

ASD Screening in Children using Machine Learning

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Objective

Develop a screening model that uses eye fixation and deep learning to determine if a child has ASD.

Background

- Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that affects social skills. Early diagnosis is critical to proper development in children.
- ASD can be characterized by abnormalities in eye movement. Eye tracking can help better understand visual precursors to attention in ASD children.
- Currently, no quantifiable medical test exists for the purpose of screening.

Methods

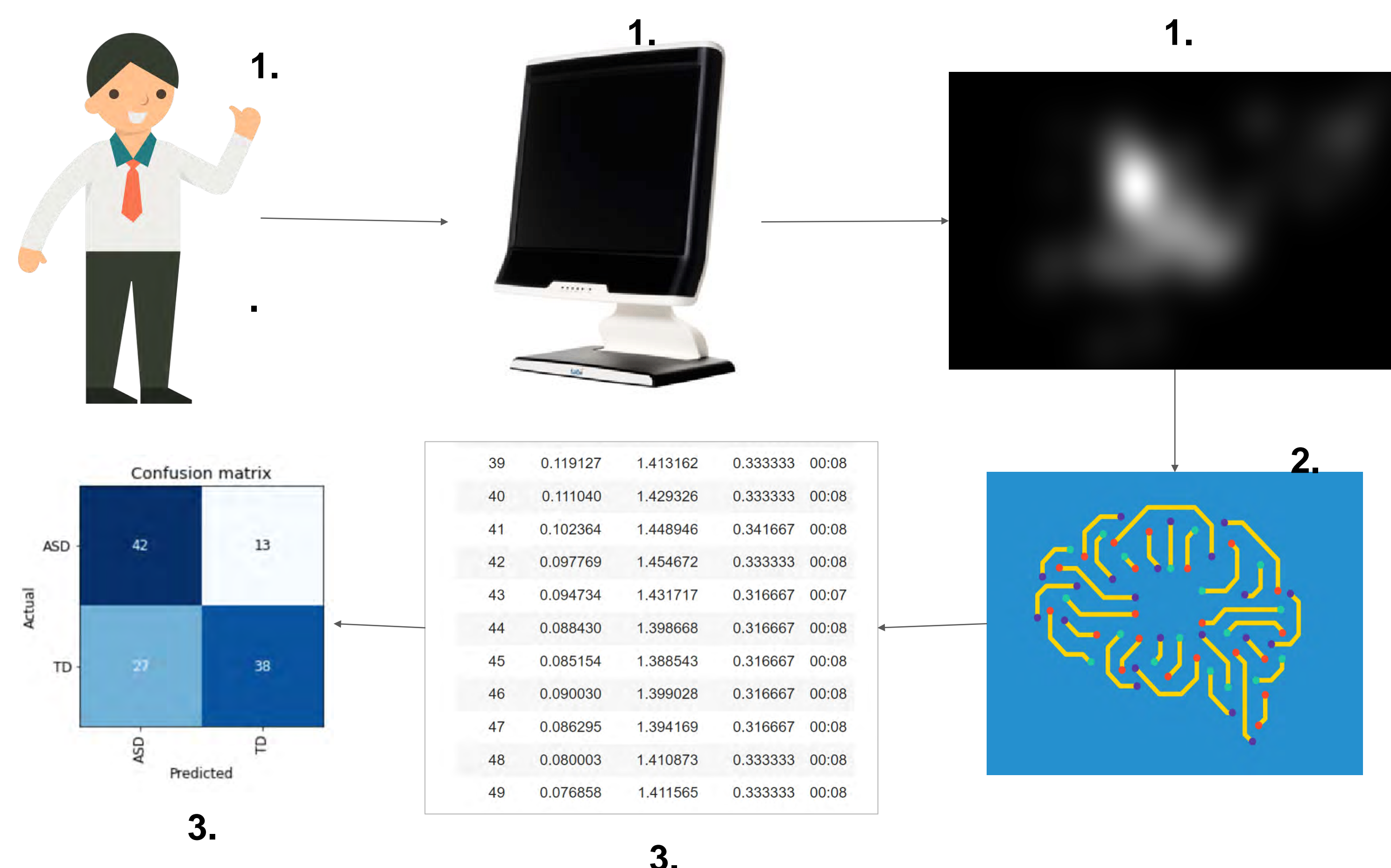


Figure 1. Schematic of methods for developing a screening model.

- Dataset (1):** An open-source dataset of eye fixation data and maps collected from ASD and typically developing (TD) children when shown a collection of varying stimuli images. Obtained published dataset from "A Dataset of Eye Movements for the Children with Autism Spectrum Disorder" by Duan et al.

- Coding the Machine Learning Model (2):** Use fastai and pytorch lightning to determine if collected eye-fixation data corresponds to ASD/TD. Coded in Google Colab using Python.
- Training, Validation, and Test Loss and Confusion Matrix (3):** Output to determine the accuracy of the model. Training set and Validation set are split 80:20, respectively

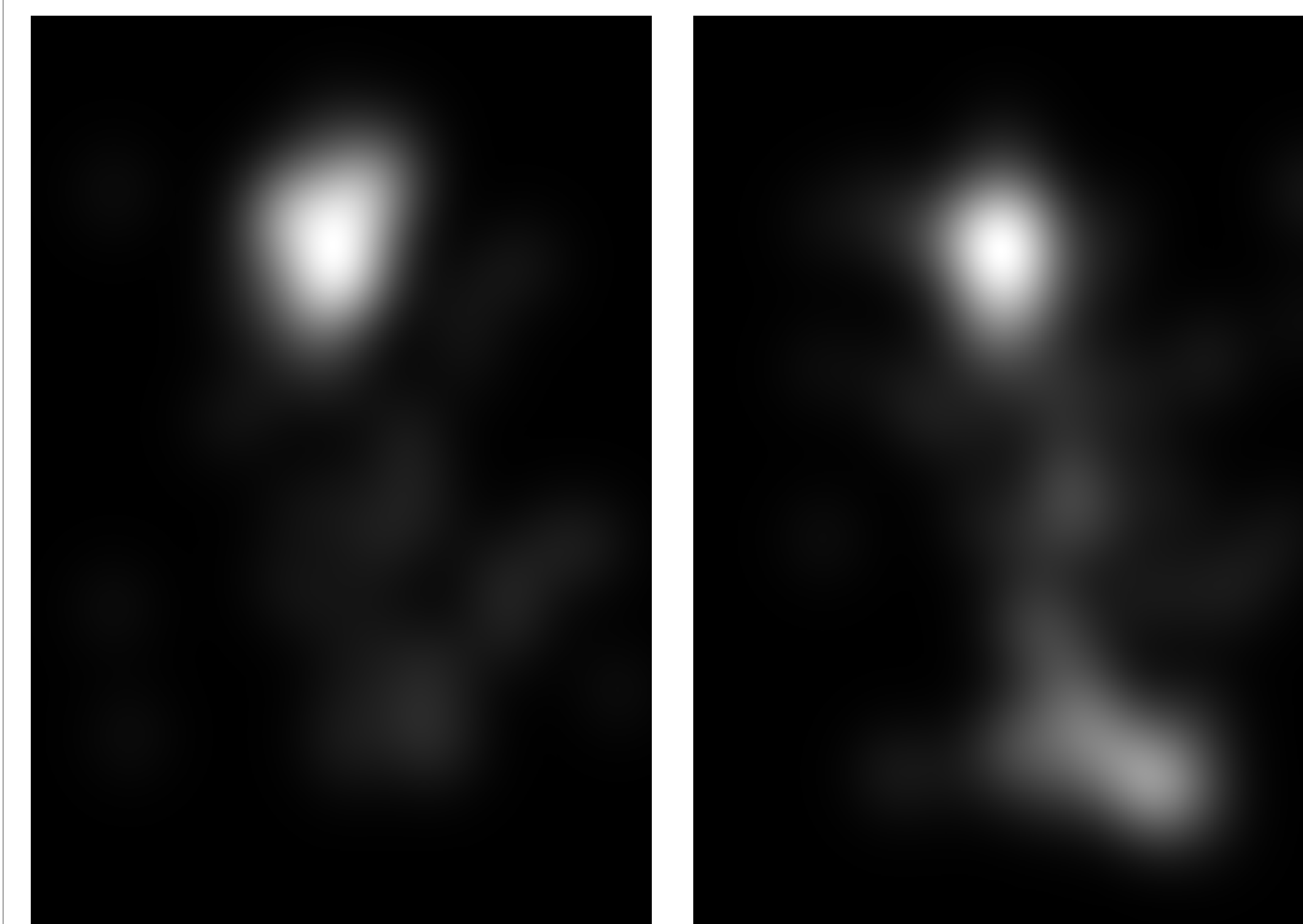


Figure 2. Examples of Binary Gaussian-blur fix maps for a. TD b. ASD children provided in the dataset from "A Dataset of Eye Movements for the Children with Autism Spectrum Disorder" by Duan et al.

Results

train_loss	train_acc	val_loss	val_acc
0.664	0.787	0.625	0.676

test_loss	test_acc	overall_acc
0.562	0.729	0.769

Table 1. Training loss (train_loss), training accuracy (train_acc), validation loss (valid_loss), validation accuracy (val_acc), test loss (test_loss), test accuracy (test_acc), overall accuracy (overall_acc).

- Training was early stopped at the epoch where valid_loss began to increase
- At the final epoch, train_loss << valid_loss (overfitting)
- Loss values are high for the mispredicted
- Accuracy by the final epoch = ~76.9%

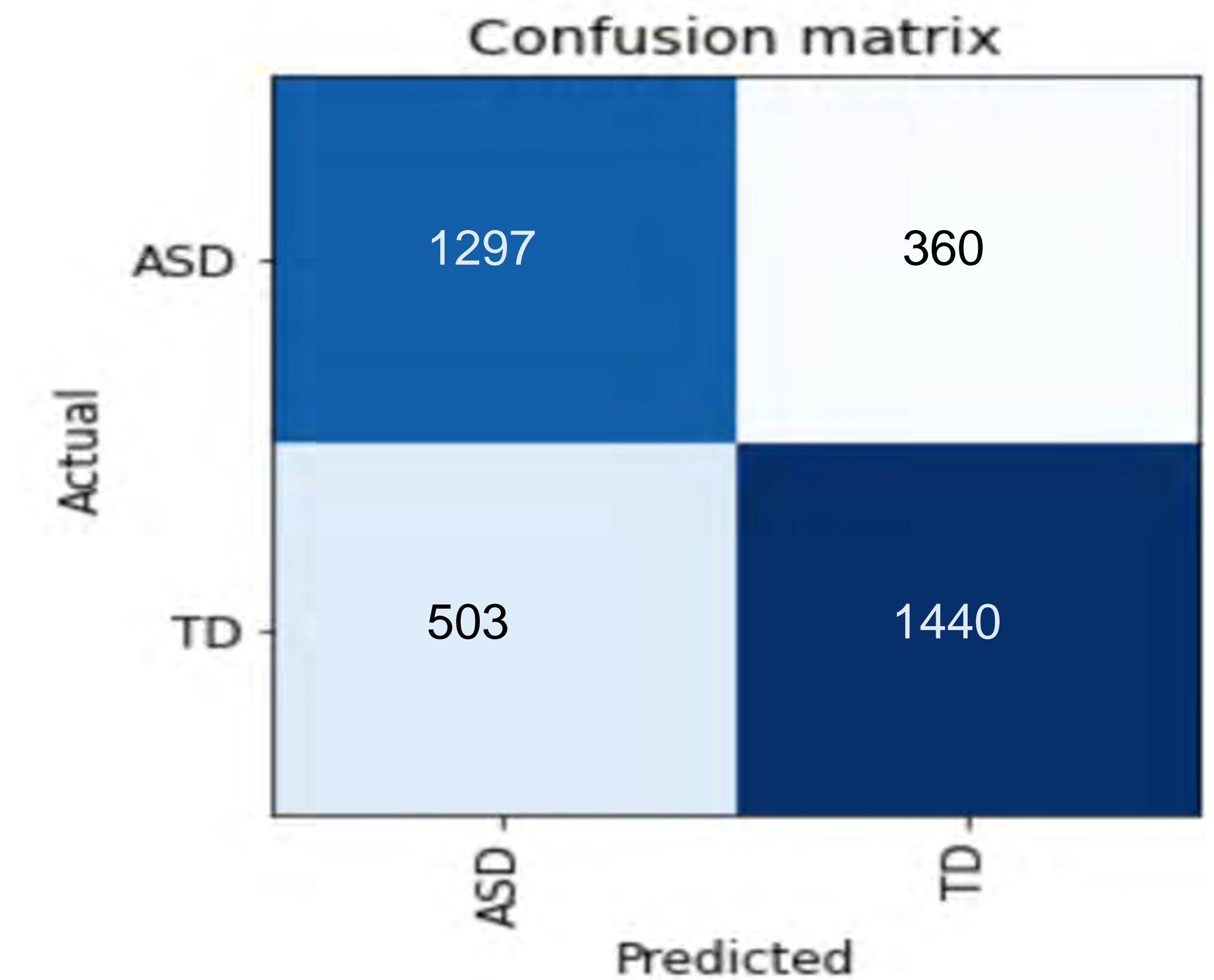


Figure 3. Confusion matrix calculated by the validation set.

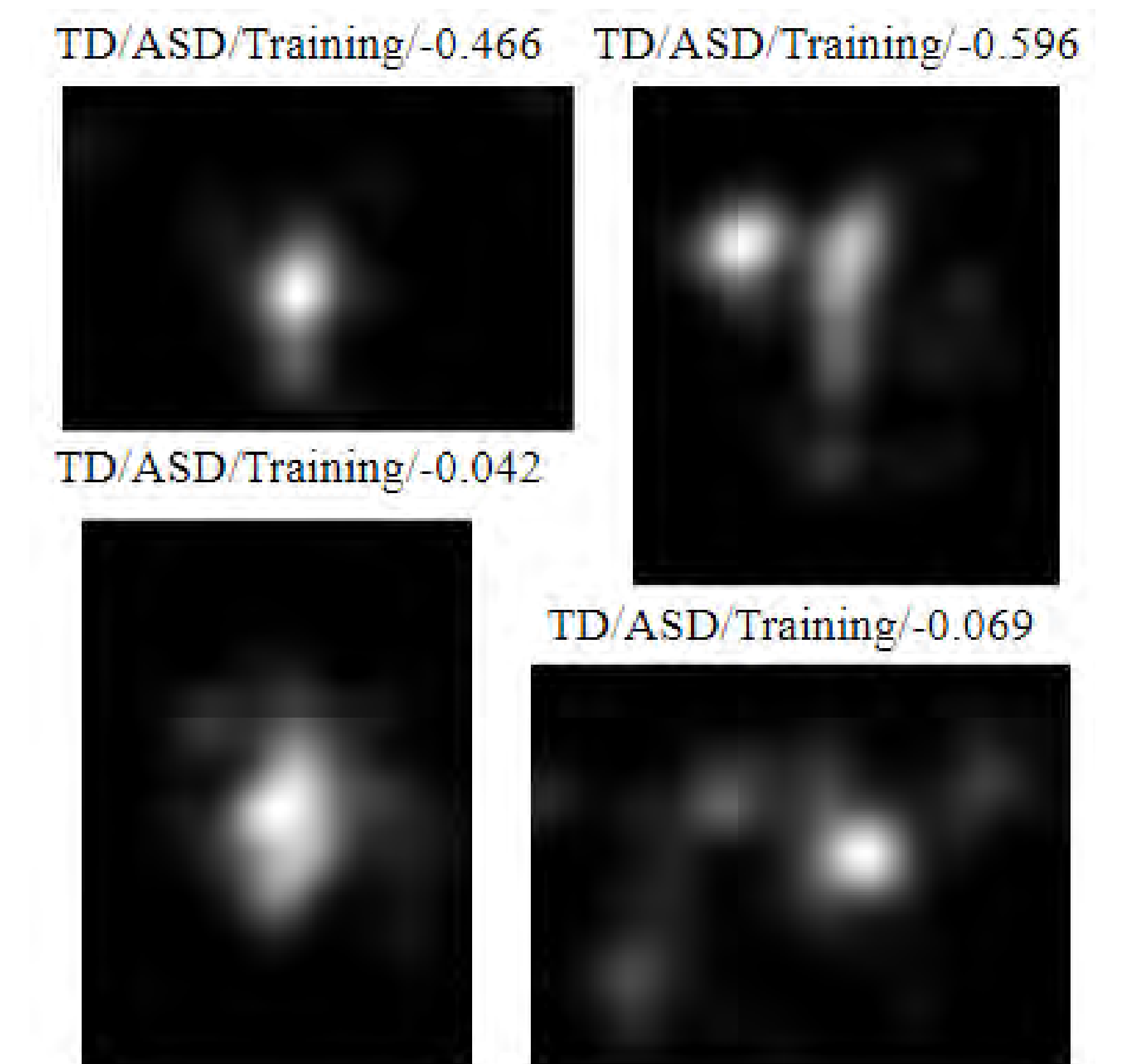


Figure 4. Top 4 losses in the validation set. The labels show Predicted/Actual/Set/Loss. Pictures are augmented from "A Dataset of Eye Movements for the Children with Autism Spectrum Disorder" by Duan et al.

Conclusion

The machine learning model is successful in catching and classifying typically developing and autistic children with some accuracy; however, this work can be improved in the future by testing other models and gathering more images. Future work may also include integrating this model with eye-tracking and an app for remote screening.