

# VITHEA-Kids: A Platform for Improving Language Skills of Children with Autism Spectrum Disorder

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## ABSTRACT

In this work, we present a platform designed for children with Autism Spectrum Disorder to develop language and generalization skills, in response to the lack of applications tailored for the unique abilities, symptoms, and challenges of the autistic children. This platform allows caregivers to build customized multiple choice exercises while taking into account specific needs/characteristics of each child. We also propose a module for the automatic generation of exercises, aiming to ease the task of exercise creation for caregivers.

## Categories and Subject Descriptors

K.3.1 [Computer Uses in Education]: Computer-assisted instruction (CAI); K.3.1 [Computer Uses in Education]: Computer-managed instruction (CMI); K.4.2 [Social Issues]: Assistive technologies for persons with disabilities.

## General Terms

Human Factors

## Keywords

Autism Spectrum Disorder, language skills development

## 1. INTRODUCTION

Autism Spectrum Disorder (ASD) is characterized by impairments in social communication and interaction, sometimes coupled with difficulties in the acquisition of language. Research indicates an interest from autistic children towards computers, leading to the development of several applications aiming to teach academic skills [3]. However, such applications are often paid, are not available in Portuguese (our target language), do not have in mind the individual needs nor the progress of each child, and/or do not allow for caregivers to control the exercises' content. To tackle these issues, we present a platform that allows caregivers to develop customized exercises for their children to solve. In this paper, we describe its features, as well as our current focus: the automatic generation of exercises.

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## 2. VITHEA-KIDS

Our solution, VITHEA-Kids, is an extension of Virtual Therapist for Aphasia Treatment (VITHEA)<sup>1</sup> [1], an internationally awarded platform, designed for aphasia patients and therapists, which comprises two modules. The first, the patient module, contains a set of exercises, in which the patient needs to orally reply to a certain stimulus (e.g. name the object in an image or describe an action in a video); the answer is then recorded and matched to a set of one or more correct answers. An animated talking character utters the exercises and the feedback to the patient's answer (which is limited to "very good" or "try again"). If the patient fails the exercise, the correct answer is not provided. The second, the administration module, allows therapists to create and manage exercises, users and the multimedia resources to be used in the exercises, as well as to check each patient's information and exercise statistics.

Although VITHEA-Kids is based on the infrastructure of VITHEA, it makes use of a different type of exercises: multiple choice exercises, which target vocabulary acquisition and/or the improvement of generalization skills, and are often used in applications for children with ASD. These exercises are composed by a question, a stimulus (picture or text) and a set of possible answers (textual or pictures, respectively), in which only one of the answers is correct (see Table 1). Each exercise can contain from zero to four distractors, easing the task of creating several exercises with small variations in content and difficulty.

Table 1. Multiple choice exercise

Fields	Values
Question	Which image corresponds to this word?
Stimulus	Fork
Correct answer	
Distractors	  

VITHEA-Kids' caregiver module allows to manage the exercises described above, as well as to upload and manage image files, and create and manage users. Unlike VITHEA, it allows for the

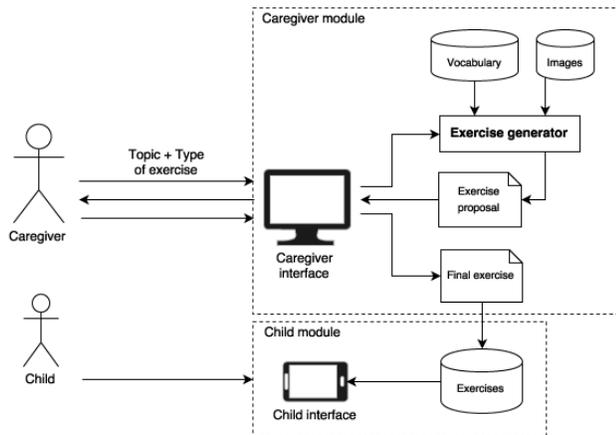
<sup>1</sup> <https://vithea.l2f.inesc-id.pt/>

caregiver to customize several interaction aspects, such as the utterances performed by the animated character featured in VITHEA. On the child's side, each exercise is presented by the animated character, which now also provides feedback using the utterances defined by the caregiver. However, the exercise area is now filled with the stimulus and the possible answers in a random order, and instead of orally naming the stimulus, the child should click/touch over the correct answer. Another difference is that our application provides clues: when solving an exercise, if the child picks one of the distractors, it will disappear as a way to prompt the child to pick the correct answer. The interface for solving exercises is shown in Figure 1.



**Figure 1 VITHEA-Kids: child's module**

The manual creation of exercises and the possibility of customization are critical features for ensuring that the application suits the characteristics of each child. However, since creating several exercises can be time-consuming for caregivers, we are currently implementing a module that allows the automatic generation of exercise content (e.g. the question, the stimulus, the correct answer and distractors). Figure 2 depicts the process of exercise generation.



**Figure 2 Automatic generation of exercises**

The exercise generator takes as input the type of exercise, the topic and/or question templates and it generates content selected from external vocabulary databases in Portuguese that include word relations such as part-whole, hyperonymy or hyponymy (e.g., MultiWordNet<sup>2</sup>, ONTO.PT [2]), and image databases that relate words to pictures (e.g., ImageNet<sup>3</sup>). For instance, if the caregiver asks for a multiple choice exercise, about the topic “Objects”, in which a word has to be illustrated with the correct picture, the exercise generator should return the question, the stimulus and the set of possible answers (see Table 1). The resulting exercise should be presented to the caregiver, who can

choose to accept it as it is, discard it, or change it. The final exercise is then saved to the database and becomes available for the child to solve it in the child application. Automatic generation of exercises has the potential for several challenges regarding Natural Language Processing (NLP), such as word sense disambiguation or gender and number agreement, and might require intermediate steps such as machine translation.

### 3. PRELIMINARY RESULTS

In a preliminary evaluation to the caregiver's module, we asked a small set of caregivers to perform three different tasks: 1) create a new exercise; 2) edit an existing image file; 3) edit child's preferences regarding the animated character's utterances. They were also asked to fill a questionnaire in order to: a) measure their experience while performing the requested tasks, as well as their overall user experience, in a scale of 1 to 5 (all caregivers fully agreed that they were able to easily and quickly perform the tasks without errors, and the majority of them reported to be very satisfied with their overall experience); b) assess their interest in the possibility of automatically generating exercises (caregivers were interested or very interested in this feature) and to collect further suggestions.

### 4. CONCLUSIONS AND FUTURE WORK

In this document, we presented a customizable platform that allows caregivers to create and manage multiple choice exercises aimed at children with ASD. We are currently working in a module of automatic generation of exercise content using NLP techniques. At long term, this platform can be extended with many other features, including, but not restricted to: a) Allowing other types of exercise; b) Turning the animated character into an intelligent/user-tuned agent; c) Increasing the customization options (e.g., interface modification, configuration of the animated character's look); d) Automatic adjustment of the difficulty level to the child's progress.

### 5. ACKNOWLEDGMENTS

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<sup>2</sup> <http://mwnpt.di.fc.ul.pt>

<sup>3</sup> <http://image-net.org>