Do not disassemble and do not dispose of in fire.
- Do not drop the battery pack or place heavy object on it. Do not apply strong pressure or physical shock to the battery pack.
- In case of problems with your electrical power circuit, immediately unplug NAO's charger. Material cited from Aldebaran Robotics *Best Practice Guide* for operating NAO robots (http://doc.aldebaran.com/2-1/nao/practices.html).

8.1.2 Using other robots: other robots in addition to NAO can be used in the project if users follow the manufacturers or developers instructions in the first instance, and be adapted appropriately for the project. All robots will conform to the guidelines given in Legal codes regarding the safe testing of robots with humans (6.2) of this manual. A safety procedure must be in place to stop the robot in a case of emergency.

8.2 Procedures for working with children: to prevent injury to a human the robot must be operated by a trained adult. The DREAM project has specified a move away from the Wizard of Oz system to the supervised autonomy of the robot. Wizard of Oz implies a hidden controller from view who is specialized to operate the robot, while supervised autonomy relies on the robot carrying out autonomous actions. As more autonomy increases, ethical considerations will be aligned with these new developments. At present, NAO comes with an instruction manual and software on operating procedures and has been extensively used in schools across Europe and can be operated without professional robotics qualifications. If robots other than NAO are used, the same principles of safety for

human protection must be followed. Operating procedures for the robot must include the following:

8.2.1 Safe Area for human protection: includes a safe area for the robot. Aldebaran robotics guidelines propose a safe area is designated at 60cm/25inches of space around NAO to safely protect any child or adult from injury if the robot falls. With adult supervision a child may touch the robot and come into closer range than that given in the official guidelines offered by Aldebaran. Touch and close proximity play a significant role in therapeutic practices and will be encouraged if the child is comfortable with closer physical contact with the robot. In cases of emergency, supervising adults will have a procedure in place to close down the robot. If NAO is operating on a table surface, the area surrounding the robot should have safety barriers. The DREAM team has designed a custom made table for experiments to minimize these issues.

Additionally, the way you position NAO is important to prevent NAO from falling. As NAO is a robot that is liable to falls causing damage to the systems engineering, the effective use of NAO as an interactive agent is supported by its safe operation and interaction with a child, for example the child can easily knock the robot over, or the robot could fall on the child. Scenarios such as this, while possible, can be prevented with careful attention by the supervising adults and the above safety guidelines in place.

8.2.2 Electrical Standards and Procedures: the robot must adhere to International, European and National guides on the safe testing of electrical equipment. The users of NAO must pay special attention to the robot's wear and tear and if the robot's outer casing become damaged and the interior electrical systems exposed, we advise that the robot should not be used in such an instance. In such cases the robot should be returned to Aldebaran robotics for reparations. We also advise that no drinks or fluids be used in any room in which the robot is stationed and used for experimental practices. This will minimize any water damage or potentially fatal scenarios.

IX. Conclusion

The Robot Ethics Manual is created as a guide to support the DREAM team in carrying out experiments with robots and children with autism. The manual will serve as a guide that can be consulted as a document throughout the project. We advise new team members to read the document thoroughly as it is an ethical framework and brings together the different practices from computer science and engineering on the one hand, and psychology and psychotherapy on the other. The manual brings together an overview of these specific professional practices in relation to the therapeutic treatment of robots for children with autism.

In Deliverable D7.2 (Human-Robot Interaction) the Robot Ethics team will explore European citizens' concerns expressed in the EU Barometer Report on Robots that affective aspects of caregiving should be cautiously delegated to robots (EU Report on Public Attitudes to Robots). These themes will be extended in Deliverable D7.3 Implementation of ethical constraints in the self-monitoring subsystem.

The following guidelines are provided in this manual to act as an ethical aid to researchers in the DREAM project:

- Ensure all robots have met with European and International codes.
- Ensure the recruitment and participation guarantees the safety of participants at all times.
- The children have the right to leave the experiments at any point. As children with autism can display high levels of anxiety and distress, it is important to be observant for any additional distress experienced by the child.
- Consent forms will be given to parents of children before any research is conducted.
- Consent forms and personal data will be secured safety in password protected storage systems.
- Never leave a robot alone with a child or an adult without proper training provided.
- Video and audio data from the experiments will not be available to the public and only be used for academic purposes, unless explicit permission to use video or audio recordings is granted by parents.
- Parents and caregivers have the right to withdraw consent from the project at any time. They also have the right to disallow any recorded data and for all personal details to be deleted from the experimental database.
- A procedure should be in place for emergencies with the robot, such as a fall, or an electrical malfunction.
- A procedure should be in place for emergencies involving children with autism.
- An adult with recommended safety training needs to attend all sessions involving the child and the robot.

X. References

Anderson M and Anderson SL. (2011). "Introduction" in *Machine Ethics*, Anderson M and Anderson SL (eds). Cambridge, Cambridge University Press.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

American Psychological Association (2001) *Publication manual of the American psychological association* (6th ed.).Washington DC: American Psychological Association.

Baron-Cohen, S. (1997). *Mindblindness: An essay on autism and theory of mind.* MIT press.

Baron-Cohen, S. (2009). Autism: The Empathizing–Systemizing (E-S) Theory. *Annals of the NewYork Academy of Sciences, 1156*(1), 68-80.

Baron-Cohen, S., Knickmeyer, R. C., & Belmonte, M. K. (2005). Sex differences in the brain: Implications for explaining autism. *Science, 5749*(310), 819-823.

Coeckelbergh, M. (2009), "Personal robots, appearance, and human good: A methodological reflection on roboethics", *International Journal of Social Robotics 1*(3), 217–221.

Coeckelbergh, M., Pop, C., Simut, R., Peca, A., Pintea, S., David D, & Vanderborght, B. (2015) .A survey of expectations about the role of robots in robot-assisted therapy for

children with ASD: Ethical acceptability, safety, trust, sociability, therapeutic promises, and data protection. *Science and Engineering Ethics,* (under review).

David, D., Costescu, C., Dobrean, A., Liu, H., Matu, S., Szentagotai, A., Thill, S. & Vernon, D. (2014) D1.1 Intervention Definition, DREAM Project: Development of Robot-enhanced Therapy for Children with Autism Spectrum Disorders. (www.dream2020.eu).

David, D., Matu, S. A., & David, O. A. (2014). Robot-Based Psychotherapy: Concepts Development, State of the Art, and New Directions. *International Journal of Cognitive Therapy, 7*(2), 192-210.

Gibilisco, P. (2011). *Politics, Disability and Social Inclusion: People with different abilities in the 21st Century*. VDM Verlag Dr. Müller.

Grinker, R. (2009). *Isabel's world: autism and the making of a modern epidemic*. Thriplow: Icon.

Howlin, P., Goode, S., Hutton, J., & Rutter, M. (2004). Adult outcome for children with autism. *Journal of Child Psychology and Psychiatry*, *45*(2), 212-229.

Lin P, Abney K, Bekey G. (2012). "Introduction" In *Robot Ethics: The ethical and social implications of robotics*. Lin P, Abney K, Bekey G (eds.). Cambridge, MA: MIT Press.

Lord, C., Rutter, M., & Le Couteur, A. (1994). Autism diagnostic interview-revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders, 24*(5), 659-685.

Lord, C., Rutter, M., Goode, S., Heemsbergen, J., Jordan, H., Mawhood, L., & Schopler, E. (1989). Autism diagnostic observation schedule: a standardized observation of communicative and social behavior. *Journal of Autism and Developmental Disorders 19*(2), 185-212.

Mordre, M., Groholt, B., Knudsen, A. K., Sponheim, E., Mykletun, A., & Myhre, A. M. (2012). Is long-term prognosis for pervasive developmental disorder not otherwise specified different from prognosis for autistic disorder? Findings from a 30-year follow-up study. *Journal of Autism and Developmental Disorders, 42*(6), 920-928.

Ochs, E and O, Solomon. (2010). Autistic Sociality. *Ethos*, Vol. 38, Issue 1. pp. 69-92.

Ozonoff, S., & Miller, J. N. (1995). Teaching theory of mind: A new approach to social skills training for individuals with autism. *Journal of Autism and developmental Disorders, 25*(4), 415-433.

Pop, C. A., Simut, R., Pintea, S., Saldien, J., Rusu, A., David, D., & Vanderborght, B. (2013). Can the social robot Probo help children with autism to identify situation-based emotions? A series of single case experiments. *International Journal of Humanoid Robotics, 10*(03).

Solomon, O. (2010). What a dog can do: Children with Autism and Therapy Dogs in Social Interaction, *Ethos,* Vol. 38, Issue 1. pp. 69-92.

Special Eurobarometer 382 '*Public Attitudes Towards Robots'* Report September 2012.

Trimingham M. (2010@ Objects in transition: the puppet and the autistic child, *Journal of Applied Arts & Health*, Volume 1, Number 3 (15) pp. 251-265.

Useful Websites:
Aldebaran Best Practices, http://doc.aldebaran.com/2-1/nao/practices.html
Autism Advocacy, http://autisticadvocacy.org/
Council Directives CE,
http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31993L0068:en:HTML
Country Report on Romania,
http://www.europarl.europa.eu/RegData/etudes/etudes/join/2013/474430/IPOL-LIBE_ET%282013%29474430_EN.pdf
UNICEF, http://www.unicef.org.uk/UNICEFs-Work/UN-Convention