Supplementary Material

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1 Temporal Gradients

Considering the input fMRI data, where $f \in \mathbb{R}^{h \times w \times d \times t}$, we calculate the temporal gradient [1] as a finite difference approximation of the partial derivative of f with respect to t, denoted as follows:

$$\nabla_t f \approx \frac{f(h,w,d,t+\delta t) - f(h,w,d,t)}{\delta t} \tag{1}$$

In our experiments, we utilized a fast temporal gradient ($\delta t = 1$) [2] as elaborately discussed in **Section 4.1: Effectiveness of Dense Visual Representation**. This approach was employed to evaluate group-level differences, as it captures intricate and finely-detailed dynamic patterns of the active region, thus serving as a crucial analytical tool. Here, we demonstrate the extracted temporal gradient for a randomly selected control subject from the test set in the figure S1.
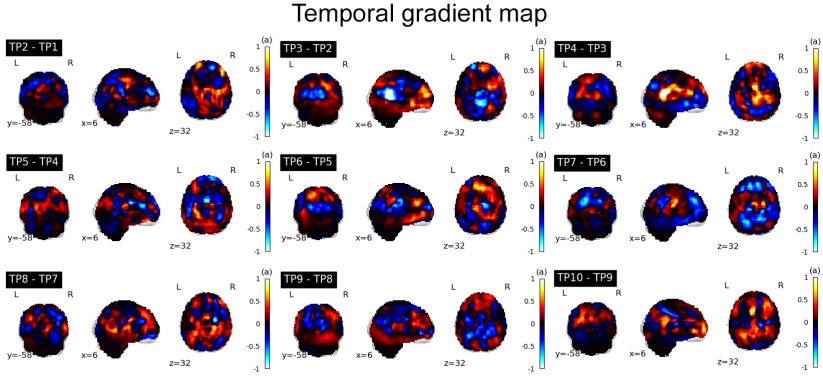
Figure S1: The temporal gradient map extracted from a randomly selected control subject provides further evidence of the model's ability to capture dynamic brain patterns.

Moreover, our investigation incorporated Shannon entropy as a metric, revealing the amount of dynamic brain activity depicted in Figure S2. By leveraging this metric, we quantified the evolving patterns across temporal dimensions, deepening our comprehension of the underlying brain dynamism.
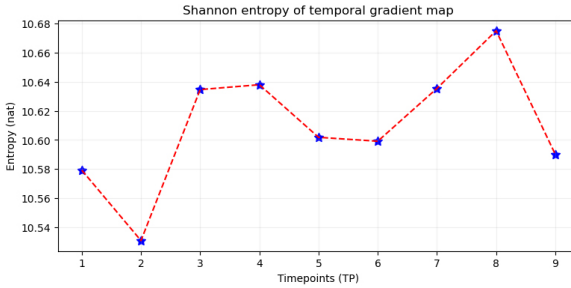

Figure S2: The temporal gradient map extracted from a randomly selected control subject provides further evidence of the model's ability to capture dynamic brain patterns.

References

[1] Marco Manzi, Markus Kettunen, Frédo Durand, Matthias Zwicker, and Jaakko Lehtinen. Temporal gradient-domain path tracing. *ACM Transactions on Graphics (TOG)*, 35(6): 1–9, 2016.

[2] Junfei Xiao, Longlong Jing, Lin Zhang, Ju He, Qi She, Zongwei Zhou, Alan Yuille, and Yingwei Li. Learning from temporal gradient for semi-supervised action recognition. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, pages 3252–3262, 2022.