

Influence of muscle movement on Brain - Heart interactions during sleep

This report presents an analysis of the influence of Electromyography (EMG) on brain-heart interactions during sleep, focusing on the effects of gender, hypertension, and sleep apnea conditions.

The study groups are formed based on 3 conditions:

Gender (M/F), **Hypertension** (1-Yes/0-No), **Sleep Apnea** (Normal, moderate, severe)

The severity of sleep apnea is categorized based on the Apnea-Hypopnea Index (AHI) scores.

AHI	Group
<5	Normal Sleep Apnea
5-15	Moderate Sleep Apnea
>15	Severe Sleep Apnea

All the samples taken are from SHHS1 (Sleep Heart Health Study 1) study.

Groups considered:

- Healthy_female_SHHS1
- Healthy_male_SHHS1
- Hypertension_female_SHHS1
- Hypertension_male_SHHS1
- Mod_OSA_female_SHHS1
- Mod_OSA_male_SHHS1
- Sev_OSA_female_SHHS1
- Sev_OSA_male_SHHS1
- Mod_OSA_Hypertension_female_SHHS1
- Mod_OSA_Hypertension_male_SHHS1
- Sev_OSA_Hypertension_female_SHHS1
- Sev_OSA_Hypertension_male_SHHS1

20 patients are considered from each group for the analysis.

Methodology:

Step 1: Using TDS method to determine the strength of the links between EEG and HR.

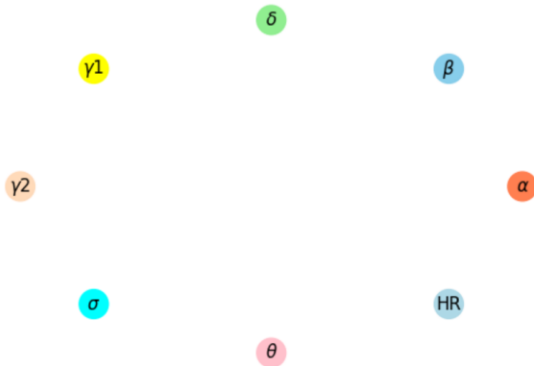
Step 2: Using LSTMCGC to determine the directionality of the links between EEG and HR:

- calculating two errors $Error_{XY_X}$ and $Error_{XYZ_X}$
- $Error_{XY_X}$ is the forecasting error of the model considering $X(t)$ and $Y(t)$ as input and predicting $X(t+1)$
- $Error_{XYZ_X}$ is the forecasting error of the model considering $X(t)$, $Y(t)$, $Z(t)$ as input and predicting $X(t+1)$
- Now, we calculate the difference between these errors. If difference ($Error_{XY_X} - Error_{XYZ_X}$) is positive, that means adding variable Z (EMG) has an impact on correlation between EEG and HR.

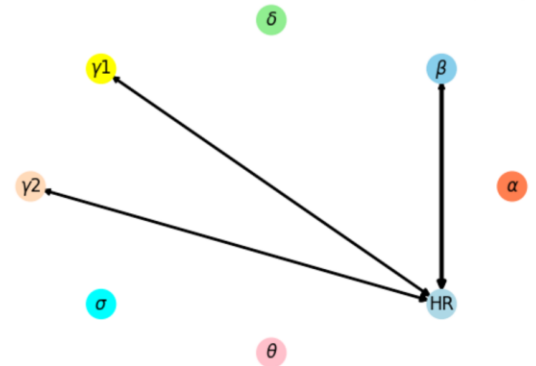
Following are the brain-heart interactions for each of the groups influenced by EMG:

Healthy female:

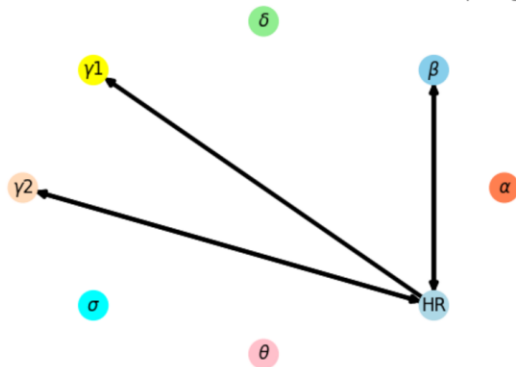
Influence of EMG on Brain-Heart Interactions in Awake Sleep Stage



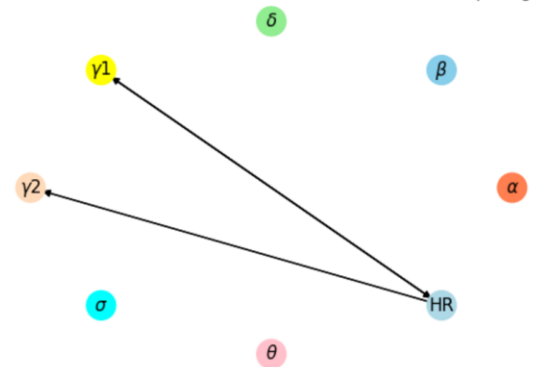
Influence of EMG on Brain-Heart Interactions in n12 Sleep Stage



Influence of EMG on Brain-Heart Interactions in n34 Sleep Stage

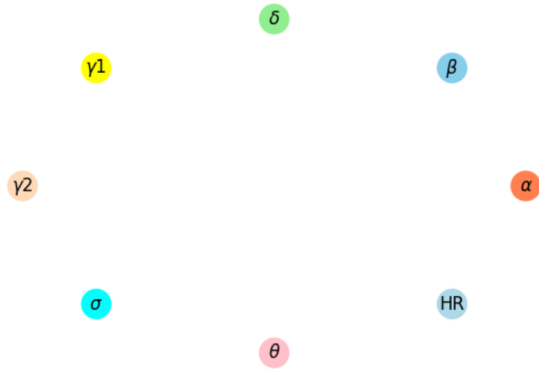


Influence of EMG on Brain-Heart Interactions in REM Sleep Stage

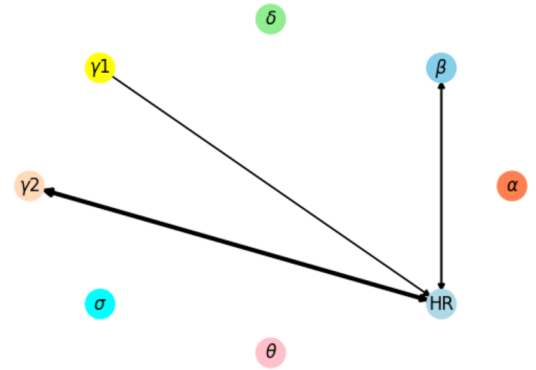


Healthy male:

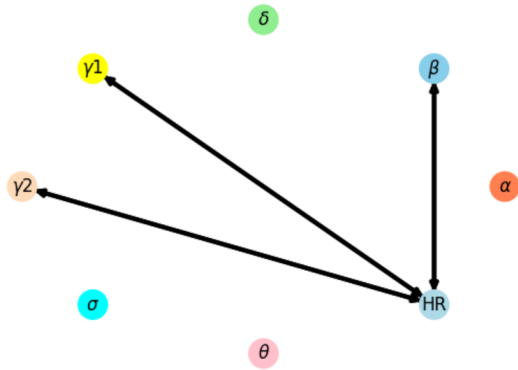
Influence of EMG on Brain-Heart Interactions in Awake Sleep Stage



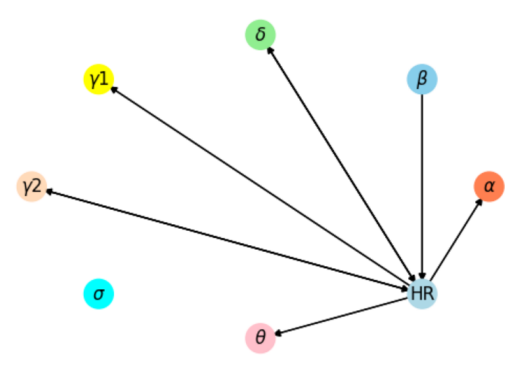
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Influence of EMG on Brain-Heart Interactions in n34 Sleep Stage

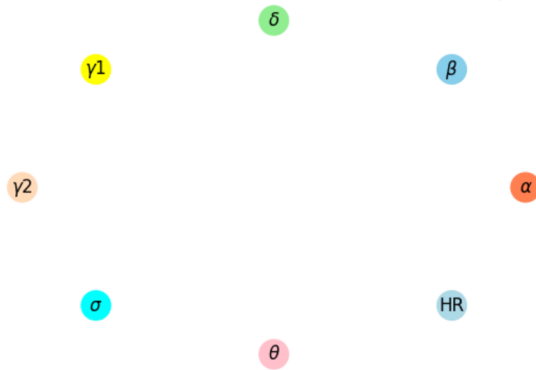


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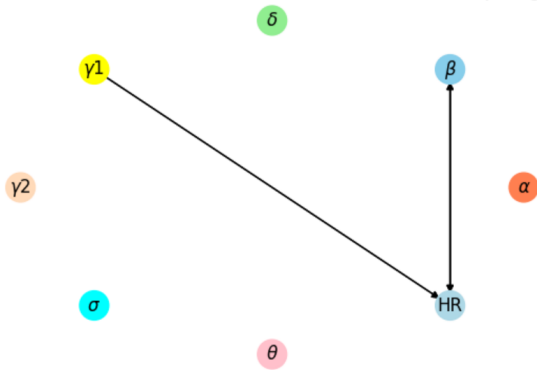


Hypertension Female:

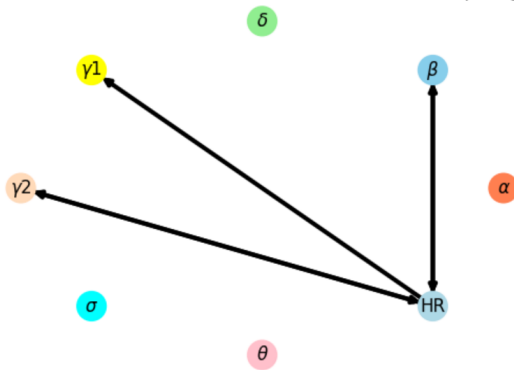
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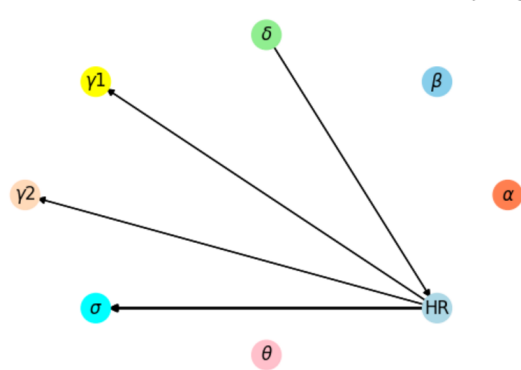
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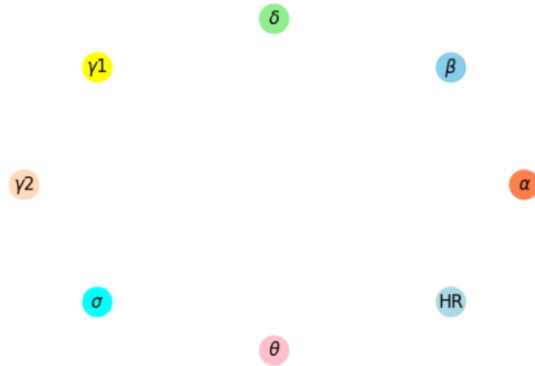


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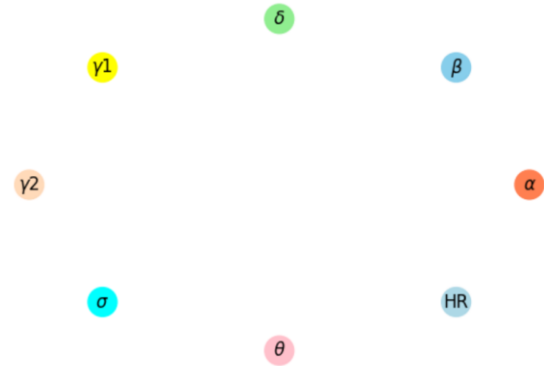


Hypertension Male:

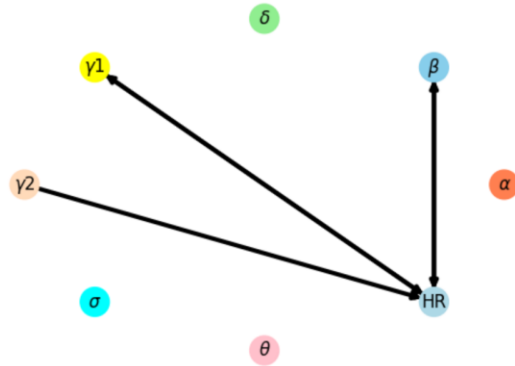
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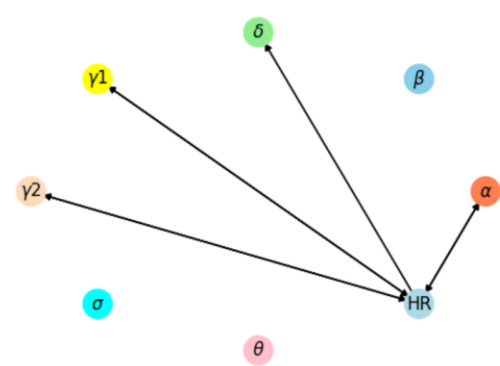
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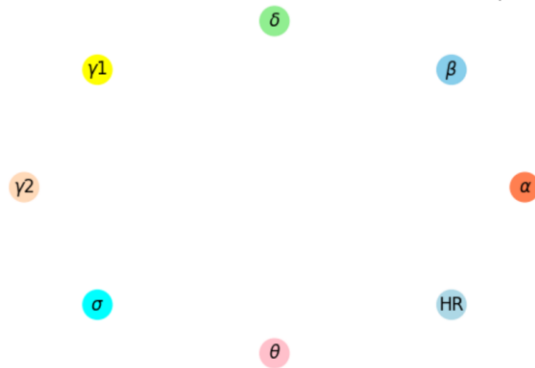


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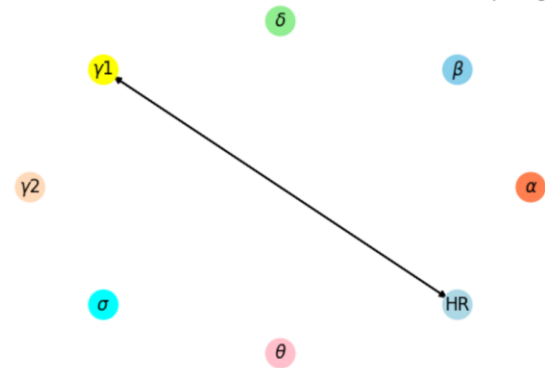


Moderate Sleep Apnea Female:

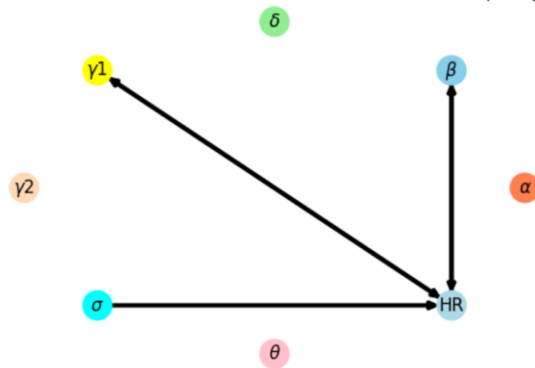
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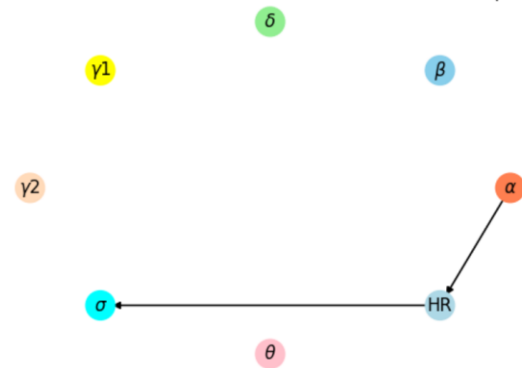
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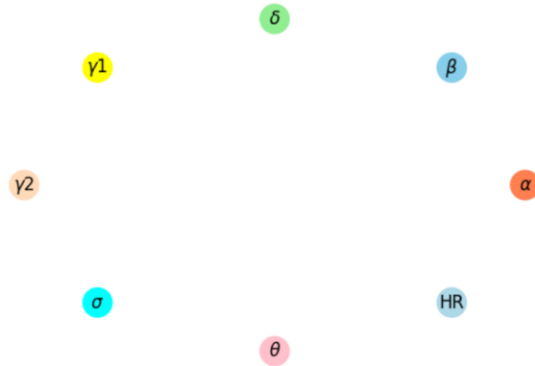


Influence of EMG on Brain-Heart Interactions in REM Sleep Stage

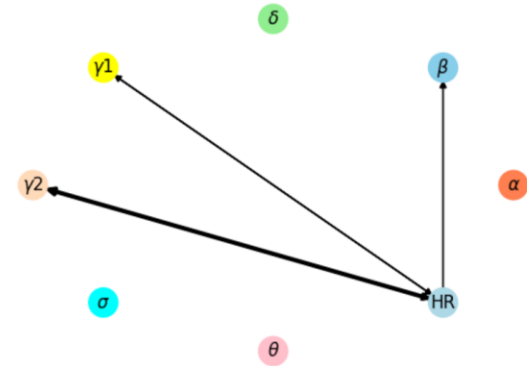


Moderate Sleep Apnea Male:

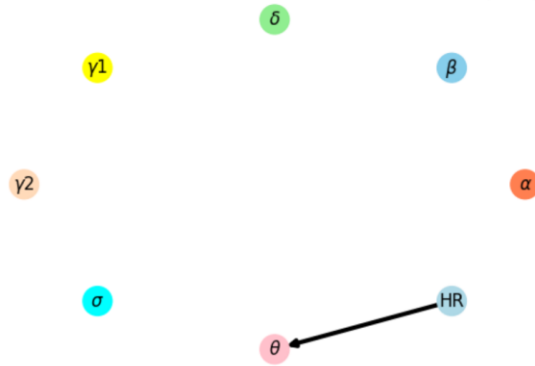
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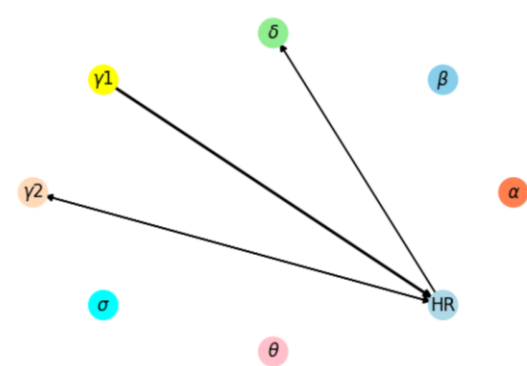
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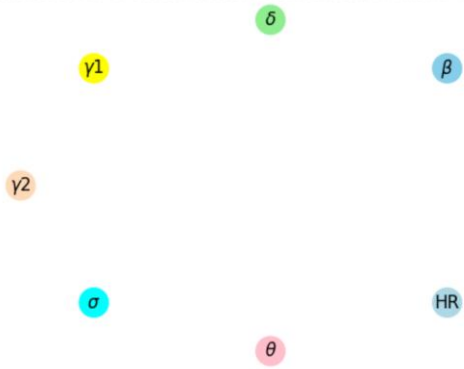


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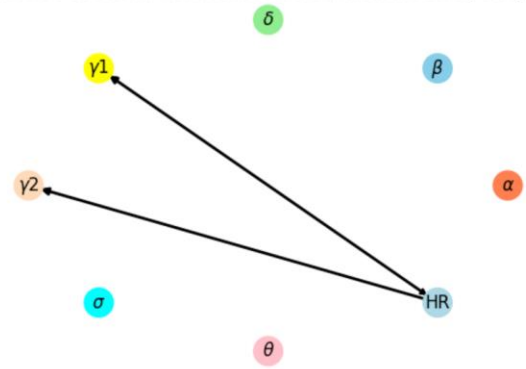


Moderate Sleep Apnea, Hypertension Female:

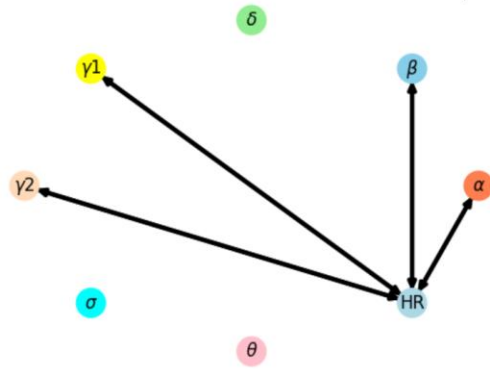
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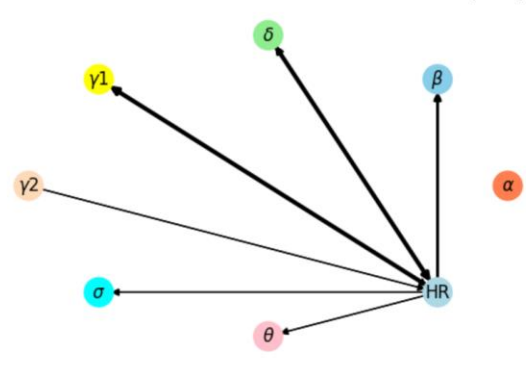
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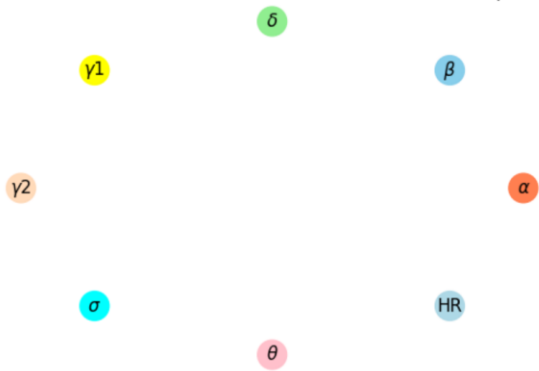


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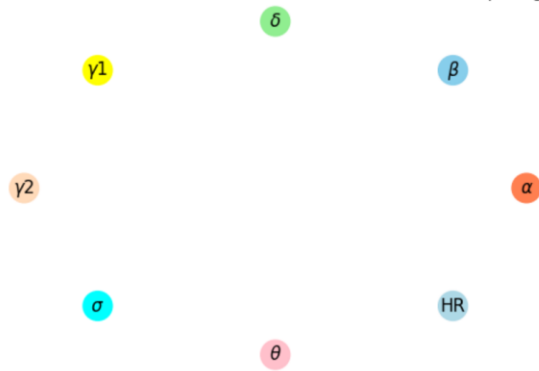


Moderate Sleep Apnea, Hypertension Male:

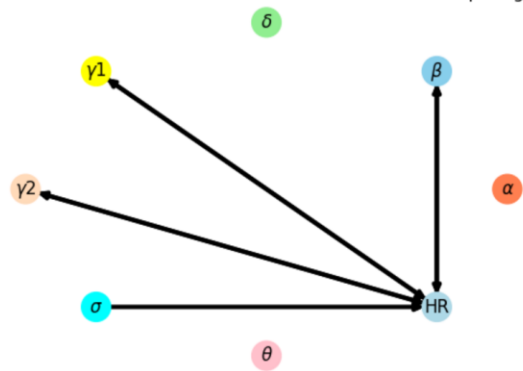
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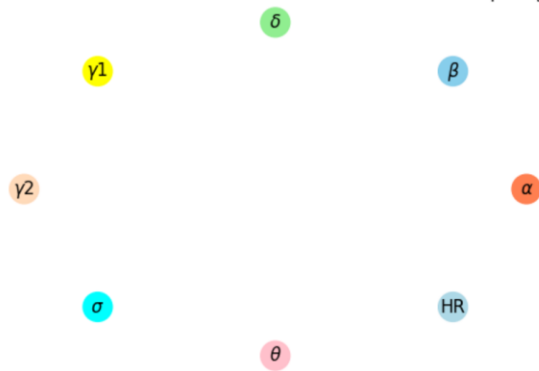
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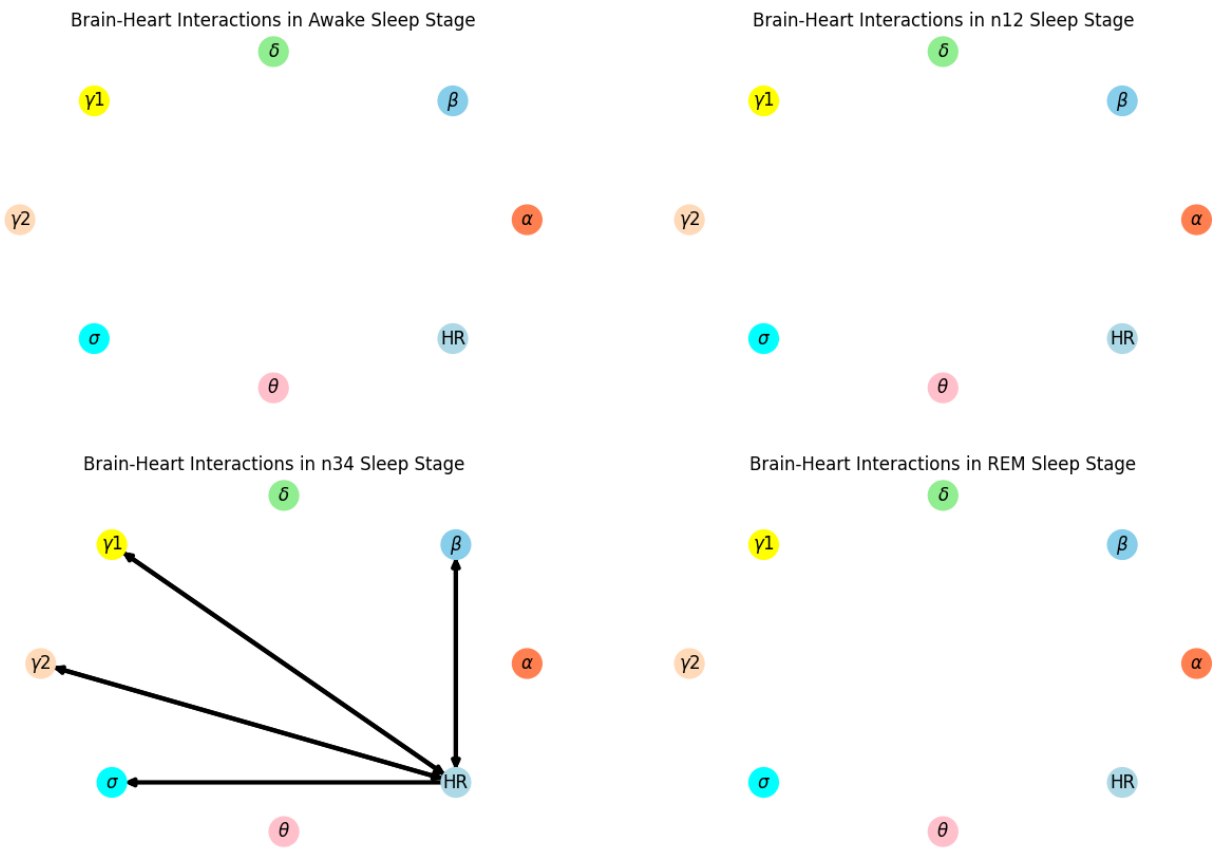
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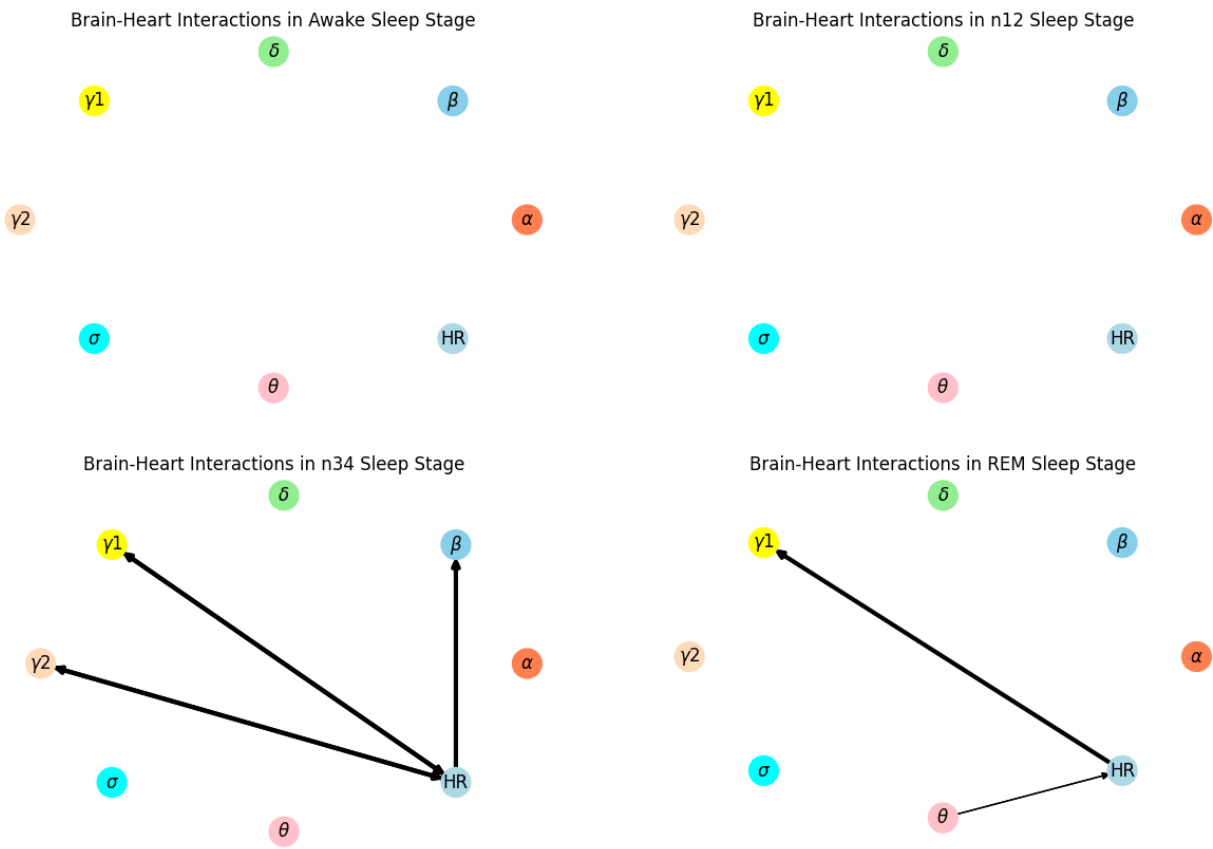
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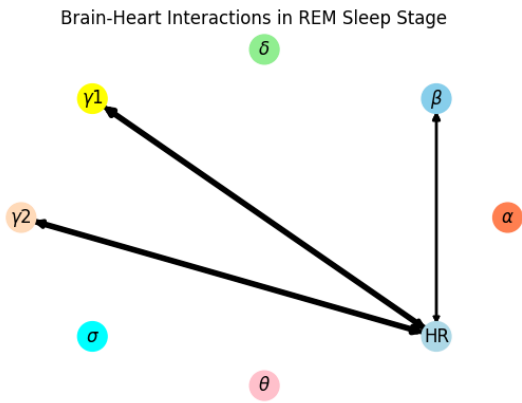
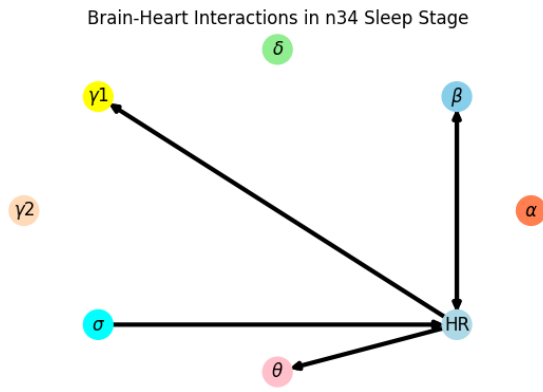
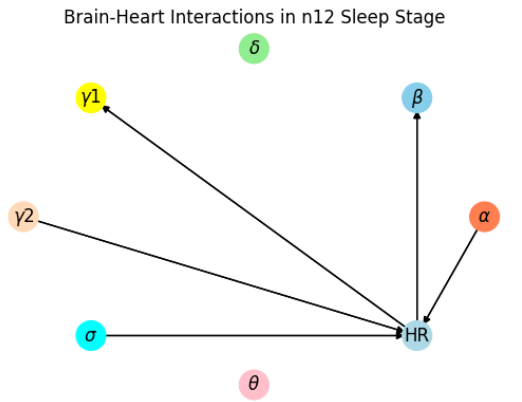
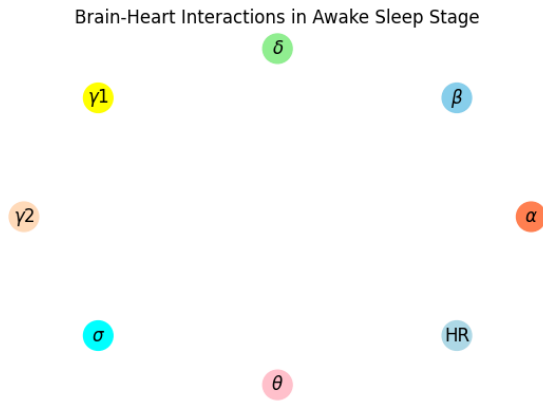
Severe Sleep Apnea Female:



Severe Sleep Apnea Male:



Severe Sleep Apnea, Hypertension Female:



Severe Sleep Apnea, Hypertension Male:

