For research article

Response to Reviewer 2 Comments

Thank you for your valuable feedback on our manuscript. We appreciate your positive comments and constructive suggestions. Below are our detailed responses to your comments:

Comment 1: "The main question addressed by this research is whether an eye-tracking methodology, combined with filtering algorithms, can improve the accuracy of data on subject engagement during activation MRI cognitive tasks. The originality of this research lies in its integration of eye-tracking technology with MRI to assess participant engagement during cognitive tasks. This approach addresses the gap in accurately quantifying subject engagement and reducing noise in activation MRI data, which is crucial for the reliability of cognitive task assessments. Including a more diverse demographic, in terms of age and other factors, could also provide more comprehensive insights. Additionally, implementing more stringent controls for environmental factors and ensuring consistency in the visual stimuli presented during the tasks would further strengthen the study's methodology."

Response 1: Thank you for recognizing the originality and importance of our research. We agree that including a more diverse demographic would provide more comprehensive insights. For this initial study, we chose a narrow age range of young, healthy adults to minimize variability and control for confounding factors. We acknowledge the importance of expanding the demographic scope in future research to validate and extend our findings. We also appreciate your suggestion regarding environmental controls and consistency in visual stimuli, which we will consider for future studies to further strengthen our methodology.

We have added these limitations and prospective to the manuscript section 4 as follows:

"4. Discussions

By initially working with a homogeneous group of young, healthy adults, we ensured that our methodology is robust and reliable before applying it to more complex and variable populations. Future research will aim to include a more diverse demographic to provide comprehensive insights and validate our findings across different populations, including individuals with Alzheimer's disease, attention deficits, and neurodevelopmental disorders. These populations present unique challenges in interpreting brain activation maps due to potential variations in patient participation and engagement with the stimuli."

Comment 2: "In Figure 3, it is excellent to see (a3) and (b3) derived from (a2) and (b2). Why? Please provide more explanations."

Response 2:

We apologize for any confusion. The purpose of Figures 3(a3) and (b3) is to illustrate the effectiveness of our filtering algorithms. Figures 3(a2) and (b2) show the raw eye-tracking data with noise and artifacts, while Figures 3(a3) and (b3) show the corrected data after applying our filtering methods. The filtered data demonstrate improved accuracy in gaze position, which is crucial for reliable eye-tracking data analysis in fMRI studies.

Additionally, we identified an error in the titles of the sub-figures within Figure 3, which may have contributed to the confusion. We have revised the titles to correct this issue. Moreover, we will modify the legend to include more details on the process between the two figures, specifying how our algorithm identified and corrected the artifacts, such as those caused by physiological noise or sensor errors. This explanation is based on the description provided in the Materials and Methods section. Additionally, we will label the sources of artifacts directly on the figure for clarity.

The updated figure titles can be found on section 2.5, Figure 3, of the new version of this article as follows:

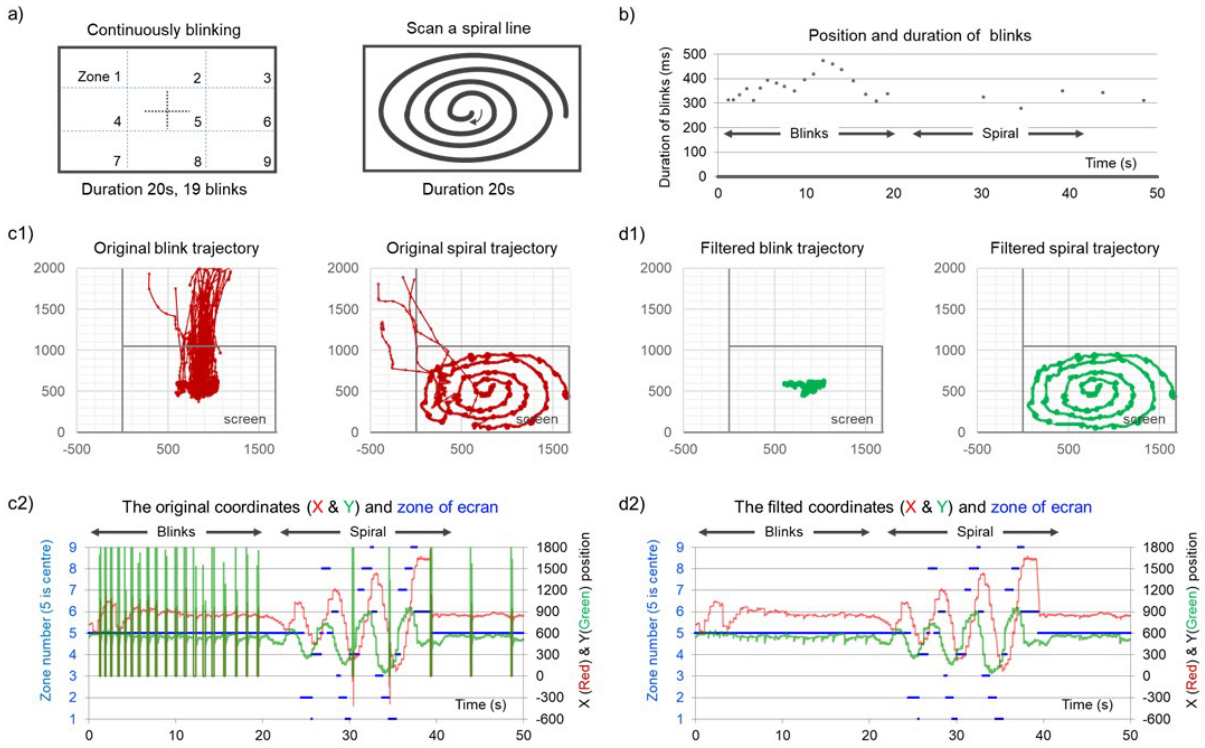

Figure 3. Two 20-second test protocols. (a) The subject fixates on the center of the screen and blinks continuously, approximately once per second, then the subject scans a spiral trajectory from the inside out. (b) Shows the moments and durations of blinks during the data collection process. (c1) Displays the raw path trajectories under the two protocols, while (d1) shows the filtered trajectories. (c2) and (c3) present time-position plots of the raw and filtered data, respectively, where blue indicates the current gaze point position on the screen, which is divided into nine sections as shown in (a), and red and green represent the coordinates of the gaze point.

Comment 3: "Figures 4 and 5 are unclear. It is suggested to replace them with two tables respectively."

Response 3:

We appreciate your suggestion. We have replaced Figures 4 and 5 with two tables that summarize the data more clearly. These tables provide a more concise and accessible presentation of the results, as you recommended.