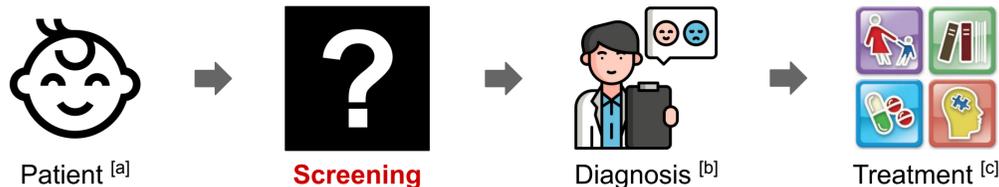


# RetinaMind

## Exploring a Quick, Objective, and Non-Invasive Method to Diagnose Neurodevelopmental Disorders Using the Retina

### Introduction: Autism and ADHD

#### The Early Diagnosis Problem



Diagnosis and treatment roadmap for Autism and ADHD patients. Figure by finalist in Google Drawings, 2025. [a,b] Obtained through Flaticon with paid license. (<https://www.flaticon.com/>) [c] Adapted from the Effective Health Care Program. (<https://effectivehealthcare.ahrq.gov/products/autism-update/consumer>)

- The **quicker** we diagnose and treat Autism Spectrum Disorder (ASD) and **ADHD**, the **better** the patient's outcome.
- Today, psychiatric diagnosis is a **lengthy** and **complex** process.
- Need: **Fast**, **Objective**, and **Accessible Early Screening**.

#### Disorder-Linked Retinal Features

ASD	ADHD
Foveal Thickness ↑	Retinal Nerve Fiber Layer Thickness ↓
Optic Disc Size ↑	Microvascular Density ↑
Vessel Density ↑	

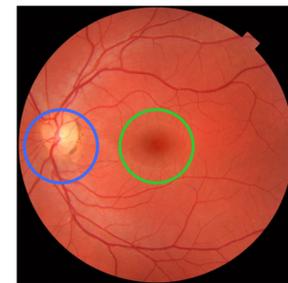


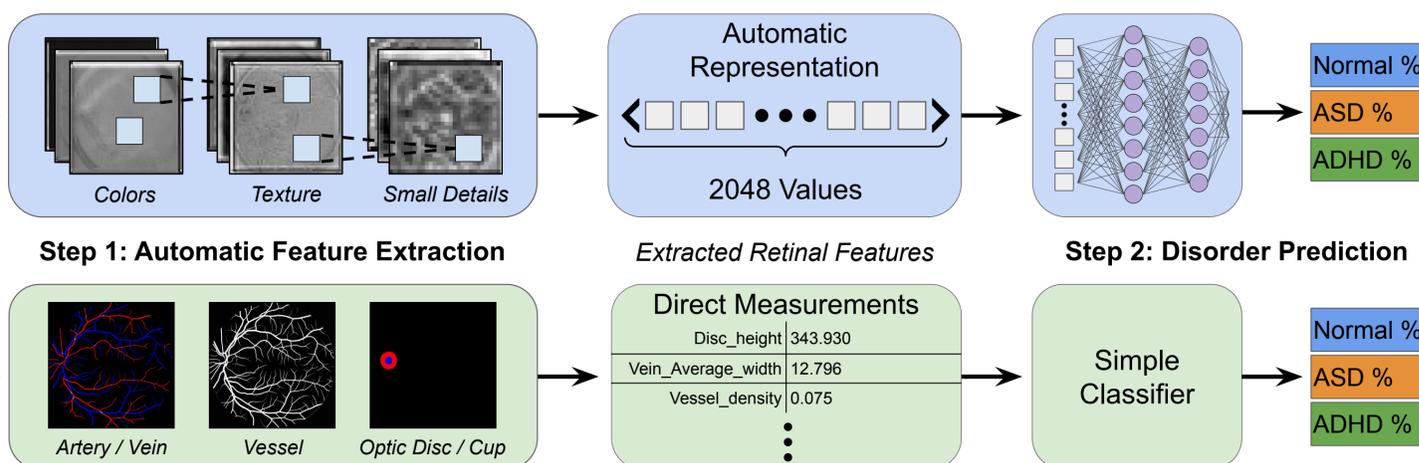
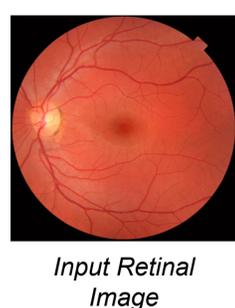
Figure by finalist in Google Drawings, 2025. Retinal image by Mikael Häggström, used with permission. (DOI:10.15347/wjmv/2014.008)

- Goals**
- 1) Develop computational models to **predict** ASD and ADHD patients using retinal images.
  - 2) Develop a biological model to better **understand** the ASD-retina connection.

### Enabling Retina-Based Diagnosis: Two Computational Models

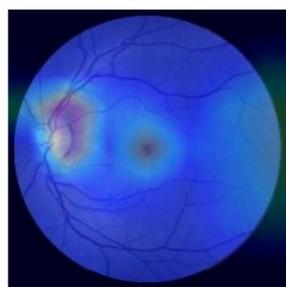
#### RetinaMind: A Dual-Model Approach

##### RetinaMind: A Dual-Model Approach



Summary of computational methodology. (Top, Blue) CNN model pipeline. (Bottom, Green) Transparency-focused model pipeline. Figure by finalist in Google Drawings and Python, 2026. Retinal images by Mikael Häggström, used with permission. (DOI:10.15347/wjmv/2014.008)

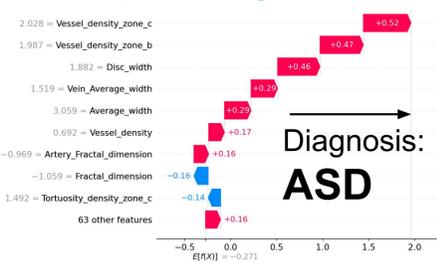
#### Convolutional Neural Network (CNN)



- Identifies **complex patterns** for high accuracy.
- **89% accuracy** in Autism and ADHD Diagnosis.
- Heatmaps reveal important retinal regions in diagnosis.

Red = important. Figure by finalist in Python, 2025. Retinal image by Mikael Häggström, used with permission. (DOI:10.15347/wjmv/2014.008)

#### Transparency-Focused Model



Sample SHAP (Lundberg & Lee, 2017) waterfall plot. Figure by finalist in Google Drawings and Python, 2026.

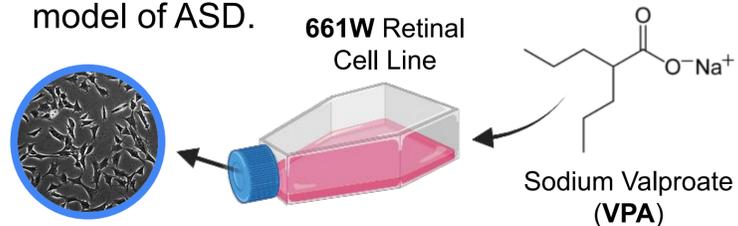
- Makes simple, **human-interpretable measurements**.
- Less accurate, but the model's **full thought process** can be understood.

**RetinaMind could help diagnose ASD and ADHD earlier.**

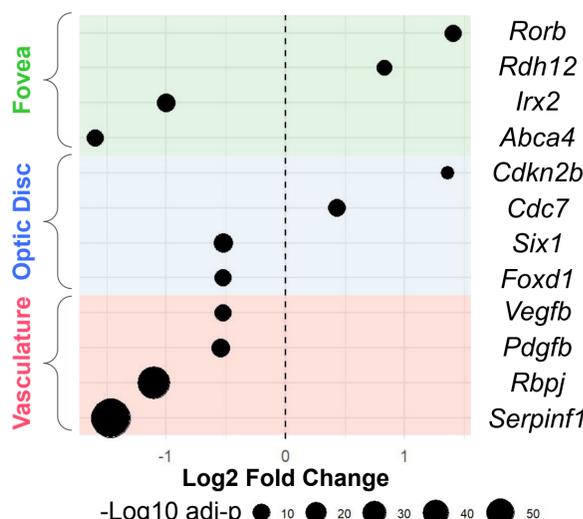
### Exploring the Autism-Retina Connection: A Biological Model

#### A Novel Retinal Cell Model of ASD

- Creating a **trustworthy** screening tool means understanding **why it works**.
- Until now, **very few** studies had explored the **genetic link** between ASD and the retina.
- This study proposes the **first ever** retinal cell model of ASD.



Summary of biological methods. Figure by finalist in BioRender, 2025. 661W cell photo taken by finalist using a tissue microscope (100x).



Retina-related genes, and how expression changes with VPA treatment. Figure by finalist in R, 2025.

- Identified dozens of **candidate genes** that may explain **why** ASD patients have retinal differences.

The findings support a **genetic foundation** for retina-based diagnosis.

The proposed cell model could enable **future research** into the brain-retina connection.