First study: Applying machine learning to identify autistic adults using imitation: An exploratory study

https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0182652

This first study explores whether movement characteristics recorded during imitation of hand movements can be used to differentiate autistic adults from non-autistic (neurotypical) controls using machine learning. Rather than relying on subjective questionnaires or clinical observation, the researchers wanted to see if objective, quantitative movement data could do the job.

A Polhemus Liberty motion sensor was attached to the index finger of the participant's dominant hand, sampling their movements at 120 times per second in 3D space. 16 autistic and 16 non-autistic adults watched short video clips of a hand performing pointing movements, then imitated them. The movements varied in speed (normal or fast), trajectory (flat or elevated arc), and whether they pointed to a visible target or not, giving eight different movement conditions in total. Data from two autistic participants was excluded due to data capture issues, leaving 14 in that group.

The key finding was that machine learning could identify which movement conditions and kinematic parameters (such as velocity, amplitude and variability) were most useful for distinguishing between the two groups, achieving a classification accuracy of 93%. This was a proof-of-concept study, and while the results were promising, the validation methods used meant the findings needed to be interpreted cautiously.

Follow-up study that built on the first: Applying Machine Learning to Kinematic and Eye Movement Features of a Movement Imitation Task to Predict Autism Diagnosis

https://www.nature.com/articles/s41598-020-65384-4

This second study was designed to address the limitations of the first, using more rigorous validation methods and testing the models on independent, unseen data. A Polhemus Fastrak motion sensor was attached to the index finger of the participant's dominant hand, the same core role as in the first paper, with a small sensor clipped to the fingertip recording its precise position in 3D space. Both the Liberty and the Fastrak are different models within the Polhemus family and work on the same electromagnetic tracking principle.

The key finding here was that non-autistic individuals tended to successfully copy the unusual elevated kinematics of the movements they watched, while autistic individuals tended to retain their usual movement style, essentially defaulting to how they naturally move rather than mirroring what they saw.

Combined with eye tracking data, the models achieved a classification accuracy of 78%.