Perspectives on High -Tech Assistive Technologies for Therapy of Communication Disorders: Findings from Delphi Studies

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***Abstract*—Recent advancements in high-tech Assistive Technologies (ATs), especially those driven by Artificial Intelligence (AI), have greatly improved the quality of life and of individuals with various neurodevelopmental disorders and communication disorders in particular, contributing to progress in education, employment, social participation and overall well-being. However, despite these improvements, considerable obstacles persist in the application of such technologies across different sectors, highlighting the need for further investigation into their future development. This study explores emerging trends and future directions in ATs, offering key insights from both national and international perspectives. A national Delphi study involving 66 experts from academia, disability-focused organizations and neurodevelopmental centers, along with an international study including 284 participants from 31 European countries, were conducted to evaluate future-oriented projections and gather insights into participants' attitudes toward ATs. The results of the national survey reflect a moderate consensus among Bulgarian experts, reveal a sense of cautious optimism regarding the use of ATs, particularly those powered by AI, for individuals with disabilities. On the other hand, the results of the international study show a similar trend but indicate a little stronger consensus among experts on the positive impact and desirability of ATs in promoting the social inclusion of individuals with neurodevelopmental disabilities.**

Keywords—High-tech Assistive Technologies, AI, Neurodevelopmental Disorders, Communication Disorders, Delphi Studies, Expert Perspectives

I. Introduction

Assistive Technologies (ATs) refer to a broad range of products, services and systems designed to support individuals with disabilities in carrying out specific tasks. These technologies foster greater independence and enable access to education, employment, and full participation in society. The advancement of Artificial Intelligence (AI) has significantly enhanced ATs, leveraging algorithms and data-driven insights to make assistive tools more powerful and effective than ever before.

According to the World Health Organization (WHO), assistive technology refers to products that support or enhance an individual's functional abilities and independence, ultimately contributing to their overall well-being [1]. The Convention on the Rights of Persons with Disabilities (CRPD) explicitly outlines that States Parties have general obligations to actively engage in or encourage research and development, as well as to promote the availability and use of new technologies—such as information and communication technologies, mobility aids, devices, and assistive technologies—that are appropriate and affordable for people with disabilities. Additionally, States are required to ensure that persons with disabilities have access to information about these mobility aids, devices, assistive technologies (including emerging technologies) and other forms of assistance, support services, and facilities [1]. MacLachlan et al. [2] highlight the significant role AT can play in enhancing access to education and employment, thereby improving overall well-being and fostering social inclusion.

Regarding education, the UNESCO-WEIDONG Group project titled "Leveraging ICT to Achieve Education 2030" highlights the importance of using Information and Communication Technologies to strengthen education systems, facilitate knowledge exchange, increase access to information, promote high-quality and effective learning, and improve the efficiency of service delivery [3]. Within this framework, ATs can be instrumental in facilitating communication and boosting the academic achievements of individuals with diverse disabilities. Additionally, AT can support the development of cognitive abilities and assist in managing challenging behaviors. It also holds the potential to increase self-confidence and foster stronger connections between teachers and students.

Over the past few decades, the field of ATs have experienced significant progress focused on improving quality of life and fostering independence for individuals with developmental conditions and communication disorders in particular. Currently, advanced Assistive Technologies, particularly Socially Assistive Robots (SARs), Virtual Reality (VR), and Conversational AI (Conv. AI), are regarded as highly effective tools in aiding professionals working in Speech and Language Therapy (SLT) for children with communication disorders.

Since there is a gap between the potential of ATs and their practical application in SLT, in the frame of ATLog project (https://atlog.ir.bas.bg/en/) a new software and ergonomic platform had to be created for seamless integration of ATs in SLT and intuitive design of interactive and engaging learning scenarios assisted by these high-tech technologies. The research objectives of this study are as follows: (1) to perform

Delphi studies with relevant statements concerning developments in ATs anticipated up to the year 2030, and (2) to evaluate the responses of participants, to draw future directions and to propose the foundational features of an ergonomic platform to streamline the integration of high-tech ATs in SLT. To achieve these objectives a national Delphi study involving 66 experts from academia, disability-focused organizations and neurodevelopmental centers, along with an international study including 284 participants from 31 European countries, were conducted to evaluate future-oriented projections and gather insights into participants' attitudes toward ATs.

II. CHARACTERISTICS OF THE DELPHI STUDY

In recent decades, the Delphi method has played an essential role in developing best practice recommendations via collective knowledge, particularly in scenarios where research is limited, logistical challenges arise or existing evidence is contradictory [4]. This methodological approach is particularly valuable for gathering perspectives on ATs in the field of communication disorders as it facilitates the collection of expert opinions and helps address challenges in this evolving field. The Delphi technique follows a structured process for forecasting by harnessing the collective expertise of a panel of specialists. It integrates both qualitative and quantitative aspects, offering a well-rounded perspective on the research problem [5]. The technique facilitates the coordination of expert discussions while ensuring compliance with four key principles: anonymity, controlled feedback, iteration and statistical group analysis [6]. The Delphi expert group is composed of members chosen primarily for their professional skills in the research subject.

III. RESULTS FROM THE DELPHI STUDIES

A. Results from the international Delphi study

Employing a two-round Delphi method, the authors in [7] carried out an international research study with a panel of 284 experts from 31 European countries, gathering both quantitative and qualitative data. The study explored perspectives on assistive technologies, incorporating ten future-oriented projections and covering five categories – politics, education, technology, employment and society. The authors established the end of 2030 as the timeframe for evaluating the potential realization of each projection and asked the specialists to assess the expected likelihood in 10% intervals. The expert panel included professionals from academia, industry, service providers and disability organizations. The main research question in the paper focused on the challenges experts recognize in the implementation and adoption of ATs for neurodevelopmental disorders with a particular focus on autism and intellectual disabilities. Figure 1 shows that the economic challenges are the most significant across the different projections, particularly in relation to technology forecasts. These challenges are associated with the development of multilingual/personalized devices using AI and the open-source hardware and software of ATs. This suggests that financial issues, such as high costs and funding challenges, are a key factor in the implementation and adoption of ATs. Technological challenges are the least significant across most projections, indicating that they are not the primary obstacles. Addressing economic and political barriers is crucial to the successful development of assistive technology solutions in the field of neurodevelopmental disorders.

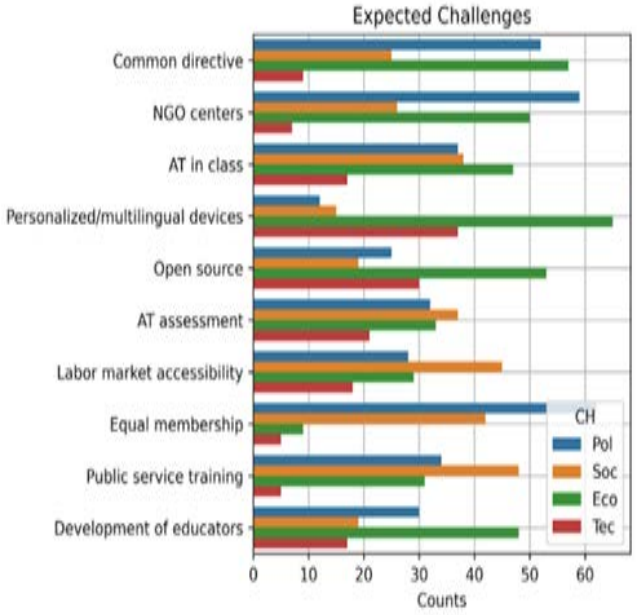

Fig. 1. A visual representation of the challenges anticipated by the experts in the study (N=284). Adapted from [7].

The essential aspects of the Delphi study included expected probability, desirability, and impact in case of occurrence of the proposed scenarios. The authors identified two clusters which are shown in Figure 2. Cluster 1 included four projections that scored higher across all three dimensions. These projections focused on personalized and multilingual devices, AT assessment, public service training, and educator development.

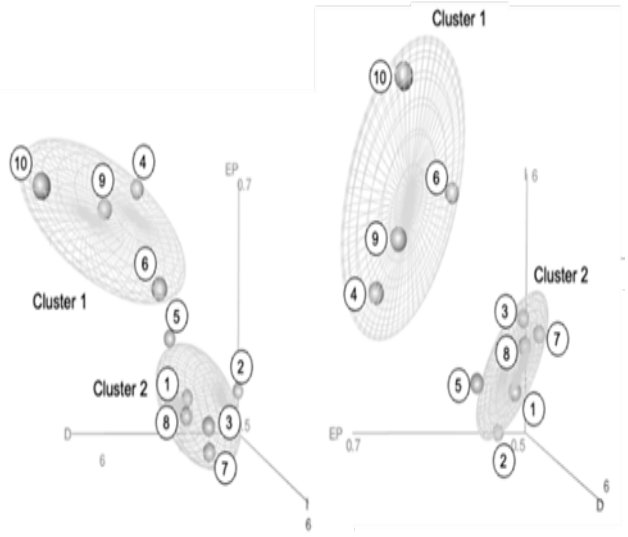

Fig. 2. Cluster-based representation of the evaluated projections. Axis definitions: EP-Expected Probability; D-Desirability; I-Impact. Adapted from [7].

Cluster 2 comprised six projections with generally lower scores, addressing a common directive: the establishment of NGO centers, the integration of ATs in education, adoption of open-source solutions, improved labor market accessibility and equal membership opportunities for individuals with intellectual disabilities and/or autistic individuals. As a whole, the results show that assistive technologies are expecting to

greatly enhancing accessibility for people with neurodevelopmental disabilities. The findings indicate a strong expert consensus on the positive impact and desirability of ATs in fostering social inclusion for individuals with neurodevelopmental disorders.

B. Results from the national Delphi study

Similarly, a national Delphi study (in Bulgaria) was conducted to further explore perspectives on AT-s in CD, involving 66 professionals from academia, disability organizations, and neurodevelopmental centers. The research experimental procedure, informed consent and protocols approved by the Ethics Committee have been uploaded to the OSF platform [8]. The study employed a two-round Delphi method to gather input on 11 forecasts covering politics, education, society, technology and employment, mirroring the categories used in the international study. The findings aimed to ensure the relevance and effectiveness of the ATL or platform during its early development stage. One of the goals of the study was to understand the attitudes and preferences of experts regarding the use of AT-s in SLT on a national level. Additionally, the study aimed to reach a consensus among the specialists on the proposed scenarios as far as possible.

The findings show that most specialists are optimistic about the potential benefits of ATs for therapy of CD in the medium term. There is a moderate consensus among experts regarding the benefits and desirability of these technologies. The majority believe it is very or moderately likely that the proposed scenarios will become reality by 2030 and that is reflected in eight out of the eleven forecasts. Figure 3 shows the results for these 8 projections.

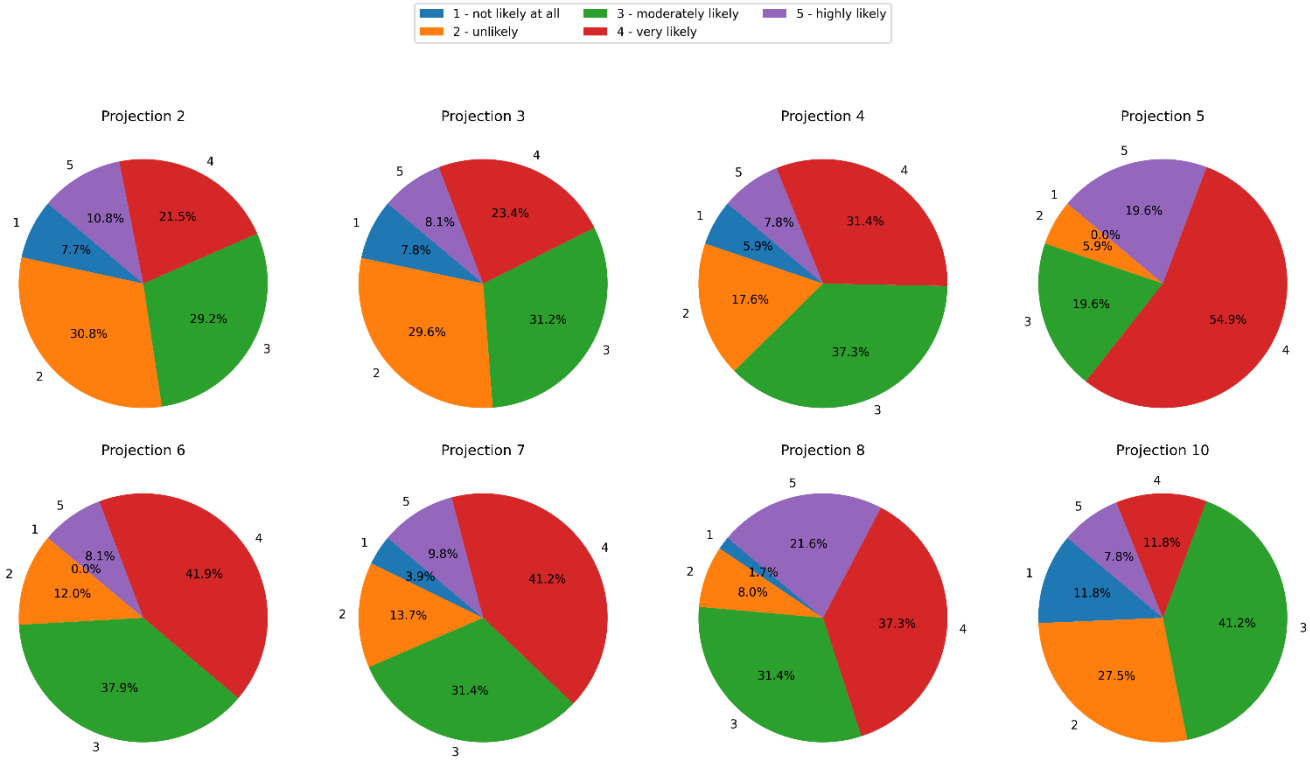

Fig. 3. Results from chosen projections: ATs in classroom (Projection 2), adoption of SARs (Projection 3), VR applications (Projection 4), integration with Bg GPT chat (Projection 5), open-source solutions (Projection 6), parent training programs (Projection 7), practitioner implementation (Projection 8), and investments in speech and language centers (Projection 10).

According to the results of the study, the most optimistic statements are for: AT-s integrated with Bg GPT chat (Projection 5), open-source hardware and software (Projection 6) and training programs for parents (Projection 7). Regarding Projection 5, experts tend to believe that it is very likely that the AI chatbot developed in Bulgarian, Bg GPT, will become very popular in interactions with people with communication disorders. The reason for this is likely the widespread use of the general Chat GPT chat bot and its expansion into more areas of public life. The chatbot's features, such as accessibility, the ability to understand and respond to a wide range of natural language queries, and customization according to specific needs and preferences, contribute to its popularity and trust. In combination with its services developed in Bulgarian, the chatbot becomes a very valuable attribute of assistive technologies in interactions with people with communication problems. For the open-source solutions (Projection 6), experts believe that it is very likely that ATs will be based on open-source software. They are hopeful that this will become a reality by 2030, so the software will be accessible to everyone working with children and adolescents — users, parents, and professionals. Given the rapid technological progress, it is entirely feasible for ATs to become more accessible and personalized in the near future. Another most optimistic statement by experts is related to training programs for parents (Projection 7), according to which there will be regular trainings on how to use various ATs by 2030. This scenario is very likely for the participants to become reality. The use of ATs is rapidly increasing due to their improvement and the growing awareness of their benefits. As more children and adolescents use these devices, the need for parents to understand and support their use will also grow.

On the other hand, the specialists are most pessimistic about the use of ATs in the classroom (Projection 2), where the most

frequent response is “unlikely”. This reflects the experts' lack of trust that every school in the country will have developed a methodology for using ATs, likely due to the uneven distribution of resources in schools in Bulgaria and the lack of sufficient equipment in many of them. As a result: there is a large discrepancy between those, who have the opportunity to integrate ATs and those who do not. Experts are pessimistic only a little regarding the adoption of SARs (Projection 3), with the response "unlikely" ranking second, following "moderately likely".

C. Discussion

The international research employing the Delphi method outlined two likely scenarios for the future evolution of ATs. The first scenario points toward a path of greater technological sophistication, broader integration, and improved accessibility, fueled by fast-paced innovation and a rising societal focus on inclusivity. Key aspects of this trajectory include the development of personalized and multilingual devices (4), advancements in ATs assessment methods (6), enhanced training for public service professionals (9), and expanded professional development for educators (10). The findings emphasize the need for strong collaboration among key stakeholders — especially between industry, policymakers, and practitioners—to overcome existing obstacles and unlock the full benefits of ATs, ideally by 2030 as projected in the study. According to a diverse group of European stakeholders, achieving this vision will require sustained investment in personalized, multilingual technologies, professional training for educators, and the expansion of public service programs.

As for the national Delphi study, it cannot be stated that professionals and other stakeholders hold a pessimistic view regarding the integration of Socially Assistive Robots (SARs), Conversational AI and Virtual Reality (VR) into their professional practice. On the contrary, many recognize the potential of these technologies to significantly enhance therapeutic and educational outcomes for individuals with communication and developmental disorders. However, there remains a degree of skepticism about the likelihood of these ATs becoming widely adopted and accessible across the country. This cautious outlook is primarily linked to the current high cost of technologies such as SAR’s, which continues to pose a major barrier to broader implementation. Limited funding, lack of infrastructure and insufficient training opportunities may also contribute to concerns about the feasibility of integrating high-tech ATs into everyday practice, especially in resource-constrained settings. As such, while the professional community remains open to innovation, the full realization of ATs potential will likely depend on future advancements in affordability, policy support and access to training and resources.

IV. Conclusions

The combined insights from bot, the international and national Delphi studies, underline a shared recognition of the potential of high-tech Assistive Technologies (ATs) in improving the quality of life. For individuals with communication and neurodevelopmental disorders, and, in particular, help draw future directions and propose the foundational features of an ergonomic platform to streamline the integration and application of high-tech ATs in such therapy. While international experts envision a promising trajectory marked by technological advancement, integration and inclusivity, driven by personalized solutions and stakeholder collaboration, the national perspective anticipates a more cautious optimism. Bulgarian professionals acknowledge the value of innovations such as Socially Assistive Robots, Conversational AI and Virtual and Augmented Reality, yet express concerns about the economic and infrastructural limitations that may hinder widespread adoption.

To bridge the gap between the potential of ATs and their practical implementation in the therapy of communication and development disorders, the ATLog project addresses the need for sustained investment, supportive policy frameworks and strong cross-sector partnerships. Based on the findings of both Delphi studies, ATLog actively advocates the position that achieving the full potential of ATs by 2030 will require concerted efforts to ensure these technologies are not only innovative but also affordable, accessible and supported by well-trained personnel.

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