

On the Creation of a Persona to Support the Development of Technologies for Children with Autism Spectrum Disorder

Ana Leal¹, António Teixeira^{2,3}, and Samuel Silva^{2,3(✉)}

¹ University of Aveiro, Aveiro, Portugal
travessaleal@ua.pt

² DETI – Department of Electronics, Telecommunications and Informatics, University of Aveiro, Aveiro, Portugal
{ajst, sss}@ua.pt

³ IEETA – Institute of Electronics and Informatics Engineering of Aveiro, University of Aveiro, Aveiro, Portugal

Abstract. When developing technologies for persons with autism spectrum disorder (ASD) there are multiple aspects posing challenges to the community. First of all, there are several viewpoints at stake, from the targeted person to family and caretakers, needing careful consideration and yielding conflicting interests and motivations that need to be considered. Second, design and development teams often include people with a very diverse background, from psychologists to software engineers, who need to be able to fully communicate their knowledge and ideas regarding the users, and understand the different team viewpoints towards the best possible outcome. In this context, we argue that Personas (and in particular, families of Personas) can be a powerful tool to tackle these challenges. As a first stage of our work, we present the methods considered for the creation of a Persona for a 10 years old kid with ASD along with its full description. At this stage, the Persona has been evaluated by a panel of experts and was considered in the design of a first application prototype for children with ASD.

Keywords: Persona · User-centered design · Autism spectrum disorder · Children

1 Introduction

When developing technologies for persons with autism spectrum disorder (ASD) there are multiple aspects posing challenges to the community. First of all, there are several viewpoints at stake, from the targeted person to family and caretakers, needing careful consideration. Therefore, conflicting interests and motivations among those who will use (or supervise the use of) the proposed system need to be carefully tackled and articulated (Hendriks et al. 2015).

A second challenge concerns the multidisciplinary nature of the required intervention, gathering knowledge and views from psychology, education, therapy, signal processing and human-computer interaction (Odom et al. 2014; Porayska-Pomsta et al. 2012). This requires that different experts are able to communicate and discuss their

ideas using a shared language, fostering a better understanding of what is at stake. For example, technology developers often have a limited knowledge regarding the target impairment and, therefore, have trouble deciding how to balance the different interests and where to focus their approach. In this case, the knowledge and views of different stakeholders regarding the focused condition, contexts, intervention approaches, and technical aspects need to be discussed and put to practice in a tight collaboration effort.

Considering these challenges, we argue that Personas, especially considering approaches in line with those presented, e.g., in Queirós et al. (2013), can be very useful in tackling both a common language among elements of a multidisciplinary team, promoting a greater understanding of the targeted individuals and condition, and articulating the different motivations of stakeholders.

Despite that Personas are widely considered in the literature, in several domains, to the best of our knowledge no substantial use of this tool has been described in the context of technology development for people with ASD. Therefore, our main goal is to propose a family of Personas (Matthews et al. 2011), i.e., a group of Personas encompassing the various stakeholders (e.g., family, teachers), based on data gathered from the different stakeholders (e.g., parents, therapists, and children) and from studies regarding autistic children communication, aiming to be a complete and well supported base to develop technology for children with ASD. In this context, we argue that a simple list of user characteristics is not enough. An empathy needs to be created with the Persona to enable a greater understanding of what is at stake.

In the scope of Marie Curie IAPP project IRIS (Freitas et al. 2014), one of the main goals is enhancing communication among individuals, particularly targeting those with speech limitations. In this context, the targeted users include children with autism spectrum disorder (ASD), providing us the application scenario for our Persona proposal.

As a first step of our work, this article presents the methods and outcomes for the creation of the Persona of a 10 years old kid with ASD. Section 2 details the method for creation of the Persona and Sect. 3 presents the first version of the Persona and its evaluation by a panel of experts. Section 4 presents a brief example regarding how, starting from the proposed Persona, we can engage in design and development of a novel application. Finally, Sect. 5 presents some conclusions and ideas for future work.

2 Building the Persona

Personas are considered a powerful communication tool for how the potential users behave, think and want to accomplish. Despite being fictitious persons, they are defined through research and observation of characteristics, needs, behaviors, motivations and expectations of real people (Queirós et al. 2013).

Personas provide a common language, which facilitates the interdisciplinary dialogue, necessary to the development of applications for groups with specific characteristics, and help to determine the features that the product should include and how it should operate. Furthermore, it is a reality check tool, which allows the multiple intervenients to test and elect, during the development process, the best

design options. This also makes it possible to achieve more viable results at the time of testing with real users (Ferreira et al. 2013).

2.1 Method for Persona Creation

The proposed method was based on the methodology described by (Cooper et al. 2007) and (Queirós et al. 2013). First, to systematize the characteristics of children with ASD at a social interaction level, receptive-expression language, communication and adaptive behavior, several online searches were conducted using search engines, such as *Scopus*, *Web of Science*, *PubMed*, *Google*, and *ASHA*. Additionally, the research also included scientific books about ASD and specific studies on the communication skills of children with ASD in Portugal, resulting from previous work at our institution (Araújo 2009; Batista 2011; Pedro 2011; Reis and Teixeira 2012).

Secondly, in order to complement the retrieved information and obtain additional details regarding the daily routine of these children, we sought the opinion of experts in the field. Thereby, caretakers and professionals, whose work is mainly with ASD children, were contacted by *e-mail* and telephone.

Based on the collected information, a set of characteristics and the most important objectives to be included in the description of the Persona were defined and expressed in a small narrative about the Persona and his lifestyle.

3 Results – Persona and Its Evaluation

The main results of the work presented in this article are the full description of the Persona for a 10 years old kid with ASD and its evaluation by a panel of experts. Both outcomes are described in what follows.

3.1 Persona of Nuno Rocha

The following text includes the description of our first version of the Persona of Nuno Rocha, a 10 years old child with ASD. For the sake of simplicity and compactness, it already includes, underlined, information added as a result of the evaluation conducted with field experts (as described in Sect. 3.2).

Nuno Rocha, born on February 20th, 2005 in Moita, Anadia county, Aveiro district, Portugal, lives with his father, mother and a 13 year old sister. At the age of 2 he went to a development appointment in the district hospital, because his parents suspected that something was wrong with his development, where we was, posteriorly, sent to an autism exam to the Pediatric Hospital of Coimbra. At the age of 3, he was diagnosed with Autism Specter Disturbance (level 2 in the scale of severity), with associated cognitive deficits.

He currently attends the 4th grade in Anadia's Basic School, were he benefits from a UEE support that delivers him a structured learning model (TEACCH) and the application of interdisciplinary intervention methodologies. It is in the school context that he also benefits from Speech Therapy sessions.

Nuno is a student with a specific individual curriculum (that consists of changes to the normal curriculum, mostly consisting on the introduction, substitution and/or elimination of goals and contents). On a daily basis, for 2 h, he attends the regular class, and the goal is to work in the

social sense, whereas functional classes (like functional Portuguese, world knowledge, functional math and every day activities) are learned at the unit.

At home, he prefers to watch TV and play computer games, so when he is asked about the professional preferences, he mentions he would like to stay at home with his mother and watch TV or play computer games.

He appears to dominate the basic functions of a computer; however, he only uses his ability to play computer games. He is not able to research information on any search engine, nor does he use the social networks for communication.

He appears to understand simple oral material, specifically words or sentences related with his social and familiar day-to-day. On the other hand, difficulties are observed on the comprehension of longer sentences that lack visual support or that are out of the context.

The elected mean of communication is speech. [He is mostly capable of using short and simple sentences (subject + verb + object). As far as it concerns reading, he recognizes all the letters from the alphabet, but he seems to struggle on the reading process, mostly syllabic, associated to a loss of purpose and hesitations]. He writes with orthographic correction but he needs support on the structuring of small texts and in answering questions. He also presents difficulties using markers and morphosyntactic constituents by omitting link words, such as prepositions, along with difficulties in number/gender agreement for definite articles. He also has trouble in matching the verbal form with the personal pronoun (e.g., "I does"). He makes requests in his areas of interest, and when questioned he has difficulties in answering, sharing daily experiences, and beginning and keeping a conversation. He shows difficulties in keeping eye contact, respecting interaction shifts and adjusting to the context and to the interlocutor. In some situations, he verbalises incoherent phrases and out of context (delayed echolalia).

In the school context, when he does not recognize his surroundings, he walks front and forward, not addressing the employees for help. [He gets anxious every time his routine is changed or when he's thwarted, presenting inappropriate and sometimes aggressive behaviors, as yelling, pinching, and biting whoever is around].

He shows attention/concentration deficit, namely failing to pay attention in the classroom, which leads him to easily demotivate if the proposed activity is not of his interest.

Regarding the daily routine activities (such as dressing and personal hygiene), usually he is able to conclude them with autonomy, requiring, from time to time, supervision to accomplish their sequence.

Motivation: *Nuno would like to be more autonomous using social networks to communicate. Plus, we would like to be able to share with his parents the activities that he does in school through the day.*

The motivation is also an important part of the Persona as it sets what are the main long term goals at stake, providing guidelines to the Persona's expectations that would potentially have a greater impact and receptivity, if attended.

3.2 Persona Assessment by Field Experts

According to Cooper et al. (2007), the data that is included in the Personas' description should mainly be collected through the observation of the potential users in real context and by conducting interviews based in ethnographic techniques. However, in this first stage of our study, due to time constraints, and agenda of the intervenients, the information used in the creation of the Persona was based in the information available in the literature and in the experts' opinion. This way, in order to assess the adequacy of the statements included in the description, as well as the necessity to include or remove some data, a validation questionnaire was considered, and presented to a panel of experts.

3.2.1 Persona Assessment by Field Experts

The validation questionnaire was divided into two parts. In the first, we gathered data to characterize the selected experts regarding age, gender, profession, academic status, number of years as a professional, school/institution where they develop their activities, research topics of interest, and number of scientific publications in the area. The second part was designed to collect information concerning the experts’ overall opinion about the whole Persona and regarding each of the statements included in its description, concerning their plausibility, representativeness, and adequacy to real life situations. The overall opinion about the Persona could be expressed, by the experts, using a five level Likert scale (very good, good, reasonable, bad, and very bad). For the detailed assessment of each of the statements included in the Persona, 11 questions were formulated, and the answers to those questions were obtained considering a three level Likert Scale (I disagree, I do not agree or disagree, I agree). The study’s objective and contextual information were provided on the first page of the questionnaire. The anonymity and confidentiality of the data were guaranteed.

Concerning the selection of the experts’ sample, a non-probabilistic sample method was used, by convenience/accident (Fortin 1999). Therefore, five experts were contacted, three Special Education Teachers and two Speech Therapists who were working at a structured teaching unit for ASD students. The average age was 37 years and the average practice was about 12 years. None of the experts had research or publications on the subject. At this stage of the investigation, these professionals were considered the most suited to provide a first validation regarding the issues under study due to their close relationship with these children.

Qualitative data, provided by the experts, were analyzed and allowed to make minor adjustments to the contents of the described Persona.

3.2.2 Evaluation Results

By analysing the experts’ answers, it was observed that, overall, the description of the Persona was evaluated as “Very Good” by 40 % of the experts, “Good” by 20 % and “Reasonable” by 40 % (see Fig. 1). It was also observed that in 70 % of the situations the experts agreed with the included statements and they maintained a neutral opinion in 23.3 % of the situations, only disagreeing with 6.7 % of the cases (Fig. 2).

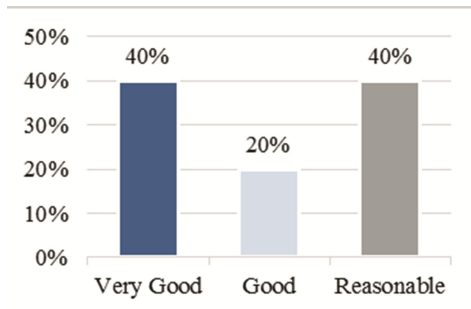


Fig. 1. Experts’ opinion on the statements included in the Persona Description.

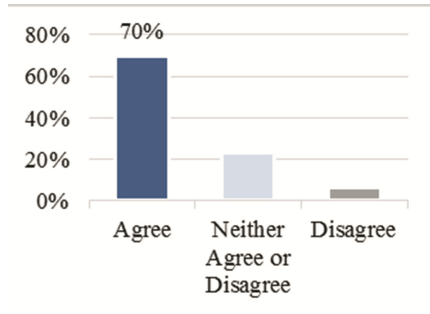


Fig. 2. Global evaluation of the proposed Persona.

In the disagreeing situations, participants did not always provide a suggestion on how to improve. In fact, only one expert from the panel suggested that a more detailed characterization of the children’s speech should be provided, more specifically concerning the type and structure of the sentences they use, and showing examples of the types of behavior they have. The changes resulting from expert suggestions are underlined in the Persona description for Nuno Rocha.

As can be observed from the presented results, the experts expressed a positive opinion regarding the overall contents of the Persona description and mostly agreed with the particular characteristics described for Nuno. Including the improvements suggested by the experts, the Persona was considered for the design and development of a first prototype of an application for children with ASD, as described in the following section.

4 Application Example

The advances in technology and informatics opened a new world filled with communicative possibilities and information access, potentially yielding a helpful tool to all children with special educative needs. The information and communication technologies increasingly allow these children in schools, making the whole educational process easier, and the goal being the integral education (Liu et al. 2007; Williams et al. 2006). Sometimes the solution for the barriers that the ASD children find is an accessible educative resource. Therefore, given their unique characteristics and their functional limitations to the conventional means, the development of applications based on tools that ease the specifications of their characteristics, necessities, and interests is fundamental.

To illustrate how the proposed Persona can serve as grounds for technology development targeting children with ASD, we briefly present the steps that need be taken to develop a novel application starting from the Persona of Nuno. This example is extracted from our ongoing work considering the scope and goals of project IRIS (Freitas et al. 2014) and supported initial development work as described in (Vieira 2015).

4.1 Context Scenario

The context scenarios describe how an application may be used in a certain context and for a certain period of time (Queirós et al. 2013). In this specific context scenario a story is described in which Nuno's Persona is able to recreate his day-to-day routine at school and improve his communicating and learning capabilities, by using a special application previously installed in a tablet. The scenario also provides a description of the surrounding environment that needs to be explored, the information requirements that need to be incorporated in the application, and the functional and interaction requirements.

Nuno just finished an activity he was performing during speech therapy and he would like to take a picture to keep it and share the moment. To do so, he only needs to access the system and touch the icon corresponding to the camera, available on the main menu. The system takes the picture and saves it automatically.

*Then, the system exhibits the editing menu, where Nuno has the chance of associating an emotion to the picture, add a little informative text about what he has been doing in the speech therapy class, and share the picture in his diary. The diary shows the information by its occurring order, as well as the day and hour of the entry. Using a mobile gadget and accessing their Facebook accounts, **Nuno's parents and friends may view the shared pictures**, therefore knowing all the activities Nuno is doing through the school day, as well as the interdisciplinary team elements that intervene.*

*Shortly after, Nuno heads to the Special Teaching Unit and when he consults his schedule he realizes that his next activity consists in solving math exercises. Knowing that this is an activity that Nuno does not like, the teacher recurs to a quiz game, available on the main menu, which is meant to make this activity more likeable and obtain a bigger motivation and participation from Nuno in the execution of the proposed tasks. Using another device, the **teacher defines the questions and the answering options and sends them to Nuno's tablet**. He chooses the option and the system informs if the option is correct or incorrect.*

When he finishes his math exercises, Nuno decides to consult his diary. The picture he shared concerning the speech therapy class has a comment from his mother, in which she congratulates him for his work. Nuno reacted with happiness and asked the teacher for help so he could reply to his mother comment.

The context scenario contains a set of elements that are worth of note. First, it contains a set of actions (a selected set is underlined in the text) that are very important for identifying the functional requirements for the envisaged application. Second, it identifies activity from other important actors (e.g., the teacher, as depicted in bold face) making it clear that the application will also serve third parties for particular actions. These other actors will have their profile and motivations that need to be considered and their identification further emphasizes the importance of our long term goal of proposing a family of Personas for developing technology for children with ASD. In the particular case of this context scenario, having a Persona for the teacher (and parents) would be one important asset and is part of our ongoing work.

4.2 Main Requirements

In line with the context scenario, the application was projected to minimize the difficulties that ASD children present in describing whatever concerns their daily activities, to promote their reading and writing skills, to develop their ability to handle different

emotions, to simplify their access to social networks, and facilitate information sharing between care-takers and the professionals from the interdisciplinary team.

The list of requirements to incorporate in the application’s prototype was based on the characterization of the potential users and on the context scenario description. Thus, the system must allow: (1) picture taking; (2) automatically saving the pictures; (3) eliminating pictures; (4) picture editing; (5) picture sharing, on a diary; (6) showing the information by order of entry; (7) registering others’ information; and (8) accessing all the information shared on his diary with others. The system must also: (9) avoid information overload by presenting only a few possibilities to choose from, at each time; (10) be user-friendly; (11) use simple, everyday words; (12) use easily recognizable icons; and (13) allow customization.

4.3 Conceptualization Using Application Mockups

The conceptualization and specification process of the application was structured based on the requirements, in order to be able to respond to the target audience specificities and necessities. Figure 3 shows some examples of the proposed interface mockups that were initially presented to the various team elements for discussion. During the discussions concerning the definition of requirements and the design of the application all intervenients were asked to continuously consider the Persona of Nuno Rocha.

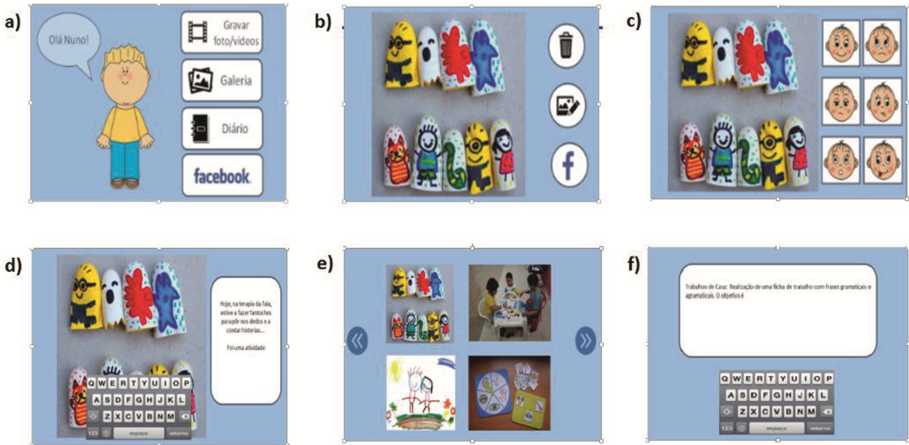


Fig. 3. Examples of user interface mockups for the application: (a) main menu; (b) editing menu; (c) “assign an emotion” section; (d) “add a description” section; (e) “my pictures” section; and (f) “notepad” section.

At this moment, the first version of the applications prototype is under development. Figure 4 depicts two of the interfaces already developed, enabling the user to login into the application prototype.

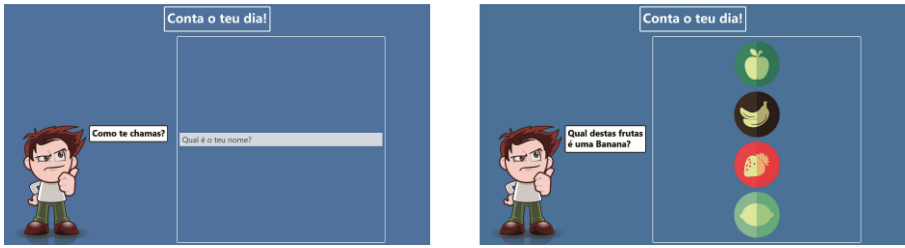


Fig. 4. Screen capture for two login alternatives available in the application prototype: left, insert name; and right, choose the correct fruit.

One of the login screens presented in Fig. 4, asking the user to select a fruit, is actually the support to one of the aspects we wish to explore in the future. As described in the Persona, Nuno has difficulties in keeping eye contact. Since eye tracking is becoming an affordable technology to use in everyday interaction (Vieira et al. 2015), we wish to explore how this new technology can be harnessed to help children with ASD, not only for interaction, but also potentially contributing to the development of a more social behavior. In the particular case of the login screen presenting the fruits, the child can answer by simply looking to the correct fruit. Based on the assessment of the usage results we acquire from this feature, which will enable us to evaluate the receptivity and utility of eye tracking in this context, we will then move to more advanced uses of the technology inside the application. This also serves to highlight how the Persona can provide a clear and powerful insight into user characteristics with an impact on design and development.

5 Conclusions

In this article we argue that in the scope of technology development for children with ASD, families of Personas can play an important role in fostering the dialog among multidisciplinary team members and in balancing the motivations of different stakeholders. As a first step of our work, we present a first version of a Persona for, Nuno Rocha, a 10 years old kid with ASD. From the analysis of experts' responses to the validation questionnaire, we found that the description of the Persona was not challenged, overall, and improved in a few details. Although there were some disagreements concerning some aspects, the experts did not offer any suggestion for its improvement. In future evaluations, as we keep evolving the proposed Persona, it may be interesting to further explore the reasons for these disagreements, maybe by conducting the questionnaire in a conversation, leading to a more detailed discussion.

In line with our initial idea that Personas would be a valuable communication instrument among the different stakeholders, we observed that to be true, since it already fostered the communication, validation, and understanding of the characteristics of Nuno, the proposed Persona, involving teachers, speech therapists, and software engineers.

Considering that the long term goal of our work is the creation of a “family of Personas”, as suggested in the methodology proposed by Matthews et al. (2011), six other people were identified (mother, father, sister, special education teacher, speech therapist, and regular teaching teacher), representative of the individuals who establish a direct connection with Nuno’s Persona, and playing an important role in the interactions with the application. For each of these, a Persona will be researched and built, using a similar methodology as the one considered for the Persona presented in this article. This will enable the definition of their different characteristics and motivations, and will be a first step towards their balancing when developing technologies for children with ASD.

Acknowledgements. The work presented in this chapter has been partially funded by IEETA Research Unit funding (Incentivo/EEI/UI0127/2014) and Marie Curie IAPP project IRIS (ref. 610986, FP7-PEOPLE-2013-IAPP).

References

- Araújo, J.: *As Perturbações do Espectro do Autismo na Região Autónoma da Madeira*. Master Speech and Hearing Sciences, DETI/DLC/SACS, Universidade de Aveiro (2009)
- Batista, J.: *O Perfil do Terapeuta da Fala em Portugal*. Master Speech and Hearing Sciences, DETI/DLC/SACS, Universidade de Aveiro (2011)
- Cooper, A., Reinmann, R., Cronin, D.: *About Face 3: The Essentials of Interaction Design. Information Visualization*, vol. 3. Wiley Publishing, Inc, Indianapolis (2007). doi:[10.1057/palgrave.ivs.9500066](https://doi.org/10.1057/palgrave.ivs.9500066)
- Ferreira, F., Almeida, N., Rosa, A.F., Oliveira, A., Casimiro, J., Silva, S., Teixeira, A.: Elderly centered design for interaction – the case of the S4S medication assistant. In: 5th International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-exclusion, DSAI (2013)
- Fortin, M.-F.: *O Processo de Investigação: Da concepção à realização*. Lusociência, Loures (1999)
- Freitas, J., Candeias, S., Dias, M.S., Lleida, E., Ortega, A., Teixeira, A., Orvalho, V.: The IRIS project: a Liaison between industry and academia towards natural multimodal communication. In: *Proceeding Iberspeech*, pp. 338–347. Las Palmas de Gran Canaria, Spain (2014)
- Hendriks, N., Slegers, K., Duysburgh, P.: Codesign with people living with cognitive or sensory impairments: a case for method stories and uniqueness. *CoDesign* **11**(1), 70–82 (2015). doi:[10.1080/15710882.2015.1020316](https://doi.org/10.1080/15710882.2015.1020316)
- Liu, Y., Cornish, A., Clegg, J.: ICT and special educational needs: using meta-synthesis for bridging the multifaceted divide. In: Shi, Y., van Albada, G.D., Dongarra, J., Slood, P.M. (eds.) *ICCS 2007, Part IV*. LNCS, vol. 4490, pp. 18–25. Springer, Heidelberg (2007)
- Matthews, T., Whittaker, S., Moran, T., Yuen, S.: Collaboration personas: a new approach to designing workplace collaboration tools. In: *SIGCHI Conference on Human Factors in Computing Systems*, pp. 2247–2256 (2011). doi:[10.1145/1978942.1979272](https://doi.org/10.1145/1978942.1979272)
- Odom, S., Thompson, J., Hedges, S., Boyd, B., Dykstra, J., Duda, M., Bord, A.: Technology-aided interventions and instruction for adolescents with autism spectrum disorder. *J. Autism Dev. Disord.* **1**, 1–15 (2014). doi:[10.1007/s10803-014-2320-6](https://doi.org/10.1007/s10803-014-2320-6)
- Pedro, M.J.N.: *O Terapeuta da Fala e o Autismo*. Master Speech and Hearing Sciences, DETI/DLC/SACS, Universidade de Aveiro (2011)

- Porayska-Pomsta, K., Frauenberger, C., Pain, H., Rajendran, G., Smith, T., Menzies, R., Lemon, O.: Developing technology for Autism: an interdisciplinary approach. *Pers. Ubiquit. Comput.* **16**(2), 117–127 (2012). doi:[10.1007/s00779-011-0384-2](https://doi.org/10.1007/s00779-011-0384-2)
- Queirós, A., Cerqueira, M., Martins, A.I., Silva, A.G., Alvarelhão, J., Teixeira, A., Rocha, N.P.: ICF inspired personas to improve development for usability and accessibility in Ambient Assisted Living. *Procedia Comput. Sci.* **27**, 409–418 (2013). doi:[10.1016/j.procs.2014.02.045](https://doi.org/10.1016/j.procs.2014.02.045)
- Reis, R., Teixeira, A.: Morphosyntactic analysis of language in children with autism spectrum disorder. In: Caseli, H., Villavicencio, A., Teixeira, A., Perdigão, F. (eds.) *PROPOR 2012*. LNCS, vol. 7243, pp. 35–45. Springer, Heidelberg (2012)
- Vieira, D.: Enhanced multimodal interaction framework and applications. Dep. of Electronics, Telecommunications and Informatics, MSc thesis, Univesity of Aveiro (2015)
- Vieira, D., Freitas, J.D., Acartürk, C., Teixeira, A., Sousa, L., Silva, S., Dias, M.S.: Read That Article: Exploring Synergies between Gaze and Speech Interaction, pp. 341–342 (2015). doi:[10.1145/2700648.2811369](https://doi.org/10.1145/2700648.2811369)
- Williams, P., Jamali, H.R., Nicholas, D.: Using ICT with people with special education needs: what the literature tells us. *Aslib Proceeding* (2006). doi:<http://dx.doi.org/10.1108/00012530610687704>