

Review

of the member of the dissertation council for the dissertation of **Nikolaev Aleksandr Sergeevich** on the topic: **Physiological basis of perception of speech of children with autism spectrum disorders**, submitted for the degree of **Candidate of Biological Sciences** in scientific specialty

1.5.5. Human and Animal Physiology

Ph.D Thesis Evaluation Report:

Student Name: Nikolaev Aleksandr Sergeevich

Title of the thesis: Physiological basis of perception of speech of children with autism spectrum disorders

University: Saint Petersburg State University

Thesis Examiner: Prof. M.Murugappan, Kuwait College of Science and Technology, Kuwait

Date of reporting: 30 Nov 2024

Overview:

An interesting problem addressed in this thesis is the correlation between adults' physiological and psychological characteristics and the perception of information contained in the speech of children with autism spectrum disorder (ASD). In most cases, children with autism have difficulties with understanding and delivering speech as a result of this neurological disorder, which makes understanding their speech vital for aiding them with intelligent speech rehabilitation systems. This thesis has three major objectives: (a) Identifying the lexical meanings of children with autism spectrum disorders (ASD) and typically developing (TD) children based on their physiological, psychophysiological, gender, and age characteristics, and establishing the characteristics of children's speech that are important to correct recognition. (b) To determine adults' ability to classify their psychoneurological state (TD or ASD) by analyzing their physiological, psychophysiological, gender, and age. Based on their physiological and psychophysiological characteristics, gender, and age, adults recognize children with ASD and TD children's emotional states. The authors have performed several experiments to investigate psychological, psychophysiological, and psychoneurological experiments. The researchers analyzed data from TDs, ASDs, and adults using different statistical methods. They achieved all the goals they outlined. Through the thesis, scientific research can better understand the major reasons for improving communication between people with ASD and TD in Russia, plus possibly help researchers in other parts of the world perform similar experiments.

Major (Common) Suggestions for improving the quality of the thesis:

- **I strongly suggest the author revise the title of the thesis if possible, since, the author did not focus much on the physiological aspect of speech perception from ASD and TD. It could be “An Investigation on the Perception of speech of Children with autism spectrum disorders”.**
- **Literature review:** The literature review is lacking, and it should be strengthened with more recent research from around the world in 2023 and 2024. Because the authors only included Russia-based works. The author needs to review more recent and relevant works in 2023 and 2024 and update the Introduction and Literature Review sections. Perhaps in the Discussion section of the work, the author could benchmark the results reported in the work with those of others.
- **References Section:** The majority of the references are in Russian, so if possible, the author should revise them in English to make them easier to understand for readers who may not be familiar with the Russian language.
- **Methodology:** There is no information about ethical approval (date, year, number), ethical statement, and informed consent statement in the thesis. This information should be incorporated into the revised thesis so that readers can better understand it.
- In the thesis, reference is made to papers published by the author (Nikolaev) derived from the thesis. This is unacceptable. It is strongly recommended that the author remove all references derived from this work from his thesis. The importance of this cannot be overstated.
- There is a lot of confusion in the thesis since auditors/subjects/adults are used at different places. It is best to keep the representation the same throughout the thesis to make readers' understanding easier. It would be better if you replaced all the places where auditors are mentioned with subjects. In this manner, you will be able to present your work in the most appropriate manner that will not cause any confusion for your readers.
- You have not provided a clear diagram showing the experimental protocol and methodology of your proposed study. Consequently, I find it highly challenging to comprehend the essence of the paper. It would be helpful if you included a detailed diagram of the methodology and protocol diagram with clear descriptions for the reader's understanding. Please revise it.
- There is a lack of proper description or abbreviation of most acronyms used in the paper. I would appreciate it if you could review and revise the entire thesis.
- I strongly recommend that the author include a List of Symbols in addition to a List of Abbreviations in the thesis. In this way, the reader will be able to gain a better understanding of the topic.

- A list of abbreviations needs to be updated in the thesis, and I suggest the author update it. There are not many major abbreviations listed.
- Each equation should have a number and a reference inside the text. It is extremely important to note this. There are times when the same equation is repeated in different places by the author (for example: LPC on page 24). It should also be rectified in the revised thesis.
- You should proofread your paper with a native English speaker and correct any typographical, grammatical, or spelling errors.
- Furthermore, I strongly suggest that the objectives of the work be revised. According to the thesis, it does not entirely reflect the work described
- A list of publications derived from this thesis has to be included as a separate section and it could be included before the references.
- Please include a picture of the data acquisition environment in which you collected the ECG signals and speech signals. Also, mention the types of equipment you used in data collection in Section 2.3.
- Please include the axis name (with unit) in all the figures in the thesis. I could not see the axis title with the unit in most of the figures. This is very important.
- Please elaborate more on the expertise of the expert who selected the emotional speech samples and others. Its highly essential to understand its value.
- Some of the figures in the thesis are not referred to inside the text. Please carefully check the entire thesis.
- There are no clear details of the features or samples extracted for each case in the present study (Section 3). Therefore, I was unable to validate the results presented here in depth.
- Its highly essential to include the major limitations and future scope of the work in the thesis. You can include in the conclusion section.
- Its also important to include the Annexure that refers to the list of words, phrases, etc used in this work. This will help the reader to a better understanding of the present work.

Suggestions for improving the quality of the thesis chapters:

1. Page 4; Paragraph 4 - The authors referred to the papers until 2020. Is it possible for you to refer to the recent works and refer to them here as well?
2. Rephrase the study's objectives completely. The work done in the thesis is not reflected in it, and it consists mostly of similar statements.
3. What is the method for quantifying whether the research used sufficient samples, as you mentioned on page 7 in "the degree of reliability"?
4. What is the CARS score mentioned on page 22?

5. How do you verify the speech material reported in AD_Child.Ru? Because it was prepared by your team. Please let me know if any other references referred to your work in their paper. Please include it here if it exists.
6. Provide information on the data acquisition equipment, experimental setting, and experimental environment used in the present study.
7. Is the source of any figures you use from other sources (for example, the Internet), please cite the references in the figure title.
8. Please don't duplicate the results. In section 3, you presented the results in both Table and Figure. It's not necessary. Please keep only one (either Table or Figure) and completely revise the entire thesis.
9. Rephrase the complete statement mentioned in page no 43 (below Figure 13).
10. According to Section 3, a majority of the figures show a higher/lower/significant/nonsignificant difference. However, the reason behind it remains a mystery. The authors need to investigate the results thoroughly and discover the reasons for them. I would appreciate it if you rewrote your thesis carefully and updated this information on all of your results.
11. Whether the VAI should be low (or) high for better recognition? (in page no 50). Please justify it in the text.
12. From Table 13 onwards, do you refer the number of subjects (or) number of samples in the confusion matrices?. (example: 54 in Table 13, etc)
13. What do you mean by Severe disorder in Figure 24?. Please justify it in the text.
14. What do you mean by the number of responses in Figure 23?. Please justify it in the text.

Important Questions:

1. How is the proposed methodology validated?
2. What do you mean by integrated approach as you mentioned in Page no 5 in Scientific Novelty?
3. What are the pros and cons of having different numbers of subjects in different age groups? What impact will this have on the study's conclusions and results?
4. Have you used any data balancing methods in your work? Please elaborate on it.
5. You mentioned ECG, HR, and RR in your work. But, you only analyzed HR and RR in your analysis. Why did you not use ECG information in your work?
6. What do you mean by open field that you mentioned in Section 2.3.1.3?
7. What methods do you use to extract HR and RR?. Have you used any separate device to capture RR (or) you derived from ECG?. If so, how did you derive it?

8. Why are there overlapping of age in Table 2? (10-11, 12-14, & 10-14).
9. How did you handle the data imbalance issue in your dataset? The report does not mention it anywhere.
10. Do you know of any other tool to measure anxiety besides the Spielberger test? It is too old and there are several other metrics available in the literature. Is there a reason why you did not use it to measure anxiety in your work?
11. Do you believe the results in your thesis are biased because of the data imbalance issue? Is that the case, how did you handle it? Could you please elaborate?
12. What type of electrode (material, impedance, type) was used to acquire ECG signals in your present work?
13. What is the sampling frequency of the ECG signals and speech signals?
14. Are the background ECGs captured under eye-open (or) eye-close conditions?.
15. How does the present work differ from previous work? (or) what is the novelty of the present work?
16. Do you think the same experiment could be performed in a different context (in another language)?
17. Would the proposed strategy also apply to other neurological disorders (Parkinson's, etc)? If so, please explain. If not, please describe the major challenges.
18. Why does the number of auditors used in the work vary significantly? (page no 28). Will it affect your experimental results and the conclusion of this study?
19. What do you mean by domestic, professional, and none in Table 3?
20. What is the significance of using UAR in your work? (page no 29). I could not see any results that discussed the measure.
21. How did you perform the normalization as you mentioned in Section 2.3.5?
22. Why have you used only three vowels (a, I, u) in your work?
23. Is it possible that the hearing impairment of some of the auditors negatively influenced the results of your experiments on the perception of children with autism spectrum disorders and developmental disabilities?

Considering the above, I believe that *Nikolaev Aleksandr Sergeevich*'s dissertation on the topic: **Physiological basis of perception of speech of children with autism spectrum disorders** meets the requirements of specialty **1.5.5. Human and Animal Physiology**.

The dissertation is a scientific qualification work that resolves a scientific problem important for the development of the relevant field of science *or* provides new science-based technical, technological or other solutions and developments vital for the national development.

No violations of paragraphs 9 and 11 of the Order No.11181/1 as of November 19, 2021 "On the Procedure for Awarding Academic Degrees at St. Petersburg State University" have been detected. The dissertation meets the criteria of dissertations for the academic degree of Candidate of Biological Sciences, established by the specified Order.

The dissertation is recommended for the defense at St. Petersburg State University.

Member of the dissertation council: Prof. M.Murugappan

Academic degree, academic title, position: Ph.D., Full Professor in Electronics, Kuwait College of Science and Technology, Kuwait

Signature:

A handwritten signature in black ink, appearing to read "M. Murugappan". The signature is written in a cursive style with a long, sweeping tail on the final letter.

Full name: Murugappan Murugappan

Date: 30 Nov 2024