

Machine Learning and AI in Autism Research

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OUTLINE

- Introduction
- Data Sources and Other Issues
- Tools
- Machine Learning – Core of AI
- Stake Holders and Impacts
- AI Environments
- Conclusions and Future Outlook (?)

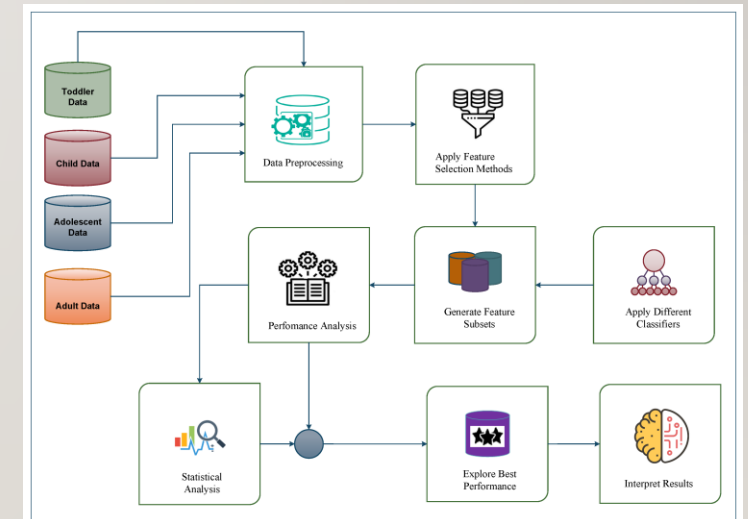
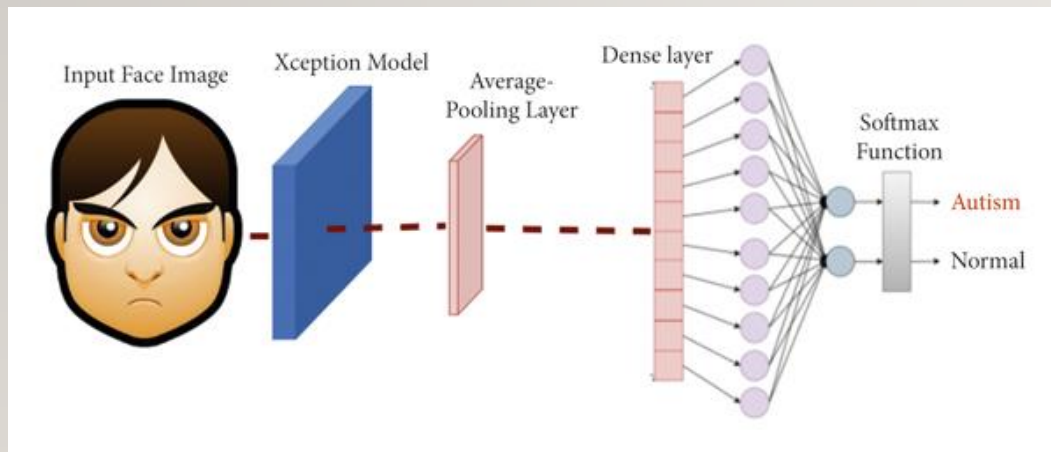
INTRODUCTION

"A growing body of evidence supports the value of early diagnosis and treatment with evidence-based interventions, which can significantly improve the quality of life of individuals with ASD as well as of their careers and families. Particularly noteworthy are early interventions that occur in natural surroundings and can be modified to address age-related goals throughout the lifespan." *Psychol Res Behav Manag.* 2017; 10: 283–292.
Published online 2017 Aug 24. doi: 10.2147/PRBM.S117499



PREDICTIVE ANALYTICS FOR EARLY DIAGNOSIS

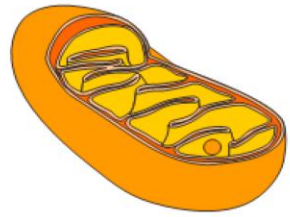
- Machine learning models to identify patterns in data
- Early detection of ASD based on behavioral and medical data
- Genetic risk factors identification
- Improved diagnostic accuracy



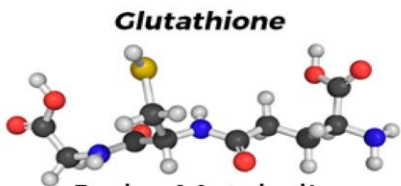
CAN AI DO IT ALONE?

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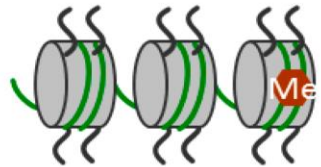
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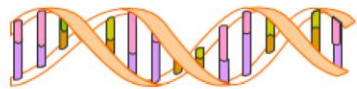
Mitochondrial Function



Redox Metabolism

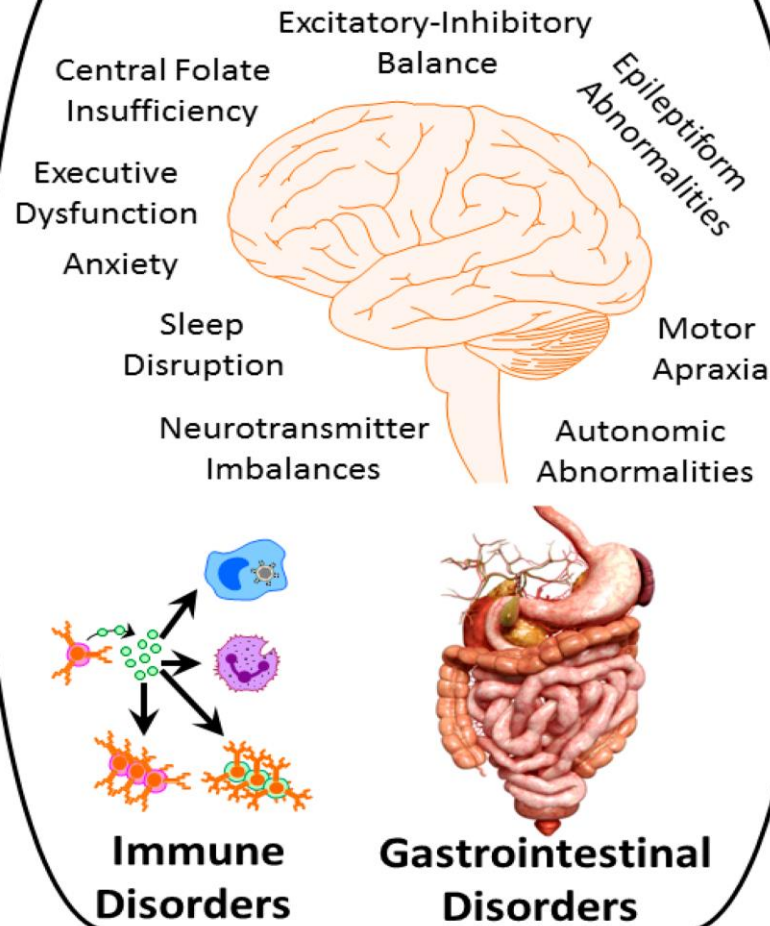


Methylation Metabolism



Genetics

Brain Based Disorders



Psychosocial Factors

- Family Stressors
- Family Coping Mechanisms

Educational Factors

- Therapies (Quality, Quantity)
- Educational Classroom Setting
- Educational Supports
- Behavioral Supports

Sensory Factors

- Noise Level
- Tactile Stimulation
- Vestibular Stimulation
- Sensory Overload

Dietary Factors

- Complete Dietary Intake
- Nutritional Supplementation

Allergens / Chemical Sensitivity

- Common Environment Allergens
- Dietary

Environmental Toxicants

- Air Quality
- Common Chemicals (Cleaners)

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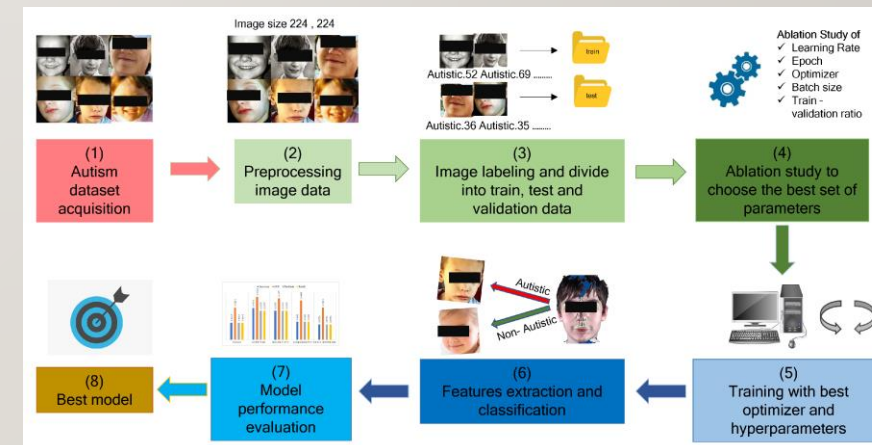
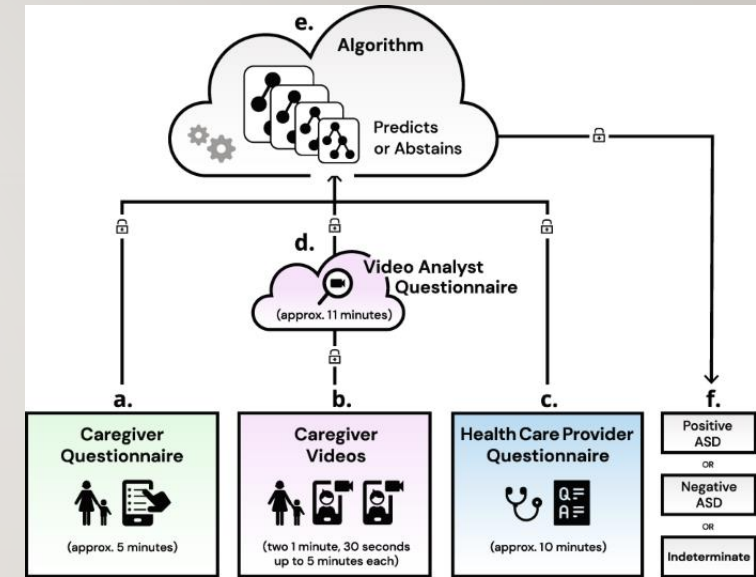
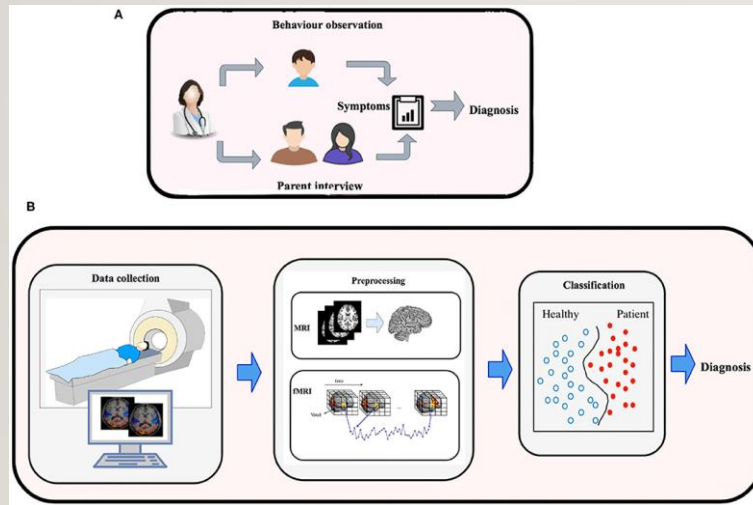
DATA SOURCES AND OTHER ISSUES



DATA SOURCES FOR MACHINE LEARNING & DATA FLOW IN AUTISM RESEARCH

- Medical records
- Genetic data
- Neuroimaging data
- Behavioral data
 - Parent Questionnaire: M-CHAT-R (Modified Checklist for Autism in Toddlers)
- Wearable devices and sensors

Ethical Consideration: Data privacy and security -- Data Deidentification, HIPAA (Health Insurance Portability and Accountability Act)



CHALLENGES IN AI AND MACHINE LEARNING FOR AUTISM RESEARCH

- Data quality and representation
- Generalizability of AI models across diverse populations
- Designing AI-based tools with universal design principles
- Avoiding overreliance on AI and maintaining the role of human expertise

Accessibility and Inclusivity in AI-driven ASD Tools (Ethical Considerations?)

- Addressing biases in machine learning algorithms
- Ensuring access to AI-driven interventions for individuals with varying abilities
- Addressing language, cultural, and socioeconomic barriers



TOOLS



NATURAL LANGUAGE PROCESSING IN ASD RESEARCH

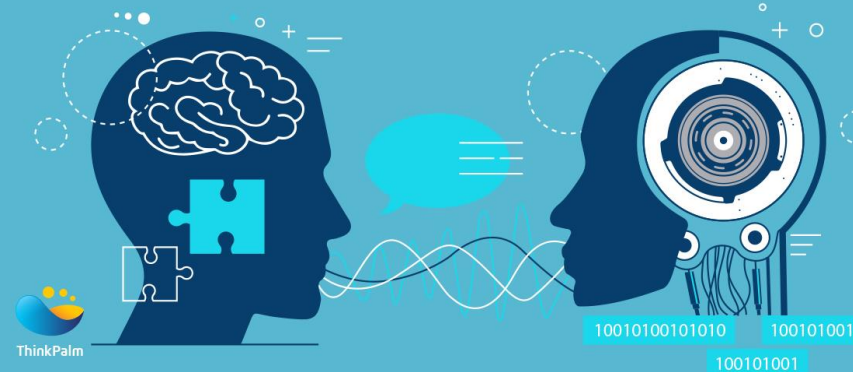
- Analysis of verbal and nonverbal communication patterns
- AI-driven assessment of language development
- Identifying communication challenges and designing targeted interventions
- *Digression -- NLP is at the heart of ChatGPT !!*

What are the Steps of Natural Language Processing?

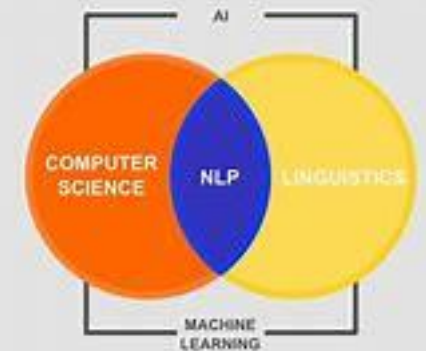


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NATURAL LANGUAGE PROCESSING (NLP)
FOR ARTIFICIAL INTELLIGENCE



What is Natural Language Processing (NLP)?



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AI-DRIVEN SOCIAL ROBOTICS

- Social robots as therapeutic tools for children with ASD
- Enhancing social interactions and communication skills
- Promoting emotional regulation and sensory processing

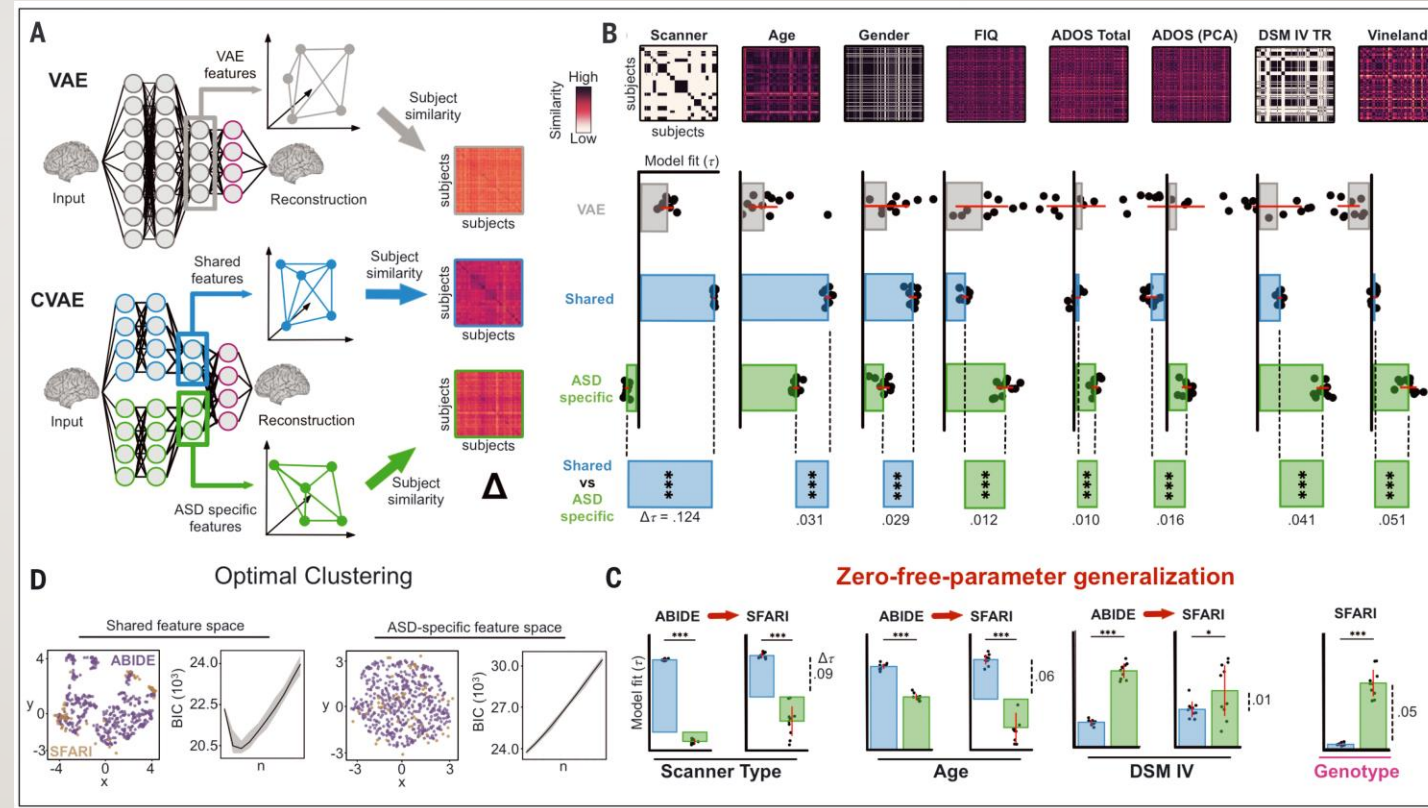
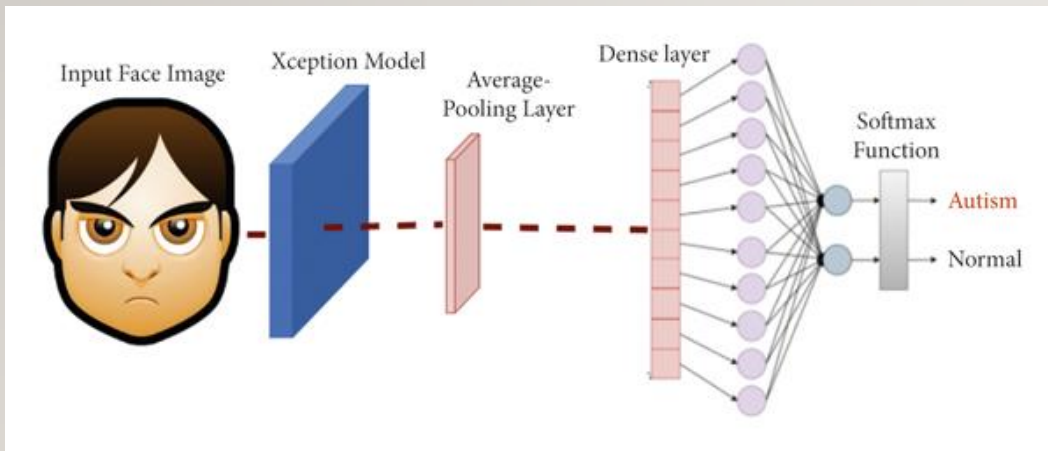


AT THE CORE OF AI (“UNDER THE HOOD”)



MACHINE LEARNING TECHNIQUES IN AUTISM RESEARCH

- Supervised learning
- Unsupervised learning
- Reinforcement learning
- Deep learning and neural networks



STAKE HOLDERS AND IMPACTS



COLLABORATION BETWEEN AI AND HUMAN EXPERTS

Between AI and Human Experts:

- AI as a tool to augment human expertise
- Strengthening interdisciplinary collaboration in ASD research
- Continuous improvement of AI models through human feedback

Public and Private Sector Partnerships

- Collaboration between academia, industry, and government
- Encouraging innovation and fostering investment in ASD research
- Promoting transparency and sharing of research findings



IMPACT ON FAMILIES AND CAREGIVERS

- Empowering caregivers with AI-based tools and resources
- Reducing stress and enhancing quality of life for families
- Promoting awareness and understanding of ASD

AI ENVIRONMENTS



AI IN EDUCATIONAL SETTINGS

- AI-based tools for personalized learning experiences
- Supporting inclusive education for children with ASD
- Monitoring progress and adapting to individual needs

INTEGRATION OF AI IN TELEHEALTH SERVICES

- Remote assessment and monitoring of individuals with ASD
- AI-driven recommendations for therapeutic interventions
- Enhancing access to services for families in rural or underserved areas

AI IN ASD-RELATED GENETIC RESEARCH

- Identifying gene variants associated with ASD
- AI-based analysis of large-scale genomic data
- Understanding the complex genetic architecture of ASD

EMOTION RECOGNITION AND AI

- Analyzing facial expressions, vocal patterns, and body language
- AI-driven emotion recognition to support social skills development
- Addressing emotion recognition challenges in individuals with ASD

AI-BASED GAMING AND ASD

- Interactive, AI-driven games for social and cognitive skills development
- Engaging and motivating children with ASD through gamification
- Data collection and progress tracking to inform personalized interventions

AI AND MACHINE LEARNING FOR ASD SUBTYPING

- Identifying distinct subtypes of ASD based on AI-driven pattern analysis
- Enhancing understanding of ASD heterogeneity
- Facilitating tailored interventions for individuals with different ASD profiles

CONCLUSION

- AI and machine learning are revolutionizing autism research
- Early diagnosis and personalized interventions are key benefits
- Ethical considerations must be addressed to ensure the responsible use of AI
- AI and machine learning are driving advances in autism research
- Potential for early diagnosis, personalized interventions, and improved support for families
- Addressing challenges and ethical considerations is essential for responsible application

FUTURE DIRECTIONS

- Integrating multiple data sources for holistic understanding
- Harnessing AI to advance precision medicine in ASD
- Expanding the availability of AI-driven tools to diverse populations

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- Dr. Angela Scarpa
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BACKUP SLIDES



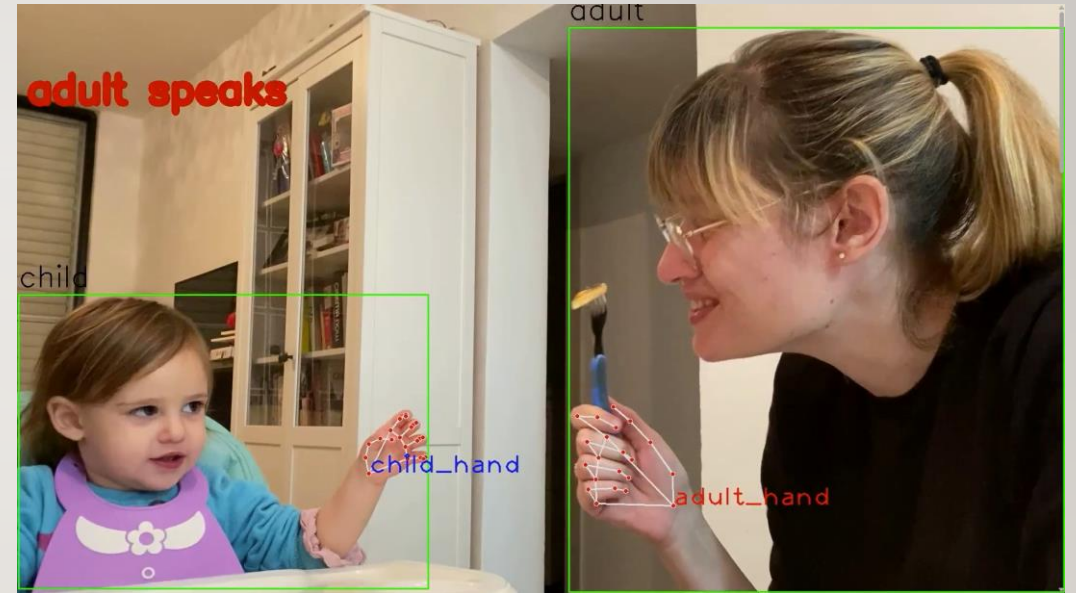
AI-DRIVEN INTERVENTION STRATEGIES

- a) Personalized interventions based on AI analysis
- b) Virtual reality and robotics for social skills training
- c) Adaptive learning technologies for cognitive and communication skills
- d) Real-time feedback and progress tracking



Case Study of a *Digital Augmented Reality Intervention for Autism* in School Classrooms: Associated With Improved Social Communication, Cognition, and Motivation via Educator and Parent Assessment

Front. Educ., 13 September 2018
Sec. Digital Education
Volume 3 - 2018 |
<https://doi.org/10.3389/feduc.2018.00057>



Child with autism learns to speak based on an AI-powered app. Parents provide recorded videos of structured therapy sessions at home. The software provides practical guidance and feedback based on AI analysis.

<https://nocamels.com/2022/12/finding-a-voice-how-ai-is-helping-children-with-autism/>

AI-DRIVEN INTERVENTION STRATEGIES - 2

Long Term

