

# APABOT: A Chatbot for ASD Treatment Implemented by ParlAI

Axel F. Shiloputra<sup>1</sup>, Jeremie Theddy D.<sup>1</sup>, Siti Lateefa Az Zahra<sup>1</sup>, Stephen Sugiharto<sup>1</sup>, \*

Viona Pricillia<sup>1</sup>, Arli Aditya Parikesit<sup>1\*</sup>

1. Bioinformatics Department, School of Life Science, Indonesia International Institute for Life Sciences \*Corresponding author: [arli.parikesit@i3l.ac.id](mailto:arli.parikesit@i3l.ac.id)

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**Abstract:** Chatbots are a conversational computer system that is built to imitate human daily conversation to give online support and guidance. As chatbots became increasingly popular, its usage became diverse as people started to create different types of chatbots. This paper will work on the usage of Chatbot for Autistic people since the Chatbot has provided a new opportunity for learning. **Purpose:** To create a chatbot that emotionally supports the needs of people with autism spectrum disorder. **Method:** The study will incorporate an AI as the basis for Chatbot dialogue using the open-source ParlAI framework. **Result:** Using the open source framework and python programming language, ParlAI is successfully made and used as an online chat bot that could be scaled toward ASD patients. **Conclusion:** Chatbot has been proven to be useful as an online conversational helping bot. As now, Chatbot can help many people to do daily talk. Not only helped to learn to communicate, but other knowledge that they might never have had. Further validation with real clinical setting is necessary, and ethical clearance should be secured for that regard.

## Keywords:

Chatbot, Autism Spectrum Disorders (ASD), Artificial intelligence (AI)

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## Introduction

Autism Spectrum Disorders (ASD) is a neurodevelopmental and pervasive disorder [1]. The pervasive characterization declares that the disorder affects the development of the person and the term disorder expresses the sense of differentiation than normal. ASD usually can be diagnosed early, starting from 4 years of age. The stages of ASD were

divers from its individual patients. However, ASD cannot be cured totally but the medication can help to control the ASD in its individual patients. The ASD individual usually showed any specific symptoms that might differ from each individual. The common group of ASD symptoms consist of communication impairment, social impairment, Impairments of interests, activities and/or behaviors [2]. Hypersensitivity is common among people with ASD, especially in childhood. The hypersensitivity sensory also known as hyperacusis in vision and hearing are one of the most common in the individuals with ASD [3]. This auditory hypersensitivity can trigger pragmatically atypical reactions that may impact social and academic domains. Hyperacusis might develop from the outside environment as well as genetics.

One of the most crucial components of human life is social skills. A lack of social skills can harm a person's future life. ASD is a developmental disorder marked by difficulty in social communication and repetitive behavior. As a result, children with autism have trouble learning social skills. As a result, children with autism require social skills therapies to help them engage in the community [4].

In the era of digitization and general access to Internet resources, it seems natural to expect fast, direct, and tailored access to the knowledge of interest. Solutions based on artificial intelligence can provide solutions to many problems of the modern world including chatbots [5]. Consider the limitations of ASD patients especially in the social and academic domains, chatbot capable of covering the problems with the help of artificial intelligence.

The chatbot itself was designed as an IOT look-alike, using machine learning to recognize the phenotypes of autism. The application of deep learning algorithms for the identification of autistic people is based on their brain activation patterns [6]. The chatbot will stimulate how the people behave as conversational partners and answer every question and carry on the conversations. By developing the chatbot it can help individuals with autism to communicate. Since the individual with autism has challenges with social skills, repetitive behavior, speech and nonverbal communication. In addition,

repetitive behavior in individuals with autism varies due to age and cognitive ability [7].

With the help of chatbot, challenges in daily life could be ameliorated. The objective of this research is to develop a chatbot prototype that could be potentially scaled for clinical setting with ASD patients.

## **Materials and Methods**

This study has a workflow that is outlined in the following Figure 1. It begins with study literature about any symptoms that are related to ASD, more specifically in the hypersensitivity part. Most of the literature is taken from journal databases, such as PubMed and PsycINFO which is a psychology database from the United States. This literature review was done with the purpose of supporting the argument that hypersensitivity is proven related to the ASD individuals with the specific range of age, which is teenager and young adults. Once that is completed, the next step is to check whether chatbots are correlated with better patient response. If the correlation between other factors and disorder progression is negative and chatbots are positively correlated with better responses, bot development was then built by using python.

## **ParlAI**

Since there are many frameworks to design and develop chatbots from, it was decided that ParlAI was selected due to its speciality in evaluating and training conversational dialogue models, ease of implementation and comprehensive set of features [8]. ParlAI will act as the machine learning natural language processing (NLP) that serves as the artificial intelligence (AI) behind the chatbot's dialogue by providing the datasets and models which are able to pre-process texts and perform word or sentence embeddings [9].

## **Training Data**

We trained our model with a pretrained model blender 90M, which contains 87,508,992 parameters and 2.86M steps [8]. We also use a dataset from blended skill talk that tries to effortlessly merge the abilities from the previous three assignments, engaging personality, empathy from empathic dialogues, and knowledge from the wizard of wikipedia. For that purpose, a 76k-utterance conversation dataset was gathered using a guided and unguided human speaker. The suggested speaker could pick utterances recommended by bots trained on the three distinct tasks. We are also focusing on

empathetic dialogues made by Rashkin et al. (2019) created the dataset containing 50k utterances of crowd workers' talks centered on emotional circumstances. In each dialogue, one speaker explains a personal experience while the other acts as a listener, demonstrating empathy throughout the conversation. Trained models are evaluated while portraying the role of the sympathetic listener.

### Hardware

We trained our model on a single system equipped with a single Tesla T4 GPU. Each training phase for our base models utilizing the hyperparameters discussed throughout the study took roughly 14 seconds. The basic models were trained for a total of 3479 steps, or 20 minutes.

### Training

For the parameters, we set our training time to at most 20 minutes and validate for every 0.25 epochs. We utilized Adam optimizer[19]using 1e-5 learning rate and warmup\_updates=100. Results still need to be validated after the development of the chatbot, and this is used to assess the model's accuracy, precision and usage are up to the desired standard.

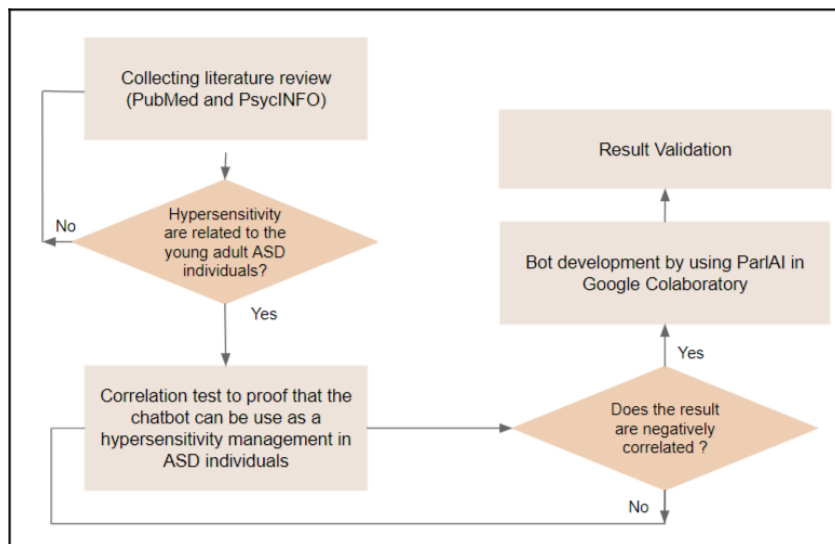


Figure 1. Workflow to conduct the study

## Result and Discussion

### Model Evaluation

	Perplexity	Per-token accuracy	Loss	GPU usage
all	13.1	.4393	2.567	.07747
blended_skill_talk	14.48	.4327	2.673	
empathetic_dialogues	11.72	.4459	2.461	

*Table 1.* Model evaluation.

Table 1 shows that the model perplexity is 13.1, with a total loss of 2.567, which shows how well the probability model can predict an input. The total of .07747 measures roughly how much GPU memory the model uses and offers the possibility to increase the model size and training time.

### Conversation

<p>Speaker: Today,as I was leaving for work in the morning,I had a tire burst in the middle of a busy road. That scared the hell out of me!</p> <p>Response: Are you fine now?</p> <p>Speaker: Yeah,I'm doing alright now, but with minor injuries.</p> <p>Response: Cool :) Is your car damaged a lot?</p>	<p>Speaker: Electrician</p> <p>That sounds dangerous. Is it worth doing such a dangerous job?</p> <p>Well it is okay if you are well trained.</p> <p>There are three levels: Apprentice, journeyman and Master.</p> <p>Which level are you at?</p> <p>Response: I received on-the-job training when i first started</p> <p>Speaker: That's great! How long have you been doing this work?</p> <p>Response: For a good number of years now.</p>
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*Table 2.* Response of model predictions.

<p>Speaker:What is ASD?</p> <p>Response: it's a disability that requires a lot of physical and mental strength .</p> <p>Speaker: How bad?</p> <p>Response: it 's not too bad , but it can be very hard to deal with .</p> <p>Speaker: Like what?</p> <p>Response: it 's hard to deal with . It's a lot of physical and mental strength .</p> <p>Speaker: I have ASD</p> <p>Response: oh , that 's interesting .</p>
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**Table 3.** Response of chatbot model comprehension on ASD.

Tables 2 and 3 provide numerous examples of effective dialogues between a generated speaker and the model. Empathy, Jobs, and skills the model frequently goes into depth when requested, Table 2 citing related jobs and showing empathy towards the speaker. The model was also tested with two significantly more in-depth instances, interactions between a speaker and the model table 3. In the example, the speaker asked the bot about ASD, and the model responded with quite subtle and thorough responses. This shows well how blended skill talk dataset utilizing wizard of Wikipedia extracting the information of ASD from Wikipedia to the response.

### **Autism Spectrum Disorder (ASD)**

The definition of Autism Spectrum Disorder or ASD is defined by the American Psychiatric Association (APA) as the neurodevelopmental disorder that is characterized by the limited capability in social interactions and having specific and restricted interests and repetitive behaviors [10]. Under the Diagnostic and Statistical Manual of Mental Disorders—5th edition (DSM-5) by the APA, diagnosis for ASD needs a minimum of two diagnostic criteria to be met while there are a total of 9 diagnostic criteria to be considered. It is also important to keep in mind that this diagnostic criteria is not universally used and there are other classification systems such as the International Classification of Disease Series that is also frequently used which has a different set of diagnostic criteria for ASD [11]. The criteria by the DSM-5 are briefly described as follows, deficiency of emotional reciprocity, deficit in nonverbal communication for social interaction, deficit in developing, maintaining, and understanding relationships, repetitive motor movements (including speech and use of objects), insistence on consistency (in relation to routines, verbal and nonverbal behavior, abnormally intense interests, and hyper- or hypoactivity in to excessive or unusual sensory stimuli [10]. Symptoms of the disorder can be observed in early developmental stages but may only be apparent once the capacity for social interaction exceeds the individual's. The cause of ASD is still unknown with the factors affecting the onset to be multi faceted, it can range from environmental and genetic factors. Risk factors for the disorder may be from 1st degree family members with ASD, genetic conditions such as a fragile X syndrome, or child born from older aged parents [12]. Despite all the concerns around ASD, a cure for

the disorder has not yet been discovered and drug treatments are targeted towards the associated symptoms, not to the core symptoms itself [13]. Alternatively, therapies such as cognitive behavioral therapy or CBT have been studied to be effective for treating comorbid anxiety disorder that is associated with ASD.

### **ParlAI**

Utilizing an open source framework to support the development of creating an AI chatbot is one of the most efficient and resource effective methods [14]. It offers an affordable, or sometimes free, solution to the development and deployment of the software as the source code is distributed openly along with the executable software. It allows software developers to open and modify the code according to their needs depending on the license granted. ParlAI is an open source chatbot framework that is implemented with the Python programming language for dialogue research [15]. It has a wide range of features that revolve around sharing, testing, and training dialogue models which can be observed in its integration with humans in Amazon Mechanical Turk, combination of real and simulated dialogue data, and all tasks submitted to the repository would contribute into the the common goal of developing a unified, multitask, general chatbot dialogue model. Multitask learning approach utilizes multiple tasks to train the model simultaneously or improves the model's performance over a specific task using peripheral tasks. This allows the model to be cost-efficient while improving the model performance and alleviating the problem of data scarcity [16]. There are over 20 tasks with various datasets to train the models that are built within the framework [15]. The datasets are sourced from popular repositories such as SQuAD, bAbI tasks , QACNN and QADailyMail, CBT, bAbI Dialog tasks , Ubuntu, and VQA while the tasks are categorized into 5 main groups namely Question Answering (QA), Sentence Completion (Cloze Tests), Goal-Oriented Dialog, Chit-Chat, and Visual Dialog that all work in tandem to achieve a versatile and multi functioning chatbot that can be realistically perceived when used.

### **Role of chatbots in ASD**

Autism is not a situational behavior and people who are diagnosed with this syndrome will have a hard time improving skills, daily conversation, and language ability. However

with the presence of Chatbots, they can learn through online bot communication in order to learn. A chatbot is a type of computer assisted therapy that is able to provide a predictable environment without direct human interaction for ASD patients that offers an enjoyable yet effective therapy alternative [17]. Conversational chatbots can deliver a psychological intervention based on anxiety or depression. They are quite a friendly user and can keep up with the person's emotional state. Thus, chatbots are quite useful in dealing with person's with special need conditions. One of the advantages that chatbots offer over therapies with human counselors is that there is no need to define a specific goal in mind when starting out [18]. Another benefit is also the various modules present in the chatbot software that are beneficial for the autistic population that patients can switch to at any time as there is no commitment or defined goal [20]. The development of Large Language Model (LLM)-based chatbot such as chatGPT and Bing AI has enabled more wide-range application in this field [21]. Therefore, future refinement could potentially produce a larger and more agile models.

## **Conclusions**

Chatbots could potentially help treat ASD as they can provide an interactive partner to talk to, share their emotional conditions, and do other daily tasks. The potential intervention could possibly relieves patients from anxiety or depression and could also induce a learning process for ASD patients to interact in social situations. ParlAI, being an open-source framework, can support the chatbot development in an easy and cost-effective way without compromising on performance. It is able to achieve a satisfactory result in dealing with a simulation of patient's emotional state through its conversational dialogues. The model can, later on, be improved by using more datasets and more training time. Due to being unable to survey an actual ASD patient, it is better to test to see their reaction and how well the model is with ASD patients. Ethical clearance will be necessary as a prerequisite to test the model with actual patients.

## **Conflicts of Interest**

The authors declare that there is no conflict of interest regarding the publication of this paper.

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### **Conflict of Interest**

The authors declare that there is no competing interest

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