

Peer Review

Review of: "State Anxiety Biomarker Discovery: Electrooculography and Electrodermal Activity in Stress Monitoring"

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The use of electrooculography (EOG)^[1] to identify biomarkers for state anxiety represents a novel extension beyond its traditional ophthalmological applications (e.g., diagnosing retinal disorders).^[2] By capturing eye movements and blink patterns to assess mental health, the study opens a new avenue for non-invasive stress monitoring.

However, the study uses a vertical EOG setup (electrodes above and below the eye) with a reference on the forehead, capturing only vertical eye movements and blinks. Horizontal eye movements, which may also reflect anxiety-related behaviors, are not recorded. The EOG setup and blink detection methods are not validated against standard ophthalmological benchmarks, raising questions about their accuracy in capturing the corneo-retinal potential and blink dynamics. While the blink detection algorithm performs well in controlled settings, its effectiveness in naturalistic environments with varied artifacts (e.g., head movements, facial expressions) is not demonstrated. The study does not account for ocular conditions (e.g., dry eye syndrome,^[3] blepharospasm)^[4] that could alter blink patterns and confound anxiety-related findings.

Although the study acknowledges the importance of context, contextual factors (e.g., task difficulty, environmental conditions) are not explicitly incorporated into the anxiety prediction model. A better approach is to benchmark against other physiological anxiety markers (e.g., heart rate variability,^[5] cortisol levels).^{[7][8]} While blink rate, duration, and amplitude align with ophthalmological principles, the study's novel features (e.g., X-Axis Deviation, Symmetry Ratio) require further validation to ensure

they meaningfully reflect physiological changes tied to anxiety rather than artifacts or unrelated ocular phenomena.

I would suggest incorporating horizontal EOG electrodes (e.g., lateral to each eye) alongside the vertical setup to capture horizontal eye movements (e.g., saccades). This could reveal additional anxiety-related patterns, as gaze shifts may reflect heightened arousal or avoidance behaviors.

References

1. ^ΔDonnell J. Creel. (2019). The electrooculogram. doi:10.1016/b978-0-444-64032-1.00033-3.
2. ^ΔDonnell J. Creel. (2019). The electrooculogram. doi:10.1016/b978-0-444-64032-1.00033-3.
3. ^ΔAnthony Oganov, Ghasem Yazdanpanah, Sayena Jabbehdari, Aditya Belamkar, et al. (2023). Dry eye disease and blinking behaviors: A narrative review of methodologies for measuring blink dynamics and inducing blink response. *The Ocular Surface*, vol. 29, 166-174. doi:10.1016/j.jtos.2023.05.011.
4. ^ΔP. Schwingenschuh, P. Katschnig, M.J. Edwards, J.T.H. Teo, et al. (2011). The blink reflex recovery cycle differs between essential and presumed psychogenic blepharospasm. *Neurology*, vol. 76 (7), 610-614. doi:10.1212/wnl.0b013e31820c3074.
5. ^ΔJulia Tomasi, Clement C. Zai, Jennie G. Pouget, Arun K. Tiwari, et al. (2023). Heart rate variability: Evaluating a potential biomarker of anxiety disorders. *Psychophysiology*, vol. 61 (2). doi:10.1111/psyp.14481.
6. ^ΔYing-Chih Cheng, Min-I Su, Cheng-Wei Liu, Yu-Chen Huang, et al. (2022). Heart rate variability in patients with anxiety disorders: A systematic review and meta-analysis. *Psychiatry Clin Neurosci*, vol. 76 (7), 292-302. doi:10.1111/pcn.13356.
7. ^ΔDuygu Kara, Nevzat Aykut Bayrak, Burcu Volkan, Cihat Uçar, et al. (2019). Anxiety and Salivary Cortisol Levels in Children Undergoing Esophago-Gastro-Duodenoscopy Under Sedation. *J. pediatr. gastroenterol. nutr.*, vol. 68 (1), 3-6. doi:10.1097/mpg.0000000000002142.
8. ^ΔR.J. Kolbe, S.A. Madathil, L.M. Marin, R. Seth, et al. (2023). Salivary Cortisol and Anxiety in Canadian Dentists over 1 Year of COVID-19. *J Dent Res*, vol. 102 (10), 1114-1121. doi:10.1177/00220345231178726.

Declarations

Potential competing interests: No potential competing interests to declare.