Granger Causality Analysis Report: Participant 8002, T2, Phase1

Introduction

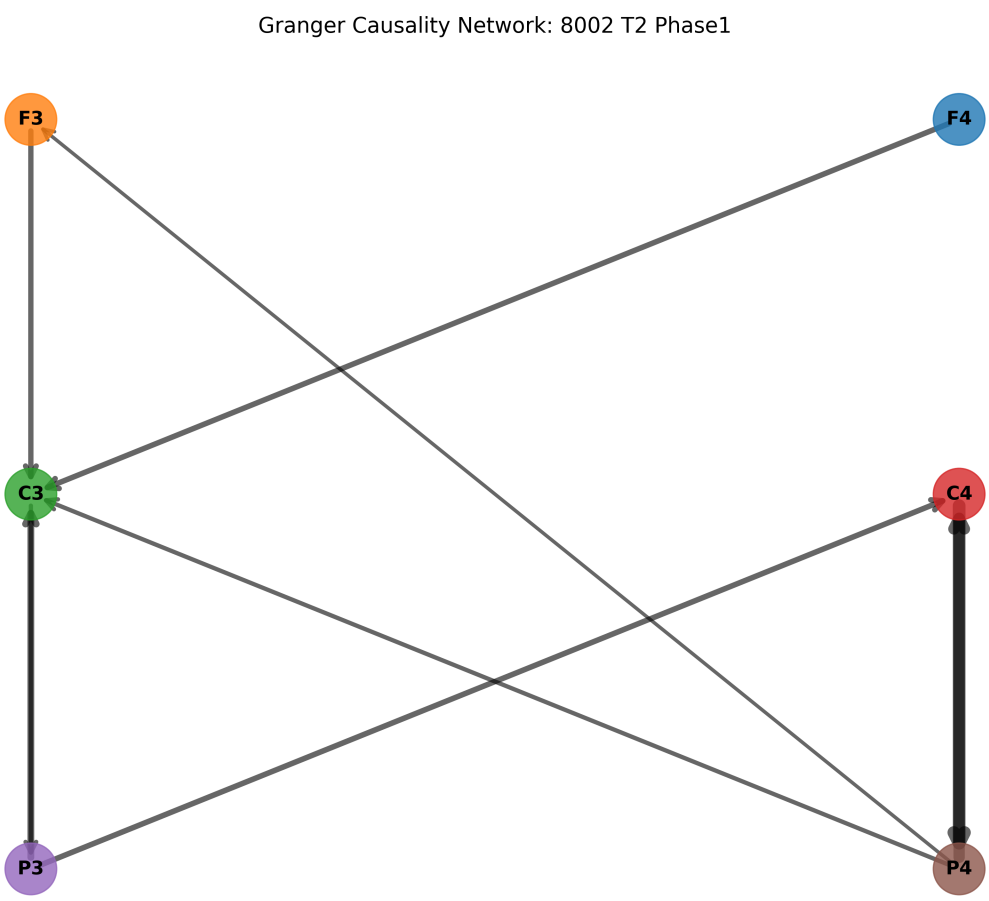
This report presents the results of Granger Causality (GC) analysis in the time domain, examining directional influences between brain regions. Granger Causality measures the extent to which past values of one signal help predict future values of another signal beyond what can be predicted by past values of the second signal alone.

1. Connectivity Matrix

The connectivity matrix shows the strength of directional influence from row (source) to column (target). Each cell represents the Granger Causality value GC(source $\rightarrow$ target). Higher values indicate stronger causal influence from the source electrode to the target electrode.

2. Network Visualization

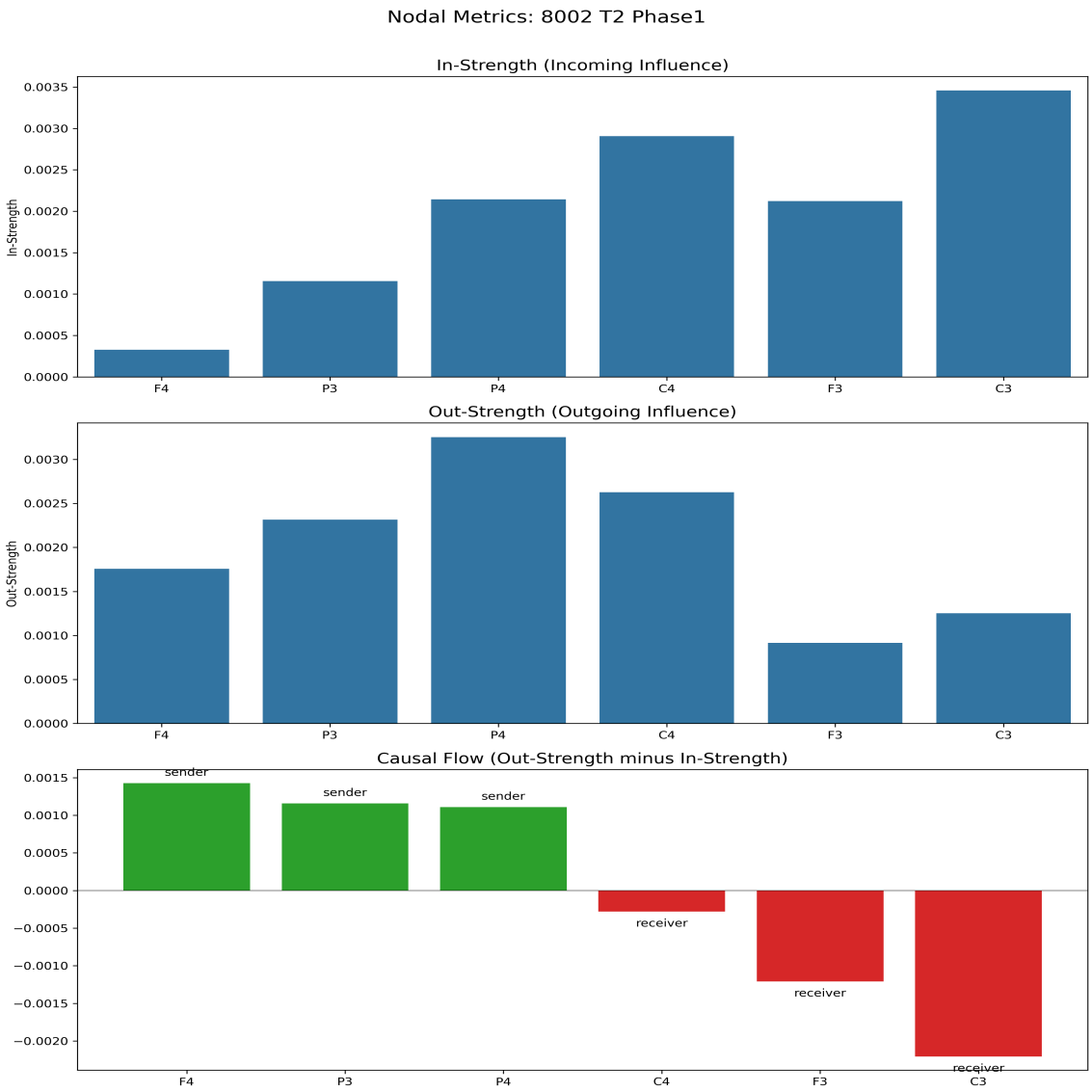
The network graph visualizes the directional connectivity between electrodes. Arrows show the direction of influence, with thicker arrows indicating stronger Granger causal connections. Only connections above a threshold (0.0005) are shown to highlight the most significant pathways.



3. Electrode-Level Metrics

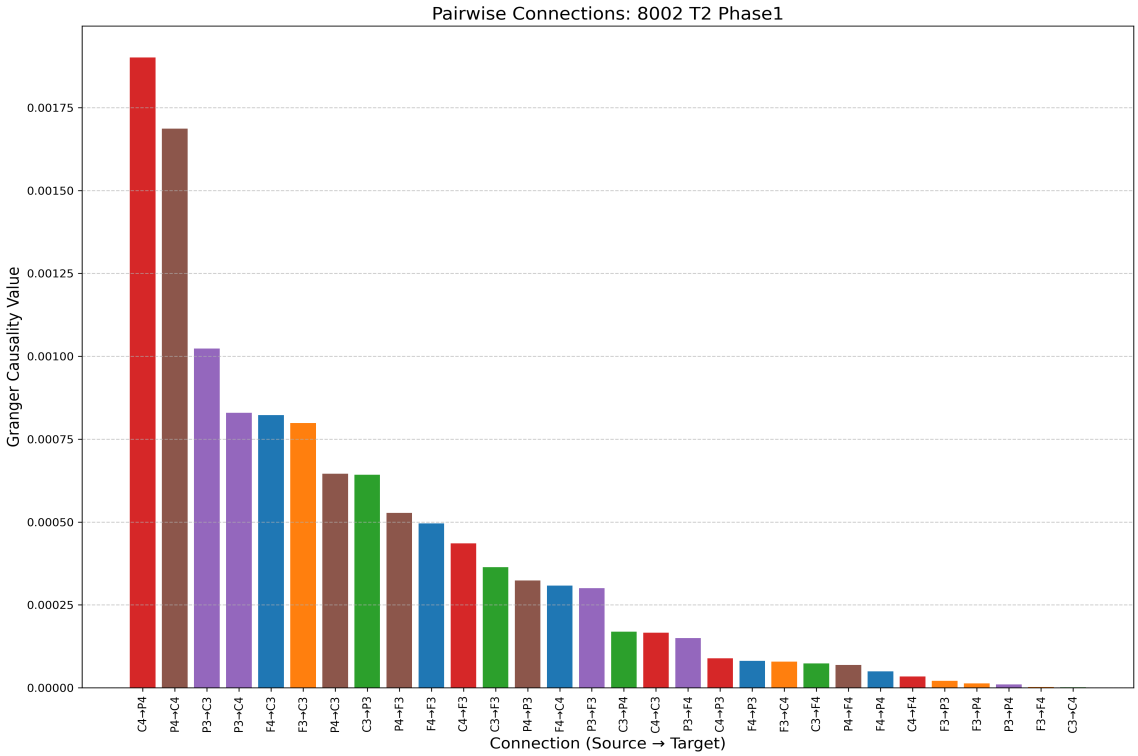
These metrics characterize each electrode's role in the network: • In-Strength: Sum of all incoming GC values to each electrode, indicating how much the electrode is influenced by others. • Out-Strength: Sum of all outgoing GC values from each electrode, showing how much the electrode influences others. • Causal Flow: The difference between out-strength and in-strength. Positive values indicate "sender" nodes that have more outgoing than incoming influence, while negative values indicate "receiver" nodes.

Electrode	In-Strength	Out-Strength	Causal Flow	Category
F4	0.000329	0.001756	0.001427	sender
P3	0.001157	0.002314	0.001157	sender
P4	0.002143	0.003252	0.001109	sender
C4	0.002905	0.002626	-0.000279	receiver
F3	0.002124	0.000914	-0.001209	receiver
C3	0.003456	0.001251	-0.002205	receiver



4. Directional Connectivity Strengths

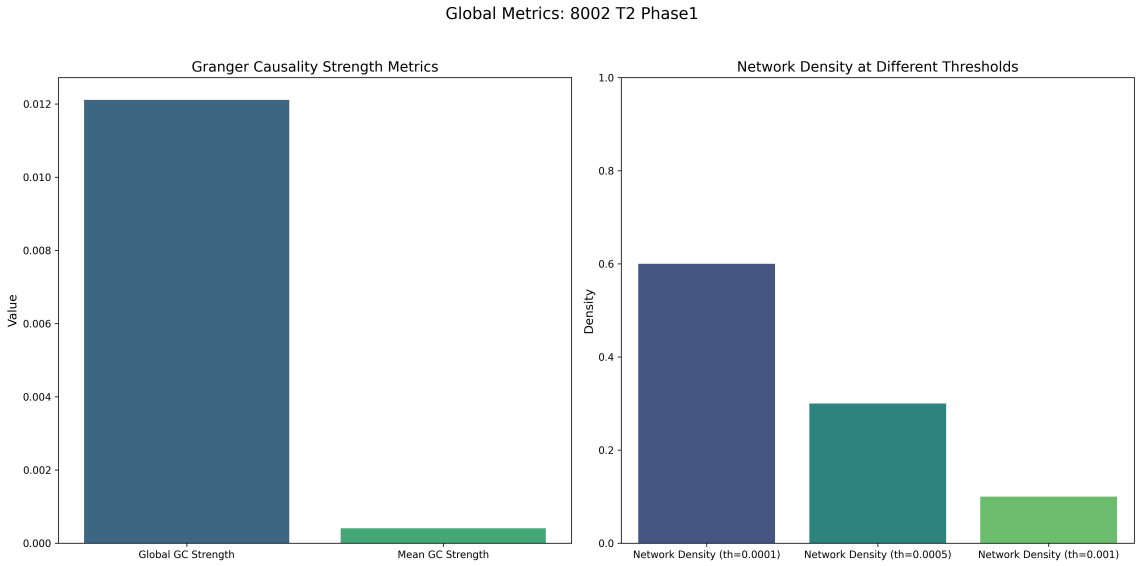
This section shows the strength of Granger causal influence for each pair of electrodes. The bars represent the GC value for each source→target connection, sorted from strongest to weakest. This allows for comparison of directional influences (e.g., C3→F4 vs F4→C3).



5. Global Network Measures

Global metrics provide an overview of the entire Granger causality network: • Global GC Strength: Sum of all GC values in the matrix, indicating overall connectivity. • Mean GC Strength: Average of all GC values, providing a normalized measure of connectivity. • Network Density: Proportion of connections that exceed specific thresholds (0.0001, 0.0005, 0.001), showing how densely connected the network is.

Metric	Value
Global GC Strength	0.012114
Mean GC Strength	0.000404
Median GC Strength	0.000235
Network Density (th=0.0001)	0.600000
Network Density (th=0.0005)	0.300000
Network Density (th=0.001)	0.100000



Conclusion

This report presents a comprehensive analysis of Granger Causality for participant 8002 during T2 in the Phase1 condition. The results provide insights into directed connectivity patterns among electrodes, highlighting key sender and receiver nodes, and quantifying the strength of directional influences between brain regions.