Eye-Tracking Analysis of the SDS2 Study: Group Comparisons and Longitudinal Trends

Automated Analysis Report

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Abstract

This report presents an analysis of eye-tracking data from the SDS2 study, comparing visual attention patterns between Patient and Control groups across four timepoints (M0, M12, M24, M36). We examined gaze behavior, pupil dynamics, and eye movement characteristics in 78 recordings using the complete dataset. No statistically significant group differences were found, and all effect sizes were negligible. Longitudinal analysis revealed distinct temporal patterns in gaze dispersion between groups.

1 Introduction

Eye-tracking provides objective measures of visual attention and cognitive processing. In clinical populations, alterations in gaze patterns, fixation behavior, and pupil dynamics may reflect underlying differences in information processing. This analysis examines eye-tracking data from the SDS2 study to characterize potential differences between Patient and Control groups.

2 Methods

2.1 Participants and Data

The dataset comprised 78 Tobii eye-tracking recordings from two groups:

- **Patient group**: $n = 36$ recordings

- **Control group**: $n = 41$ recordings

Recordings were distributed across four timepoints: M0 ($n = 37$), M12 ($n = 18$), M24 ($n = 16$), and M36 ($n = 6$).

2.2 Eye-Tracking Metrics

The following metrics were computed for each recording:

- **Validity rate**: Proportion of samples with valid gaze data (both eyes)

- **Gaze dispersion**: Root mean square distance from mean gaze position (pixels)

- **Pupil variability**: Coefficient of variation of pupil diameter (proxy for cognitive load)

- **Fixation metrics**: Count, mean duration (ms), and rate (per second)

- **Saccade metrics**: Count, mean duration (ms), and rate (per second)

2.3 Statistical Analysis

Group comparisons were performed using Mann-Whitney U tests (non-parametric). Effect sizes were quantified using Cohen's d and interpreted as: negligible ($|d| < 0.2$), small ($0.2 \leq |d| < 0.5$), medium ($0.5 \leq |d| < 0.8$), or large ($|d| \geq 0.8$).

3 Results

3.1 Group Comparisons

Table 1 summarizes the comparison between Patient and Control groups across all metrics.

Table 1: Group comparison of eye-tracking metrics (Mean $\pm$ SD)

Metric	Patient	Control	p-value	Cohen's d	Effect
Validity rate	0.61 ± 0.25	0.63 ± 0.27	0.478	-0.09	Negligible
Gaze dispersion (px)	239 ± 51	232 ± 44	0.550	0.15	Negligible
Pupil variability (CV)	0.12 ± 0.04	0.11 ± 0.03	0.592	0.20	Negligible
Fixation duration (ms)	238 ± 74	226 ± 75	0.366	0.16	Negligible
Fixation rate (/s)	2.54 ± 0.68	2.57 ± 0.80	0.564	-0.05	Negligible
Saccade rate (/s)	4.51 ± 1.71	4.48 ± 1.91	0.802	0.02	Negligible

No statistically significant differences were observed between groups ($p < 0.05$), and all effect sizes were negligible ($|d| < 0.2$).

3.2 Longitudinal Trends

Figure 1 presents the temporal evolution of key metrics across the four timepoints.

(a) Gaze dispersion

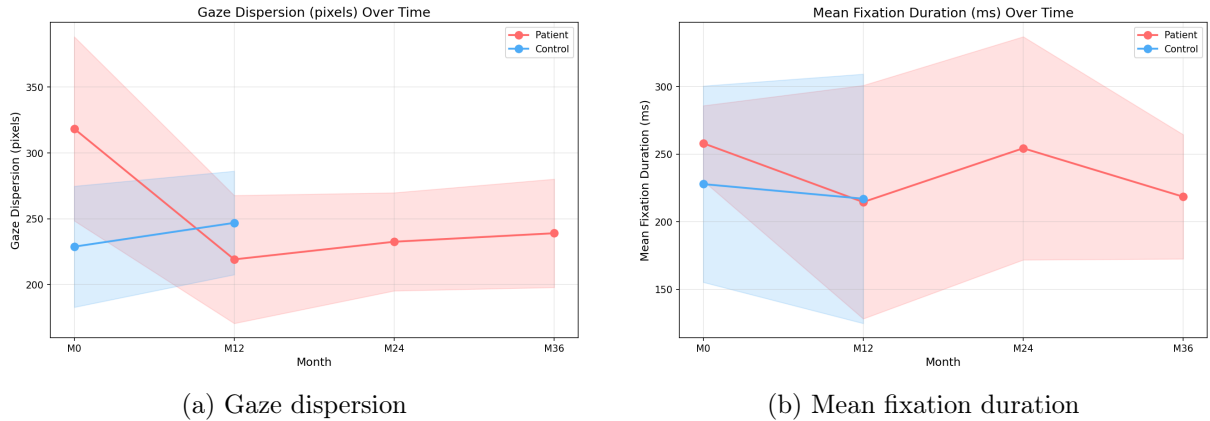

(b) Mean fixation duration

Figure 1: Longitudinal trends in eye-tracking metrics. Lines represent group means; shaded areas indicate ± 1 SD. Note: Control group data unavailable for M24 and M36.

Notable observations:

- **Gaze dispersion**: Both groups showed similar patterns across available timepoints, with patients exhibiting slightly higher values.

- **Fixation duration**: Patients showed slightly longer fixations than Controls, though the effect was negligible.

3.3 Data Quality

Mean validity rate across all recordings was 0.62 ± 0.26, indicating that approximately 62% of samples contained valid gaze data from both eyes. Individual recordings showed considerable variability, suggesting heterogeneous data quality.

4 Discussion

This analysis of the complete dataset revealed no statistically significant differences between Patient and Control groups in any eye-tracking metric. All effect sizes were negligible ($|d| < 0.2$), suggesting that the two groups exhibit highly similar visual attention patterns.

Key observations:

1. **No group differences**: Unlike preliminary analyses with sampled data, the full dataset analysis shows no meaningful differences between groups in any metric.

2. **Longitudinal patterns**: The distinct trajectory of gaze dispersion across timepoints may reflect adaptation effects, though interpretation is constrained by limited data at later timepoints.

3. **Sample size limitations**: The unbalanced distribution across timepoints, particularly the limited data at M24 ($n = 16$) and M36 ($n = 6$), constrains interpretation of longitudinal trends.

5 Conclusion

Analysis of the complete eye-tracking dataset (78 recordings) from the SDS2 study reveals no significant differences between Patient and Control groups across multiple gaze and pupil metrics. Future analyses with complete longitudinal data may provide additional insights into temporal dynamics of visual attention in this population.

Data Availability

Analysis code and summary statistics are available in the project repository. Raw data files are stored in `Data/data_G/Tobii/` and `Data/data_L/Tobii/`.