

Developing a Model for Mood Disorder Classification Using Eye Movements

Evita Conway, Michael J Kleiman

INTRODUCTION

Misdiagnosis rates are high

- Depression historically identified in only **47.3%** of patients.¹

Eye Movement analysis can already reliably detect:

- ADHD
- Alzheimer's Disease
- Autism
- Concussions

Eye tracking can also identify **Major Depressive Disorder (MDD)** and **General Anxiety Disorder (GAD)**.

- Depressed individuals orient/fixate gaze on negative images.²
- Anxious individuals orient gaze away from threatening or negative images in favor of positive or neutral images.³
- Healthy individuals do not show these biases.

Goals of the present study:

1. Distinguish gaze patterns present in healthy and unhealthy individuals.
2. Employ machine learning to create a **predictive classification model** capable of identifying those at risk for MDD and GAD.
3. Develop a cost-effective, easy to use, **objective** method of diagnosis.

METHOD

Depression and Anxiety ratings:

- Calculated via clinical self-report questionnaires (**GAD-7**: anxiety / **PHQ9**: depression)

Eye tracking measures:

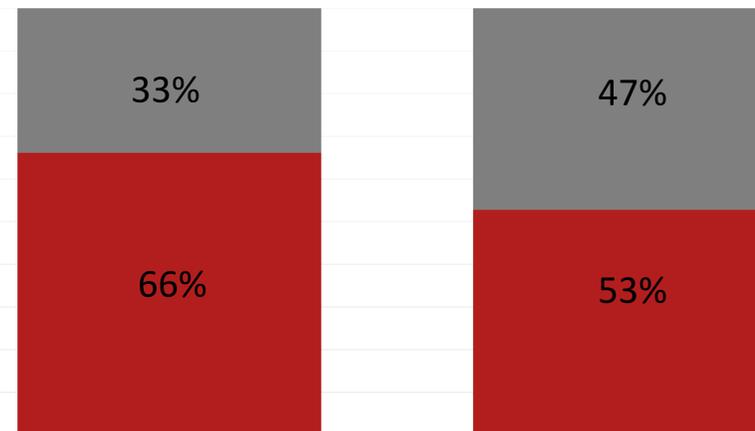
- **Fixation Duration: Total vs Visit**
- **Fixation Count: Total vs Visit**

Two tasks:

- Emotional context (4 images)
- Implicit memory (2 images, novel vs repeated)

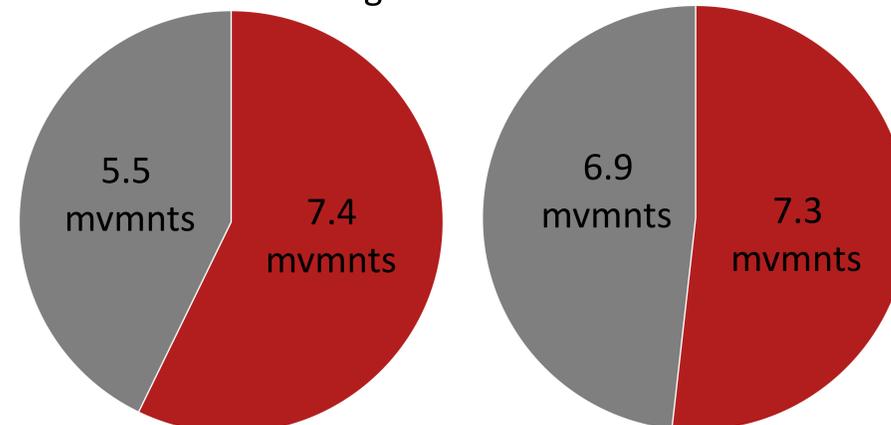


DURATION TOTALS PER STIMULUS FOR DEPRESSION



High Depression Low Depression

■ Negative ■ Neutral



MOVEMENTS PER STIMULUS FOR DEPRESSION

RESULTS

Depression

High Depression Rating:

- Looked more at negative images than neutrals
- Moved eyes between all images less
- Moved eyes within neutral images less

Low Depression Rating:

- Looked at negative and neutral images equally
- Moved eyes between all images more
- Moved eyes similarly within negative/neutral images

Predictive Analysis:

- Avg of **80% detection rate** ($p=.003$)
- Used Logistic Regression (60/40 train/test split)
- Our results: comparable to state-of-the-art models

Anxiety

- Overall, threatening images most looked at
- Only small differences between High and Low ratings

Predictive Analysis:

- Avg of **65% accuracy** (*not significant*)

CONCLUSION

Risk of depression may be able to be predicted using **only eye movement behavior**

Anxiety detection was inconclusive

Additional testing may increase detection rates, especially if clinical populations are utilized

REFERENCES

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2. Peckham, A. D., McHugh, R. K., & Otto, M. W. (2010). A meta-analysis of the magnitude of biased attention in depression. *Depression and Anxiety*, 27, 1135–1142
3. Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & van IJendoorn, M. H. (2007). Threat-related attentional bias in anxious and non-anxious individuals: A meta-analytic study. *Psychological Bulletin*, 133,1–24.