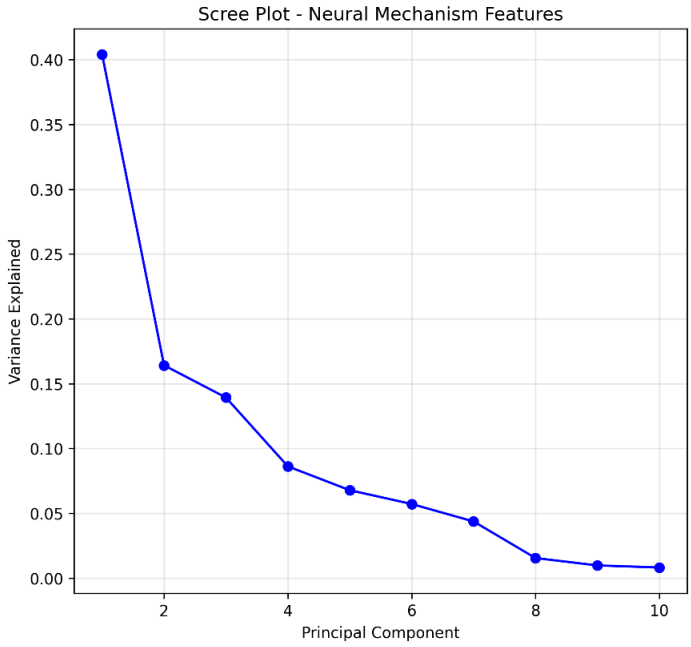
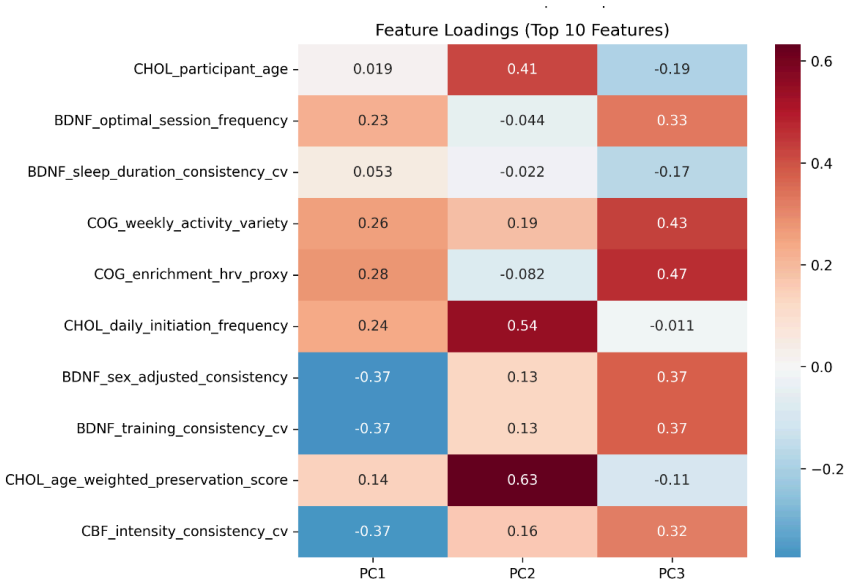
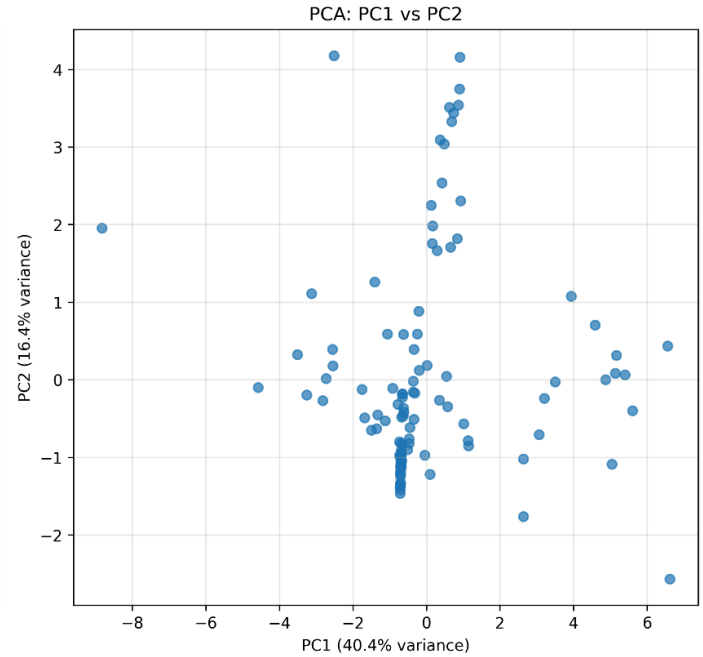


(A)

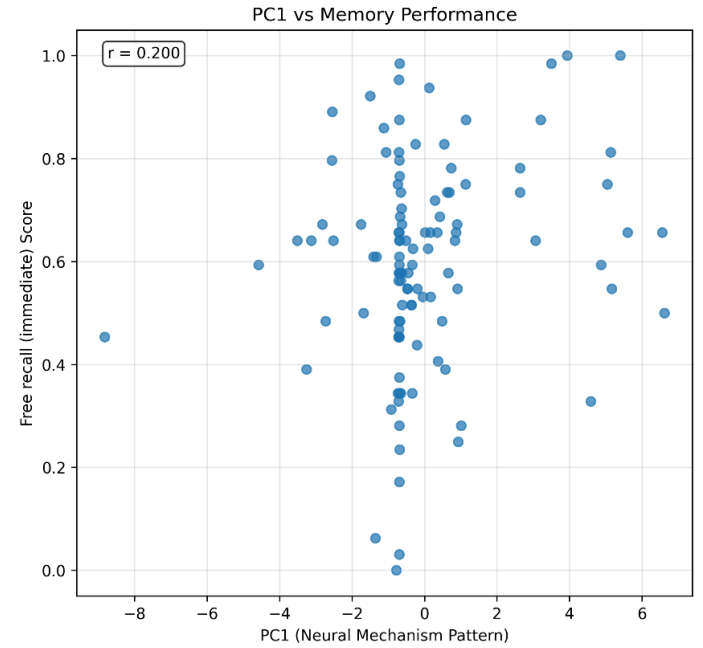


(B)

Figure 1. Neural mechanism PCA results (Analysis 1). **(A) Scree plot** showing variance explained by each principal component, with PC1 capturing 40.4% of total variance, indicating a dominant pattern of neural mechanism optimization. **(B) Feature loadings heatmap for top 10 neural mechanism features** across the first three principal components. BDNF and CBF features show strong positive loadings on PC1. (red), while cholinergic and cognitive enrichment features display more complex patterns across components.

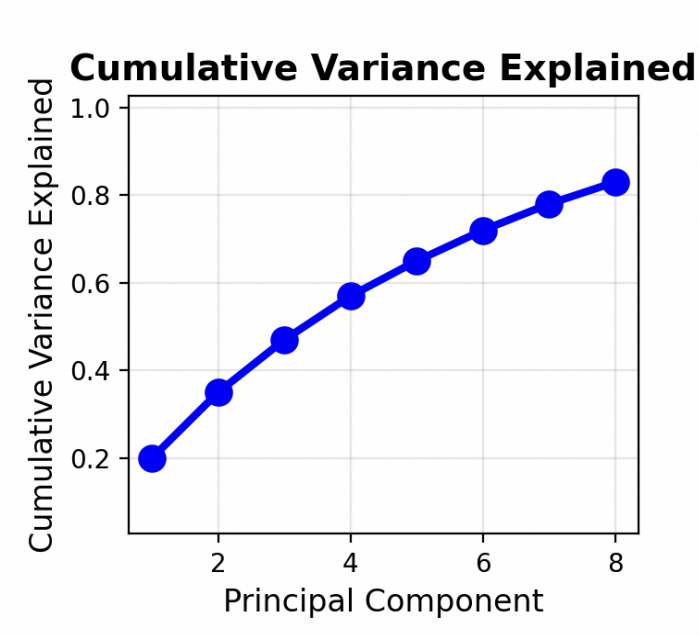


(A)

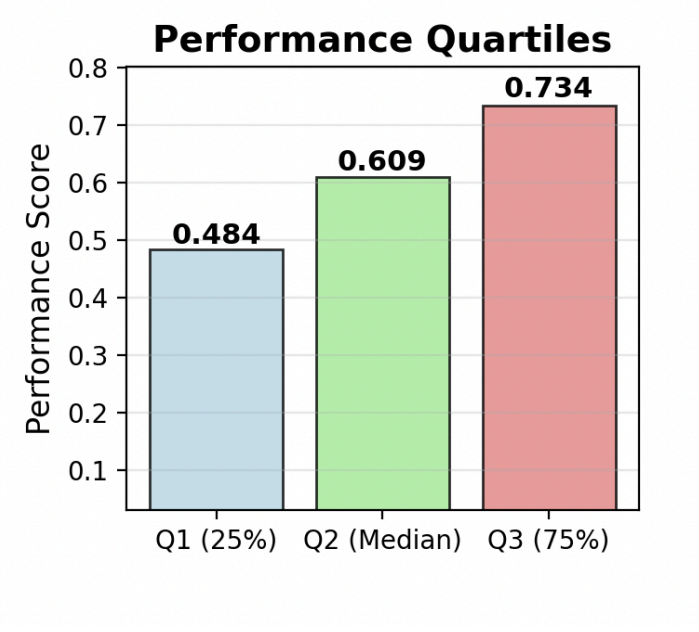


(B)

Figure 2. Participant distribution and memory associations (Analysis 1). **(A) PC1 vs PC2 scatter plot** showing continuous distribution of participants across neural mechanism optimization space, with no discrete clustering apparent. **(B) Relationship between PC1 scores and immediate free recall performance**, revealing a modest positive correlation (r = 0.200) between neural mechanism optimization patterns and memory outcomes.

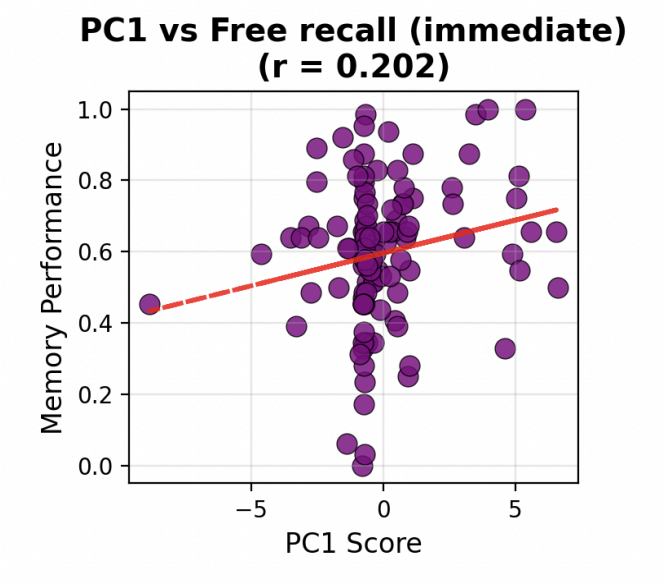


(A)

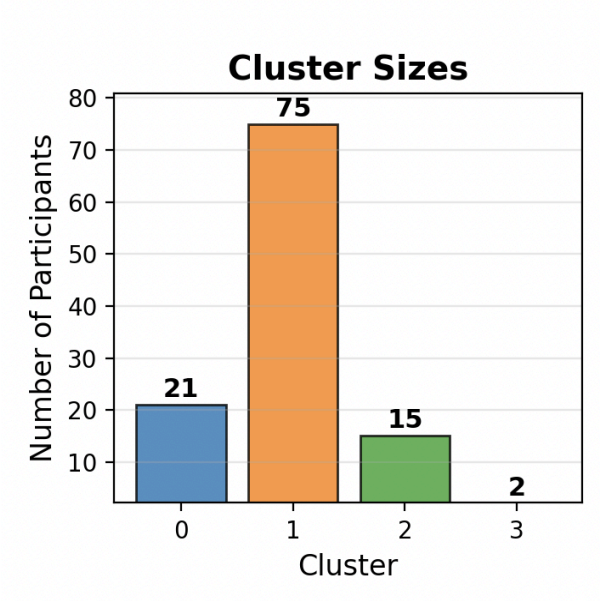


(B)

Figure 3. Expanded analysis variance and performance distributions (Analysis 2). **(A) Cumulative variance explained** by principal components in the 18-feature analysis, with the first five components capturing 87% of total variance. **(B) Memory performance quartiles** showing distribution across participants, with Q3 performers (0.734) substantially outperforming Q1 (0.484) and median (0.609) groups.



(A)



(B)

Figure 4. Cluster analysis and memory relationships (Analysis 2). **(A) PC1 vs immediate free recall performance** with trend line, showing weak positive correlation (r = 0.202) between neural mechanism optimization and memory outcomes. **(B) K-means cluster sizes** revealing four distinct phenotypes, with Cluster 1 representing the majority (66%) of participants and Cluster 2 (13%) showing highest optimization patterns.