**Methods**

**Participants**

Deidentified participant data was released through NCANDA\_RELEASE\_BASE\_RESTINGSTATE\_IMAGES\_V03, NCANDA\_RELEASE\_BASE\_STRUCTURAL\_IMAGES\_V03, NCANDA\_PUBLIC\_BASE\_REDCAP\_V02 ,NCANDA\_PUBLIC\_BASE\_RESTINGSTATE\_V01.

**MRI Processing**

Image processing started with segmenting the T1-weighted structural images using standard six tissue priors and warping the images to Montreal Neurological Institute (MNI) standard space ({[www.mni.mcgill.ca](http://www.mni.mcgill.ca)}). The first 10 volumes of the functional scan were removed and the remaining volumes were corrected for slice-time differences, then realigned to the first volume. Motion and other artifacts were removed from the functional images with the independent component analysis-based method Automatic Removal of Motion Artifacts (ICA-AROMA) (Pruim et al., 2015). The previously defined warp to MNI space was then applied to the aligned and slice-time corrected functional images to perform analyses in standard space. To further remove physiological noise and low frequency drift, the functional data was filtered using a standard band pass filter (0.009-0.08Hz). Whole brain gray matter, white matter, and cerebral spinal fluid mean signals, along with the six degrees of freedom (DOF) motion parameters obtained from realignment were regressed from the functional data. The functional images were then parcellated into functionally defined 268 regions based on the Shen atlas (Shen et al., 2013) and the time series from each voxel within a region were in each region of the atlas. For the network analyses applied here, each region served as a network node. For information on nodes assigned to each specific network, please see Supplemental Table 1. A Pearson’s (full) correlation was then calculated between each of the functional time series from pair of nodes within the atlas to create a weighted network to be used in our statistical analyses. It is important to note that, in this study, we chose to focus on positive correlation values (setting all negative correlation values to zero) since defining several network measures, including clustering coefficient, in networks containing negative correlation values is computationally challenging. Additionally, the interpretation of several network variables varies greatly in networks that do or do not contain negative edges (Bahrami et al., 2022; Fraiman et al., 2009; Parente et al., 2018).

While acquiring data at five sites has provided more statistical power and generalizability, our initial assessments demonstrated significant differences in network topology between data collected at the different sites as well as from different scanners. The site effect resulted in different network edge distributions across the five sites (Supplemental Figure 1). Muller-Oehring and colleagues also noted significant differences in seed-based connectivity between scanner types and developed a method to correct this, however this seed-based correction method was not applicable to brain networks. Therefore, we used quantile normalization as an alternative correction method that could be appropriately applied to brain networks to remove site and scanner effects. Quantile normalization was originally developed for removing batch effects in gene expression microarrays (Amaratunga & Cabrera, 2001; Bolstad et al., 2003) and has become a popular technique to remove effects that result in different distributions. Specifically, we used the following steps to apply quantile normalization to our data: i) combining all weighted networks within each site and ranking them; ii) averaging the connectivity values that occupy the same rank across the five sites; iii) replacing all connectivity values occupying the same rank with the computed average in ii; and iv) Rearranging the updated connectivity values into their original place in each network. Supplemental figure 1 illustrates the distributions for a given brain region’s connectivity (correlation values representing weighted edges) (Shen region 77) across the five sites, before and after correcting for site effects using quantile normalization. We also incorporated site as a confounding variable in our mixed-effects regression modeling detailed below.

**Statistical Modeling Framework**

We used a two-part mixed-effects regression framework (Bahrami et al., 2019a; Simpson & Laurienti, 2015), suited for testing hypotheses on brain networks, to examine if/how heavy alcohol drinking, as our desired covariate, impacts the desired RNs. This multivariate model also allowed for the inclusion of possible confounding covariates including age, sex, and site effects, as well as endogenous network-related confounding effects, such as the spatial distance between the brain regions. This model then allowed quantifying the relationship between the desired and confounding covariates, as independent variables, and the probability (presence/absence – Part I) and strength of present brain connections (Part II), as dependent variables, in two separate models, and providing statistical inference for the quantified relationships. Network metrics (CC and GE) were also included as independent covariates in both models, and incorporating their interactions with the main covariates of interest (i.e., the grouping covariate separating the heavy alcohol drinkers from no/low alcohol drinkers) allowed us to examine if/how the relationship between brain connectivity (probability/strength) and network metrics (characterizing topology) was modified by the grouping covariate (i.e., heavy alcohol drinking). Below we have provided more detail about this methodology.

Let Rijk denote a binary variable which is one if the correlation value between node j and node k of the ith participant’s network is positive, and zero otherwise. This variable specifies whether a connection exists between node j and node k of the ith child’s network. Also, let Yijk denote a continuous variable for positive correlation values (present connections) between node j and node k of the ith child’s network. Then, we can define the following conditional probabilities:

|  |  |
| --- | --- |
|  | (S1) |
|  | (S2) |

Where pijk is the probability of having a connection between node j and node k of the ith subject’s network, βr is the fixed effects (population) parameters vector (note that the original paper which introduces this new extension uses θ for fixed effects parameters. We used β as it is a more familiar notation for fixed effect parameters), and bri is the random-effects parameter vector modeling correlation (dependence) between repeated network features for subject i. If Sijk denotes a variable specifying present connections between node j and node k of the ith participant’s network (i.e., Sijk = [Yijk|Rijk = 1]), we can define the following two-part mixed modeling framework for the probability and strength of brain connections:

|  |  |
| --- | --- |
|  | (S3) |
|  | (S4) |

Where Tijk and Zijk are design matrices for the fixed- and random-effects, respectively, eijk captures the random noise (not captured by random effects) in the connection strength between node j and node k of the ith Participant’s network, and βs and bsi are analogous parameters to βr and bri, respectively, but for the connection strength. Eq. S3 is a logistic regression model that quantifies the relationship between the connection probability and sets of desired covariates. FZT is the Fisher’s Z-transform applied to ensure that normality assumption is met. By including network metrics (such as CC and GE) and regional covariates modeling brain RSNs (DMN, SMN, etc.), this framework allows testing hypotheses about the DMN and whole brain connectivity and network metrics and assessing how covariates of interest affect the connectivity and topology at local and global levels. For more detail, see the referenced paper. We used the WFU\_MMNET toolbox (Bahrami et al., 2019b) and in-house Matlab scripts to generate the appropriate datasets for this modeling framework, and used SAS v.9.4 to fit the statistical models. 7 separate analyses were run for the 7 desired networks with each analysis using the two-part model for the probability and strength of brain connections.

The differences in the studied RSNs (DMN, CEN, SMN, etc.) between the two groups and were determined by applying appropriate contrast statements (estimates of linear combinations of appropriate covariates) on already estimated residuals in post-hoc analyses. Specifically, to obtain inference about if/how the relationship between network metrics (CC, GE) and brain connectivity within a RSN (e.g., DMN) is modified by the grouping covariate (i.e., if the relationship is different between heavy alcohol drinkers and no/low alcohol drinkers). The contrast statements are provided in Table SX, but, it is important to note that these statements (i.e., combination of parameters) were not used as additional independent variables, and rather were used to test hypotheses (i.e., obtain inference) on combinations of estimated parameters by using their already estimated residuals. A summary of what each important interaction (i.e., interactions that include network measures and the covariate-of-interest, or AUH) shows, and how contrast statements for comparing the RSNs are obtained via the interaction covariates are in the supplemental material of (Bahrami et al., 2022)**.** To better understand the conducted analyses, we have presented the independent covariates used in the analysis that examined the effects of our covariate of interest (AUH), i.e., grouping covariate separating the two groups, on the DMN in supplemental Table 2.

**Results**

**Mixed-Effects Results from Connection Probability Models**

There were significant three-way interactions (GE \*RSN\*AUH and CC \*RSN\*AUH) in the connection probability model for the BGN, CEN, VN, FTN, SMN, and DMN. A significant three-way interaction indicates that topology comparisons between the RSN and the remainder of the brain were different between the no/low and hazardous drinkers (Table 3). For both the BGN and the CEN, the direction of the group differences in the network topology were in the same direction, but larger than, the reminder of the brain. For the VN, FTN, SMN, and DMN, the direction of the topological differences between drinking groups was opposite of that observed in the remainder of the brain. This is noted by the reversal of the sign of the estimates (-/+) when comparing the two-way and three-way interactions for each topological variable.

**Mixed-Effects Results from Connection Strength Models**

For within RSN analyses, the BGN, CEN, SMN, DAN, VN, and FTN all exhibited significant differences between drinking groups for GE in the connection strength model. In addition, all networks except the VN had significant group differences for CC (Table 5). Results from these three-way interactions indicate that topology comparisons between the RSN and the remainder of the brain were different between the no/low and hazardous.

**Supplemental Figures**

**Supplemental Table 1: Subnetwork node assignments**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **DMN Node ID** | **CEN Node ID** | **DAN Node ID** | **SMN Node ID** | **SN Node ID** | **BGN Node ID** | **VN Node ID** | **FTN Node ID** |
| 3 | 7 | 31 | 23 | 15 | 93 | 42 | 1 |
| 5 | 8 | 43 | 24 | 16 | 94 | 72 | 2 |
| 6 | 9 | 44 | 25 | 20 | 95 | 75 | 4 |
| 10 | 11 | 49 | 26 | 21 | 99 | 76 | 18 |
| 12 | 14 | 66 | 27 | 28 | 101 | 77 | 51 |
| 13 | 17 | 67 | 32 | 29 | 103 | 79 | 52 |
| 48 | 19 | 68 | 33 | 34 | 104 | 80 | 57 |
| 50 | 22 | 69 | 38 | 35 | 105 | 82 | 58 |
| 53 | 30 | 71 | 39 | 36 | 117 | 87 | 59 |
| 54 | 47 | 73 | 40 | 37 | 118 | 98 | 60 |
| 55 | 70 | 74 | 41 | 46 | 120 | 106 | 92 |
| 56 | 111 | 78 | 45 | 65 | 121 | 205 | 96 |
| 63 | 112 | 81 | 61 | 91 | 122 | 208 | 97 |
| 64 | 114 | 102 | 62 | 144 | 123 | 211 | 107 |
| 83 | 116 | 113 | 84 | 155 | 124 | 212 | 135 |
| 85 | 131 | 119 | 89 | 168 | 125 | 213 | 136 |
| 86 | 139 | 177 | 108 | 169 | 126 | 215 | 185 |
| 88 | 142 | 178 | 109 | 170 | 127 | 216 | 186 |
| 90 | 143 | 198 | 110 | 181 | 128 | 236 | 189 |
| 100 | 147 | 200 | 130 | 188 | 129 | 244 | 194 |
| 115 | 149 | 203 | 158 | 192 | 132 | 248 | 195 |
| 134 | 150 | 204 | 159 | 220 | 133 |  | 201 |
| 137 | 151 | 206 | 160 | 221 | 217 |  | 202 |
| 138 | 152 | 207 | 161 | 249 | 228 |  | 232 |
| 140 | 154 | 209 | 162 | 250 | 229 |  | 234 |
| 141 | 156 | 210 | 163 |  | 230 |  | 235 |
| 145 | 157 | 214 | 165 |  | 231 |  |  |
| 146 | 164 | 238 | 166 |  | 233 |  |  |
| 148 | 184 | 240 | 167 |  | 237 |  |  |
| 153 | 199 | 241 | 171 |  | 243 |  |  |
| 176 | 246 |  | 172 |  | 251 |  |  |
| 182 | 247 |  | 173 |  | 252 |  |  |
| 183 | 253 |  | 174 |  | 255 |  |  |
| 187 | 268 |  | 175 |  | 256 |  |  |
| 190 |  |  | 179 |  | 257 |  |  |
| 193 |  |  | 180 |  | 258 |  |  |
| 196 |  |  | 191 |  | 259 |  |  |
| 197 |  |  | 218 |  | 260 |  |  |
| 219 |  |  | 226 |  | 261 |  |  |
| 222 |  |  | 245 |  | 262 |  |  |
| 223 |  |  | 254 |  | 263 |  |  |
| 224 |  |  |  |  | 264 |  |  |
| 225 |  |  |  |  | 265 |  |  |
| 227 |  |  |  |  | 266 |  |  |
| 239 |  |  |  |  | 267 |  |  |
| 242 |  |  |  |  |  |  |  |

**Table S1:** Resting-state network node assignments based on methods outlined in (Laurienti et al., 2023). Shen (Yale) atlas was used to define nodes (Shen et al., 2013). Abbreviations: BGN, basal ganglia network; CEN, central executive network; DMN, default mode network; DAN, dorsal attention network; FTN, fronto-temporal network; SN, salience network; SMN, sensorimotor network; VN, visual network.

**Supplemental Figure 1: Quantile Normalization procedure**

Chart, box and whisker chart

Description automatically generated

**Figure S1:** Removing site effects from functional network data of NCANDA. This figure demonstrates the distribution of correlation value of a sample ROI (ROI 77 from Shen Atlas) (Shen et al., 2013) before (A and C) and after (B and D) correcting for site effects using quantile normalization.

**Supplemental Table 2: Independent variables used for mixed-effects regression analyses**

|  |  |  |  |
| --- | --- | --- | --- |
| Covariates | Parameters | |  |
|  | **Probability Model** | **Strength Model** | |
| Covariate of Interest | βr,AUH | βs,AUH | |
| RSN covariate | βr,RSN | βs,RSN | |
| Network metric covariates | βr,CC | βs,CC | |
|  | βr,GE | βs,GE | |
| Interaction covariates | βr,AUH×RSN | βs,AUH×RSN | |
|  | βr,AUH× CC | βs,AUH× CC | |
|  | βr,AUH× GE | βs,AUH× GE | |
|  | βr,RSN× CC | βs,RSN× CC | |
|  | βr,RSN× GE | βs,RSN× GE | |
|  | βr,AUH×RSN× CC | βs,AUH×RSN× CC | |
|  | βr,AUH×RSN× GE | βs,AUH×RSN× GE | |
| Confounding covariates | βr,Dist | βs,Dist | |
|  | βr,Dist2 | βs,Dist2 | |
|  | βr,Site | βs, Site | |
| Contrast Statements\* | βr,AUH× CC + βr,AUH×RSN× CC | βs,AUH× CC + βs,AUH×RSN× CC | |
|  | βr,AUH× GE + βr,AUH×RSN× GE | βs,AUH× GE + βs,AUH×RSN× GE | |

**Table S2:** \*Contrast statements were not used as additional independent variables. They were rather used in post-hoc analyses to test hypotheses (i.e., obtain inference) on combinations of estimated parameters using their already estimated residuals.

Abbreviations: CC, Clustering Coefficient; GE, Global Efficiency; AUH, Covariate of Interest; RSN, resting state network.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Supplemental Table 3: Whole-Brain regression results for AUH** | | | | |
|  | **Estimate** | **SE** | **t Value** | **P-Value** |
| **AUH- Connection Probability** | | | | |
| **GE\*AUH** | -0.02608 | 0.01851 | -1.41 | 0.1589 |
| **CC\*AUH** | 0.02488 | 0.02228 | 1.12 | 0.2642 |
| **AUH- Connection Strength** | | | | |
| **GE\*AUH** | 0.000498 | 0.001019 | 0.49 | 0.6255 |
| **CC\*AUH** | 0.001206 | 0.001424 | 0.85 | 0.3971 |
|  |  |  |  |  |

**Table S3:** Results are from network analyses from whole-brain regression analyses for alcohol use history (AUH) for both connection strength and probability models. Asterisks represent interactions between variables. There were no significant whole-brain interactions for any of the covariates of interest across either model. P-values were adjusted using the adaptive false discovery rate procedure (Benjamini & Hochberg, 2000).

Abbreviations: GE, Global efficiency; CC, clustering coefficient; AUH, alcohol use history; SE, standard error.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Supplemental Table 4 - Regression results for AUH** | | | | |
|  | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Connection probability** | | | | |
| ***Salience Network (SN)*** | | | | |
| **GE\*AUH** | -0.02777 | 0.01837 | -1.51 | 0.1306 |
| **CC\*AUH** | 0.02572 | 0.02213 | 1.16 | 0.2451 |
| **GE\*AUH\*SN** | -0.00119 | 0.04130 | -0.03 | 0.9770 |
| **CC\*AUH\*SN** | 0.04005 | 0.03888 | 1.03 | 0.3030 |
| ***Dorsal Attention Network (DAN)*** | | | | |
| **GE\*AUH** | -0.02715 | 0.01885 | -1.44 | 0.1498 |
| **CC\*AUH** | 0.02626 | 0.02265 | 1.16 | 0.2463 |
| **GE\*AUH\*DAN** | 0.04001 | 0.03007 | 1.33 | 0.1833 |
| **CC\*AUH\*DAN** | -0.01416 | 0.02746 | -0.52 | 0.6060 |
| **Connection strength** | | | | |
| ***Default Mode Network (DMN)*** | | | | |
| **GE\*AUH** | 0.000914 | 0.001104 | 0.83 | 0.4077 |
| **CC\*AUH** | 0.000895 | 0.001415 | 0.63 | 0.5271 |
| **GE\*AUH\*DMN** | 0.002568 | 0.001748 | 1.47 | 0.1418 |
| **CC\*AUH\*DMN** | -0.00160 | 0.001552 | -1.03 | 0.3014 |
| ***Salience Network (SN)*** | | | | |
| **GE\*AUH** | 0.000239 | 0.001031 | 0.23 | 0.8163 |
| **CC\*AUH** | 0.001310 | 0.001416 | 0.92 | 0.3550 |
| **GE\*AUH\*SN** | -0.00159 | 0.003394 | -0.47 | 0.6385 |
| **CC\*AUH\*SN** | 0.002278 | 0.003099 | 0.73 | 0.4624 |

**Table S4:** Results are from network analyses for the SN and DAN from the connection probability model as well as DMN and SN from the connection strength model. Asterisks represent interactions between variables. No significant interactions were observed. P-values were adjusted using the adaptive false discovery rate procedure (Benjamini & Hochberg, 2000).

Abbreviations: GE, Global efficiency; CC, clustering coefficient; AUH, alcohol use history; SE, standard error.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Supplemental Table 5 - Post-hoc contrast statements for AUH** | | | | |
|  | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Connection probability** | | | | |
| **GE\*AUH within SN** | -0.02897 | 0.04502 | -0.64 | 0.5199 |
| **CC\*AUH within SN** | 0.06577 | 0.04454 | 1.48 | 0.1398 |
| **GE\*AUH within DAN** | 0.01286 | 0.03526 | 0.36 | 0.7153 |
| **CC\*AUH within DAN** | 0.01209 | 0.03534 | 0.34 | 0.7322 |
| **Connection strength** | | | | |
| **GE\*AUH within DMN** | 0.003482 | 0.002007 | 1.73 | 0.0828 |
| **CC\*AUH within DMN** | -0.00071 | 0.002040 | -0.35 | 0.7281 |
| **GE\*AUH within SN** | -0.00136 | 0.003514 | -0.39 | 0.6998 |
| **CC\*AUH within SN** | 0.003587 | 0.003371 | 1.06 | 0.2873 |

**Table S5:** Post hoc findings on within-network topological characteristics within the SN and DAN from the connection probability model as well as DMN and SN from the connection strength model. Asterisks represent interactions between variables. No significant interactions were observed. P-values were adjusted using the adaptive false discovery rate procedure (Benjamini & Hochberg, 2000).

Abbreviations: GE, Global efficiency; CC, clustering coefficient; AUH, alcohol use history; SE, standard error. SN, salience network; DAN, dorsal attention network; DMN, default mode network.

**Supplemental Table 6-** **Full mixed-effects results for Basal Ganglia Network (BGN) Connection Probability Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Intercept** | -0.2688 | 0.01369 | -19.64 | <.0001 |
| **AUH** | 0.006857 | 0.01344 | 0.51 | 0.6100 |
| **BGN** | 0.6333 | 0.008708 | 72.72 | <.0001 |
| **GE** | 0.1847 | 0.01283 | 14.39 | <.0001 |
| **CC** | -0.2299 | 0.01531 | -15.02 | <.0001 |
| **Degree** | -0.08587 | 0.005433 | -15.81 | <.0001 |
| **Modularity** | 0.03379 | 0.006632 | 5.10 | <.0001 |
| **GE\*AUH** | -0.02109 | 0.01815 | -1.16 | 0.2453 |
| **CC\*AUH** | 0.01752 | 0.02166 | 0.81 | 0.4187 |
| **AUH\*BGN** | 0.03694 | 0.01258 | 2.94 | 0.0033 |
| **GE\*BGN** | 0.4427 | 0.01388 | 31.90 | <.0001 |
| **CC\*BGN** | -0.2404 | 0.01585 | -15.17 | <.0001 |
| **GE\*AUH\*BGN** | -0.1386 | 0.01973 | -7.03 | <.0001 |
| **CC\*AUH\*BGN** | 0.2160 | 0.02256 | 9.57 | <.0001 |
| **Dist** | -0.2090 | 0.003836 | -54.47 | <.0001 |
| **Dist2** | 0.1799 | 0.002232 | 80.60 | <.0001 |
| **Site A** | 0.008627 | 0.01948 | 0.44 | 0.6578 |
| **Site B** | 0.008850 | 0.01941 | 0.46 | 0.6484 |
| **Site C** | -0.01309 | 0.02018 | -0.65 | 0.5165 |
| **Site D** | -0.00330 | 0.02085 | -0.16 | 0.8742 |
| **Site E** | 0 | . | . | . |

**Table S6:** Alcohol use history (AUH): A binary variable representing alcohol use history group (0- no/low, 1- hazardous). Adjusted using the adaptive FDR procedure described in (Benjamini & Hochberg, 2000).

Abbreviations: AUH, alcohol use history; GE, global efficiency; CC, clustering coefficient; Dist, distance; SE, standard error; BGN, basal ganglia network.

**Supplemental Table 7-** **Full mixed-effects results for Basal Ganglia Network (BGN) Connection Strength Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Intercept** | 0.1895 | 0.003104 | 61.06 | <.0001 |
| **AUH** | 0.004943 | 0.003050 | 1.62 | 0.1050 |
| **BGN** | 0.03088 | 0.000762 | 40.52 | <.0001 |
| **GE** | 0.02689 | 0.000743 | 36.20 | <.0001 |
| **CC** | 0.07067 | 0.001044 | 67.68 | <.0001 |
| **Degree** | -0.03825 | 0.000421 | -90.97 | <.0001 |
| **Modularity** | -0.01209 | 0.001506 | -8.02 | <.0001 |
| **GE\*AUH** | 0.001081 | 0.001052 | 1.03 | 0.3040 |
| **CC\*AUH** | 0.000708 | 0.001478 | 0.48 | 0.6319 |
| **AUH\*BGN** | -0.00570 | 0.001100 | -5.18 | <.0001 |
| **GE\*BGN** | 0.03689 | 0.001331 | 27.72 | <.0001 |
| **CC\*BGN** | -0.03353 | 0.001472 | -22.79 | <.0001 |
| **GE\*AUH\*BGN** | -0.01102 | 0.001897 | -5.81 | <.0001 |
| **CC\*AUH\*BGN** | 0.005730 | 0.002092 | 2.74 | 0.0062 |
| **Dist** | -0.03776 | 0.000411 | -91.83 | <.0001 |
| **Dist2** | 0.02783 | 0.000223 | 125.07 | <.0001 |
| **Site A** | 0.007507 | 0.004418 | 1.70 | 0.0893 |
| **Site B** | -0.00689 | 0.004402 | -1.56 | 0.1178 |
| **Site C** | 0.000941 | 0.004579 | 0.21 | 0.8371 |
| **Site D** | 0.01018 | 0.004729 | 2.15 | 0.0313 |
| **Site E** | 0 | . | . | . |

**Table S7:** Alcohol use history (AUH): A binary variable representing alcohol use history group (0- no/low, 1- hazardous). Adjusted using the adaptive FDR procedure described in (Benjamini & Hochberg, 2000).

Abbreviations: AUH, alcohol use history; GE, global efficiency; CC, clustering coefficient; Dist, distance; SE, standard error; BGN, basal ganglia network.

**Supplemental Table 8-** **Full mixed-effects results for Central Executive Network (CEN) Connection Probability Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Intercept** | -0.2671 | 0.01373 | -19.45 | <.0001 |
| **AUH** | 0.006756 | 0.01348 | 0.50 | 0.6163 |
| **CEN** | 0.7243 | 0.009239 | 78.40 | <.0001 |
| **GE** | 0.1691 | 0.01324 | 12.77 | <.0001 |
| **CC** | -0.2195 | 0.01584 | -13.86 | <.0001 |
| **Degree** | -0.08401 | 0.005423 | -15.49 | <.0001 |
| **Modularity** | 0.03342 | 0.006652 | 5.02 | <.0001 |
| **GE\*AUH** | -0.02511 | 0.01873 | -1.34 | 0.1802 |
| **CC\*AUH** | 0.02172 | 0.02240 | 0.97 | 0.3323 |
| **AUH\*CEN** | 0.1309 | 0.01301 | 10.05 | <.0001 |
| **GE\*CEN** | 0.4172 | 0.01917 | 21.77 | <.0001 |
| **CC\*CEN** | -0.2346 | 0.01927 | -12.18 | <.0001 |
| **GE\*AUH\*CEN** | -0.1113 | 0.02654 | -4.19 | <.0001 |
| **CC\*AUH\*CEN** | 0.2436 | 0.02663 | 9.15 | <.0001 |
| **Dist** | -0.2241 | 0.003955 | -56.65 | <.0001 |
| **Dist2** | 0.1781 | 0.002267 | 78.56 | <.0001 |
| **Site A** | 0.007729 | 0.01954 | 0.40 | 0.6924 |
| **Site B** | 0.008256 | 0.01947 | 0.42 | 0.6715 |
| **Site C** | -0.01322 | 0.02025 | -0.65 | 0.5139 |
| **Site D** | -0.00441 | 0.02091 | -0.21 | 0.8331 |
| **Site E** | 0 | . | . | . |

**Table S8:** Alcohol use history (AUH): A binary variable representing alcohol use history group (0- no/low, 1- hazardous). Adjusted using the adaptive FDR procedure described in (Benjamini & Hochberg, 2000).

Abbreviations: AUH, alcohol use history; GE, global efficiency; CC, clustering coefficient; Dist, distance; SE, standard error; CEN, central executive network.

**Supplemental Table 9-** **Full mixed-effects results for Central Executive Network (CEN) Connection Strength Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Intercept** | 0.1892 | 0.003066 | 61.71 | <.0001 |
| **AUH** | 0.004858 | 0.003013 | 1.61 | 0.1069 |
| **CEN** | 0.06372 | 0.000904 | 70.46 | <.0001 |
| **GE** | 0.02447 | 0.000742 | 32.98 | <.0001 |
| **CC** | 0.07260 | 0.001050 | 69.12 | <.0001 |
| **Degree** | -0.03798 | 0.000419 | -90.65 | <.0001 |
| **Modularity** | -0.01224 | 0.001488 | -8.23 | <.0001 |
| **GE\*AUH** | 0.000684 | 0.001050 | 0.65 | 0.5151 |
| **CC\*AUH** | 0.000676 | 0.001487 | 0.45 | 0.6496 |
| **AUH\*CEN** | 0.004251 | 0.001243 | 3.42 | 0.0006 |
| **GE\*CEN** | 0.06609 | 0.001851 | 35.71 | <.0001 |
| **CC\*CEN** | -0.05414 | 0.001801 | -30.06 | <.0001 |
| **GE\*AUH\*CEN** | -0.00889 | 0.002535 | -3.51 | 0.0005 |
| **CC\*AUH\*CEN** | 0.01810 | 0.002437 | 7.43 | <.0001 |
| **Dist** | -0.03906 | 0.000419 | -93.20 | <.0001 |
| **Dist2** | 0.02722 | 0.000224 | 121.67 | <.0001 |
| **Site A** | 0.007502 | 0.004365 | 1.72 | 0.0856 |
| **Site B** | -0.00689 | 0.004349 | -1.58 | 0.1130 |
| **Site C** | 0.000959 | 0.004524 | 0.21 | 0.8321 |
| **Site D** | 0.01032 | 0.004672 | 2.21 | 0.0272 |
| **Site E** | 0 | . | . | . |

**Table S9:** Alcohol use history (AUH): A binary variable representing alcohol use history group (0- no/low, 1- hazardous). Adjusted using the adaptive FDR procedure described in (Benjamini & Hochberg, 2000).

Abbreviations: AUH, alcohol use history; GE, global efficiency; CC, clustering coefficient; Dist, distance; SE, standard error; CEN, central executive network.

**Supplemental Table 10-** **Full mixed-effects results for Dorsal Attention Network (DAN) Connection Probability**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Intercept** | -0.2673 | 0.01383 | -19.33 | <.0001 |
| **AUH** | 0.006955 | 0.01359 | 0.51 | 0.6087 |
| **DAN** | 0.5025 | 0.009811 | 51.21 | <.0001 |
| **GE** | 0.1803 | 0.01333 | 13.53 | <.0001 |
| **CC** | -0.2322 | 0.01601 | -14.50 | <.0001 |
| **Degree** | -0.08474 | 0.005413 | -15.66 | <.0001 |
| **Modularity** | 0.03459 | 0.006703 | 5.16 | <.0001 |
| **GE\*AUH** | -0.02715 | 0.01885 | -1.44 | 0.1498 |
| **CC\*AUH** | 0.02626 | 0.02265 | 1.16 | 0.2463 |
| **AUH\*DAN** | 0.01630 | 0.01385 | 1.18 | 0.2394 |
| **GE\*DAN** | 0.03004 | 0.02120 | 1.42 | 0.1565 |
| **CC\*DAN** | 0.09423 | 0.01860 | 5.07 | <.0001 |
| **GE\*AUH\*DAN** | 0.04001 | 0.03007 | 1.33 | 0.1833 |
| **CC\*AUH\*DAN** | -0.01416 | 0.02746 | -0.52 | 0.6060 |
| **Dist** | -0.2169 | 0.003934 | -55.12 | <.0001 |
| **Dist2** | 0.1841 | 0.002262 | 81.42 | <.0001 |
| **Site A** | 0.007359 | 0.01969 | 0.37 | 0.7085 |
| **Site B** | 0.008817 | 0.01962 | 0.45 | 0.6531 |
| **Site C** | -0.01339 | 0.02040 | -0.66 | 0.5115 |
| **Site D** | -0.00513 | 0.02107 | -0.24 | 0.8077 |
| **Site E** | 0 | . | . | . |

**Table S10:** Alcohol use history (AUH): A binary variable representing alcohol use history group (0- no/low, 1- hazardous). Adjusted using the adaptive FDR procedure described in (Benjamini & Hochberg, 2000).

Abbreviations: AUH, alcohol use history; GE, global efficiency; CC, clustering coefficient; Dist, distance; SE, standard error; DAN, dorsal attention network.

**Supplemental Table 11-** **Full mixed-effects results for Dorsal Attention Network (DAN) Connection Strength Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Intercept** | 0.1883 | 0.003060 | 61.54 | <.0001 |
| **AUH** | 0.004732 | 0.003007 | 1.57 | 0.1156 |
| **DAN** | 0.09934 | 0.000991 | 100.20 | <.0001 |
| **GE** | 0.02673 | 0.000707 | 37.79 | <.0001 |
| **CC** | 0.06988 | 0.001003 | 69.68 | <.0001 |
| **Degree** | -0.03788 | 0.000419 | -90.35 | <.0001 |
| **Modularity** | -0.01203 | 0.001485 | -8.10 | <.0001 |
| **GE\*AUH** | 0.000106 | 0.001001 | 0.11 | 0.9159 |
| **CC\*AUH** | 0.001683 | 0.001420 | 1.19 | 0.2359 |
| **AUH\*DAN** | 0.003808 | 0.001393 | 2.73 | 0.0063 |
| **GE\*DAN** | -0.00140 | 0.002127 | -0.66 | 0.5103 |
| **CC\*DAN** | 0.01770 | 0.001822 | 9.72 | <.0001 |
| **GE\*AUH\*DAN** | 0.008460 | 0.003021 | 2.80 | 0.0051 |
| **CC\*AUH\*DAN** | -0.00750 | 0.002712 | -2.77 | 0.0056 |
| **Dist** | -0.03792 | 0.000417 | -90.98 | <.0001 |
| **Dist2** | 0.02820 | 0.000225 | 125.50 | <.0001 |
| **Site A** | 0.007425 | 0.004356 | 1.70 | 0.0883 |
| **Site B** | -0.00688 | 0.004341 | -1.58 | 0.1130 |
| **Site C** | 0.000894 | 0.004515 | 0.20 | 0.8430 |
| **Site D** | 0.01012 | 0.004662 | 2.17 | 0.0300 |
| **Site E** | 0 | . | . | . |

**Table S11:** Alcohol use history (AUH): A binary variable representing alcohol use history group (0- no/low, 1- hazardous). Adjusted using the adaptive FDR procedure described in (Benjamini & Hochberg, 2000).

Abbreviations: AUH, alcohol use history; GE, global efficiency; CC, clustering coefficient; Dist, distance; SE, standard error; DAN, dorsal attention network.

**Supplemental Table 12****- Full mixed-effects results for Default Mode Network (DMN) Connection Probability Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Intercept** | -0.2924 | 0.01437 | -20.35 | <.0001 |
| **AUH** | 0.009540 | 0.01411 | 0.68 | 0.4991 |
| **DMN** | 1.0773 | 0.007547 | 142.74 | <.0001 |
| **GE** | 0.1689 | 0.01361 | 12.41 | <.0001 |
| **CC** | -0.2567 | 0.01671 | -15.36 | <.0001 |
| **Degree** | -0.08206 | 0.005424 | -15.13 | <.0001 |
| **Modularity** | 0.03903 | 0.006961 | 5.61 | <.0001 |
| **GE\*AUH** | -0.02346 | 0.01925 | -1.22 | 0.2229 |
| **CC\*AUH** | 0.02431 | 0.02364 | 1.03 | 0.3037 |
| **AUH\*DMN** | -0.02083 | 0.01041 | -2.00 | 0.0454 |
| **GE\*DMN** | 0.1289 | 0.01520 | 8.48 | <.0001 |
| **CC\*DMN** | 0.4892 | 0.01508 | 32.44 | <.0001 |
| **GE\*AUH\*DMN** | 0.06644 | 0.02115 | 3.14 | 0.0017 |
| **CC\*AUH\*DMN** | -0.04831 | 0.02071 | -2.33 | 0.0196 |
| **Dist** | -0.2234 | 0.004008 | -55.74 | <.0001 |
| **Dist2** | 0.1809 | 0.002298 | 78.70 | <.0001 |
| **Site A** | 0.004343 | 0.02045 | 0.21 | 0.8318 |
| **Site B** | 0.01281 | 0.02037 | 0.63 | 0.5294 |
| **Site C** | -0.01483 | 0.02119 | -0.70 | 0.4840 |
| **Site D** | -0.01069 | 0.02188 | -0.49 | 0.6253 |
| **Site E** | 0 | . | . | . |

**Table S12:** Alcohol use history (AUH): A binary variable representing alcohol use history group (0- no/low, 1- hazardous). Adjusted using the adaptive FDR procedure described in (Benjamini & Hochberg, 2000).

Abbreviations: AUH, alcohol use history; GE, global efficiency; CC, clustering coefficient; Dist, distance; SE, standard error; DMN, default mode network.

**Supplemental Table 13****- Full mixed-effects results for Default Mode Network (DMN) Connection Strength Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Intercept** | 0.1870 | 0.002930 | 63.84 | <.0001 |
| **AUH** | 0.004909 | 0.002879 | 1.71 | 0.0881 |
| **DMN** | 0.05498 | 0.000698 | 78.80 | <.0001 |
| **GE** | 0.02404 | 0.000780 | 30.81 | <.0001 |
| **CC** | 0.06762 | 0.000999 | 67.66 | <.0001 |
| **Degree** | -0.03757 | 0.000402 | -93.45 | <.0001 |
| **Modularity** | -0.01145 | 0.001422 | -8.05 | <.0001 |
| **GE\*AUH** | 0.000914 | 0.001104 | 0.83 | 0.4077 |
| **CC\*AUH** | 0.000895 | 0.001415 | 0.63 | 0.5271 |
| **AUH\*DMN** | 0.005724 | 0.000963 | 5.94 | <.0001 |
| **GE\*DMN** | 0.05537 | 0.001242 | 44.60 | <.0001 |
| **CC\*DMN** | -0.00738 | 0.001117 | -6.61 | <.0001 |
| **GE\*AUH\*DMN** | 0.002568 | 0.001748 | 1.47 | 0.1418 |
| **CC\*AUH\*DMN** | -0.00160 | 0.001552 | -1.03 | 0.3014 |
| **Dist** | -0.03877 | 0.000423 | -91.61 | <.0001 |
| **Dist2** | 0.02738 | 0.000223 | 123.01 | <.0001 |
| **Site A** | 0.006904 | 0.004170 | 1.66 | 0.0979 |
| **Site B** | -0.00653 | 0.004156 | -1.57 | 0.1162 |
| **Site C** | 0.000812 | 0.004323 | 0.19 | 0.8509 |
| **Site D** | 0.009419 | 0.004464 | 2.11 | 0.0349 |
| **Site E** | 0 | . | . | . |

**Table S13:** Alcohol use history (AUH): A binary variable representing alcohol use history group (0- no/low, 1- hazardous). Adjusted using the adaptive FDR procedure described in (Benjamini & Hochberg, 2000).

Abbreviations: AUH, alcohol use history; GE, global efficiency; CC, clustering coefficient; Dist, distance; SE, standard error; DMN, default mode network.

**Supplemental Table 14-** **Full mixed-effects results for Fronto-Temporal Network (FTN) Connection Probability Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Intercept** | -0.2642 | 0.01380 | -19.15 | <.0001 |
| **AUH** | 0.007832 | 0.01355 | 0.58 | 0.5633 |
| **FTN** | 0.6089 | 0.01554 | 39.19 | <.0001 |
| **GE** | 0.1880 | 0.01300 | 14.45 | <.0001 |
| **CC** | -0.2353 | 0.01565 | -15.03 | <.0001 |
| **Degree** | -0.08526 | 0.005411 | -15.76 | <.0001 |
| **Modularity** | 0.03394 | 0.006686 | 5.08 | <.0001 |
| **GE\*AUH** | -0.02687 | 0.01839 | -1.46 | 0.1440 |
| **CC\*AUH** | 0.02617 | 0.02215 | 1.18 | 0.2374 |
| **AUH\*FTN** | -0.02428 | 0.02323 | -1.05 | 0.2959 |
| **GE\*FTN** | 0.2349 | 0.02407 | 9.76 | <.0001 |
| **CC\*FTN** | -0.08330 | 0.02676 | -3.11 | 0.0019 |
| **GE\*AUH\*FTN** | 0.08199 | 0.03451 | 2.38 | 0.0175 |
| **CC\*AUH\*FTN** | -0.1313 | 0.03949 | -3.33 | 0.0009 |
| **Dist** | -0.2167 | 0.003916 | -55.33 | <.0001 |
| **Dist2** | 0.1828 | 0.002260 | 80.88 | <.0001 |
| **Site A** | 0.007923 | 0.01964 | 0.40 | 0.6866 |
| **Site B** | 0.007733 | 0.01957 | 0.40 | 0.6927 |
| **Site C** | -0.01318 | 0.02035 | -0.65 | 0.5170 |
| **Site D** | -0.00441 | 0.02102 | -0.21 | 0.8338 |
| **Site E** | 0 | . | . | . |

**Table S14:** Alcohol use history (AUH): A binary variable representing alcohol use history group (0- no/low, 1- hazardous). Adjusted using the adaptive FDR procedure described in (Benjamini & Hochberg, 2000).

Abbreviations: AUH, alcohol use history; GE, global efficiency; CC, clustering coefficient; Dist, distance; SE, standard error; FTN, fronto-temporal network.

**Supplemental Table 15-** **Full mixed-effects results for Fronto-Temporal Network (FTN) Connection Strength Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Intercept** | 0.1897 | 0.003095 | 61.29 | <.0001 |
| **AUH** | 0.004880 | 0.003041 | 1.60 | 0.1086 |
| **FTN** | 0.05417 | 0.001430 | 37.89 | <.0001 |
| **GE** | 0.02752 | 0.000719 | 38.25 | <.0001 |
| **CC** | 0.06986 | 0.001004 | 69.56 | <.0001 |
| **Degree** | -0.03820 | 0.000418 | -91.39 | <.0001 |
| **Modularity** | -0.01209 | 0.001502 | -8.05 | <.0001 |
| **GE\*AUH** | 0.000445 | 0.001019 | 0.44 | 0.6620 |
| **CC\*AUH** | 0.001431 | 0.001422 | 1.01 | 0.3142 |
| **AUH\*FTN** | 0.002481 | 0.002125 | 1.17 | 0.2431 |
| **GE\*FTN** | 0.04830 | 0.002326 | 20.77 | <.0001 |
| **CC\*FTN** | -0.03909 | 0.002527 | -15.47 | <.0001 |
| **GE\*AUH\*FTN** | 0.01523 | 0.003358 | 4.53 | <.0001 |
| **CC\*AUH\*FTN** | -0.02452 | 0.003820 | -6.42 | <.0001 |
| **Dist** | -0.03817 | 0.000412 | -92.55 | <.0001 |
| **Dist2** | 0.02797 | 0.000224 | 124.99 | <.0001 |
| **Site A** | 0.007492 | 0.004405 | 1.70 | 0.0890 |
| **Site B** | -0.00699 | 0.004390 | -1.59 | 0.1113 |
| **Site C** | 0.000947 | 0.004566 | 0.21 | 0.8357 |
| **Site D** | 0.01019 | 0.004715 | 2.16 | 0.0306 |
| **Site E** | 0 | . | . | . |

**Table S15:** Alcohol use history (AUH): A binary variable representing alcohol use history group (0- no/low, 1- hazardous). Adjusted using the adaptive FDR procedure described in (Benjamini & Hochberg, 2000).

Abbreviations: AUH, alcohol use history; GE, global efficiency; CC, clustering coefficient; Dist, distance; SE, standard error; FTN, fronto-temporal network.

**Supplemental Table 16-** **Full mixed-effects results for Sensorimotor Network (SMN) Connection Probability Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Intercept** | -0.2774 | 0.01408 | -19.70 | <.0001 |
| **AUH** | 0.003054 | 0.01383 | 0.22 | 0.8252 |
| **SMN** | 0.9485 | 0.008174 | 116.04 | <.0001 |
| **GE** | 0.1792 | 0.01281 | 13.99 | <.0001 |
| **CC** | -0.2522 | 0.01525 | -16.53 | <.0001 |
| **Degree** | -0.08141 | 0.005420 | -15.02 | <.0001 |
| **Modularity** | 0.03874 | 0.006823 | 5.68 | <.0001 |
| **GE\*AUH** | -0.02580 | 0.01811 | -1.42 | 0.1543 |
| **CC\*AUH** | 0.02294 | 0.02158 | 1.06 | 0.2878 |
| **AUH\*SMN** | 0.09365 | 0.01148 | 8.15 | <.0001 |
| **GE\*SMN** | 0.1314 | 0.01679 | 7.83 | <.0001 |
| **CC\*SMN** | 0.4250 | 0.01486 | 28.60 | <.0001 |
| **GE\*AUH\*SMN** | 0.07347 | 0.02388 | 3.08 | 0.0021 |
| **CC\*AUH\*SMN** | -0.07970 | 0.02145 | -3.72 | 0.0002 |
| **Dist** | -0.2098 | 0.003995 | -52.51 | <.0001 |
| **Dist2** | 0.1817 | 0.002257 | 80.50 | <.0001 |
| **Site A** | 0.005290 | 0.02004 | 0.26 | 0.7918 |
| **Site B** | 0.009716 | 0.01997 | 0.49 | 0.6265 |
| **Site C** | -0.01507 | 0.02077 | -0.73 | 0.4679 |
| **Site D** | -0.01091 | 0.02145 | -0.51 | 0.6108 |
| **Site E** | 0 | . | . | . |

**Table S16:** Alcohol use history (AUH): A binary variable representing alcohol use history group (0- no/low, 1- hazardous). Adjusted using the adaptive FDR procedure described in (Benjamini & Hochberg, 2000).

Abbreviations: AUH, alcohol use history; GE, global efficiency; CC, clustering coefficient; Dist, distance; SE, standard error; SMN, sensorimotor network.

**Supplemental Table 17-** **Full mixed-effects results for Sensorimotor Network (SMN) Connection Strength Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Intercept** | 0.1878 | 0.002940 | 63.88 | <.0001 |
| **AUH** | 0.004401 | 0.002889 | 1.52 | 0.1277 |
| **SMN** | 0.06974 | 0.000755 | 92.41 | <.0001 |
| **GE** | 0.02639 | 0.000799 | 33.04 | <.0001 |
| **CC** | 0.06715 | 0.001130 | 59.43 | <.0001 |
| **Degree** | -0.03754 | 0.000401 | -93.55 | <.0001 |
| **Modularity** | -0.01136 | 0.001427 | -7.96 | <.0001 |
| **GE\*AUH** | 0.001498 | 0.001131 | 1.33 | 0.1850 |
| **CC\*AUH** | -0.00025 | 0.001599 | -0.15 | 0.8776 |
| **AUH\*SMN** | 0.001125 | 0.001044 | 1.08 | 0.2812 |
| **GE\*SMN** | 0.02814 | 0.001362 | 20.67 | <.0001 |
| **CC\*SMN** | 0.007240 | 0.001067 | 6.79 | <.0001 |
| **GE\*AUH\*SMN** | -0.01663 | 0.001929 | -8.62 | <.0001 |
| **CC\*AUH\*SMN** | 0.01991 | 0.001550 | 12.85 | <.0001 |
| **Dist** | -0.03710 | 0.000412 | -90.11 | <.0001 |
| **Dist2** | 0.02790 | 0.000223 | 125.06 | <.0001 |
| **Site A** | 0.007202 | 0.004185 | 1.72 | 0.0853 |
| **Site B** | -0.00666 | 0.004170 | -1.60 | 0.1104 |
| **Site C** | 0.000548 | 0.004338 | 0.13 | 0.8994 |
| **Site D** | 0.009315 | 0.004479 | 2.08 | 0.0376 |
| **Site E** | 0 | . | . | . |

**Table S17:** Alcohol use history (AUH): A binary variable representing alcohol use history group (0- no/low, 1- hazardous). Adjusted using the adaptive FDR procedure described in (Benjamini & Hochberg, 2000).

Abbreviations: AUH, alcohol use history; GE, global efficiency; CC, clustering coefficient; Dist, distance; SE, standard error; SMN, sensorimotor network.

**Supplemental Table 18-** **Full mixed-effects results for Salience Network (SN) Connection Probability Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Intercept** | -0.2693 | 0.01383 | -19.48 | <.0001 |
| **AUH** | 0.006032 | 0.01358 | 0.44 | 0.6569 |
| **SN** | 0.7704 | 0.01542 | 49.97 | <.0001 |
| **GE** | 0.1694 | 0.01299 | 13.04 | <.0001 |
| **CC** | -0.2285 | 0.01565 | -14.60 | <.0001 |
| **Degree** | -0.08487 | 0.005403 | -15.71 | <.0001 |
| **Modularity** | 0.03502 | 0.006699 | 5.23 | <.0001 |
| **GE\*AUH** | -0.02777 | 0.01837 | -1.51 | 0.1306 |
| **CC\*AUH** | 0.02572 | 0.02213 | 1.16 | 0.2451 |
| **AUH\*SN** | 0.06687 | 0.02144 | 3.12 | 0.0018 |
| **GE\*SN** | 0.7098 | 0.02914 | 24.36 | <.0001 |
| **CC\*SN** | -0.2381 | 0.02656 | -8.97 | <.0001 |
| **GE\*AUH\*SN** | -0.00119 | 0.04130 | -0.03 | 0.9770 |
| **CC\*AUH\*SN** | 0.04005 | 0.03888 | 1.03 | 0.3030 |
| **Dist** | -0.2172 | 0.003952 | -54.96 | <.0001 |
| **Dist2** | 0.1839 | 0.002263 | 81.29 | <.0001 |
| **Site A** | 0.007069 | 0.01968 | 0.36 | 0.7194 |
| **Site B** | 0.009855 | 0.01960 | 0.50 | 0.6152 |
| **Site C** | -0.01264 | 0.02039 | -0.62 | 0.5354 |
| **Site D** | -0.00586 | 0.02106 | -0.28 | 0.7810 |
| **Site E** | 0 | . | . | . |

**Table S18:** Alcohol use history (AUH): A binary variable representing alcohol use history group (0- no/low, 1- hazardous). Adjusted using the adaptive FDR procedure described in (Benjamini & Hochberg, 2000).

Abbreviations: AUH, alcohol use history; GE, global efficiency; CC, clustering coefficient; Dist, distance; SE, standard error; SN, salience network.

**Supplemental Table 19-** **Full mixed-effects results for Salience Network (SN) Connection Strength Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Intercept** | 0.1888 | 0.003021 | 62.49 | <.0001 |
| **AUH** | 0.004704 | 0.002969 | 1.58 | 0.1131 |
| **SN** | 0.04431 | 0.001484 | 29.85 | <.0001 |
| **GE** | 0.02464 | 0.000728 | 33.85 | <.0001 |
| **CC** | 0.07060 | 0.001000 | 70.60 | <.0001 |
| **Degree** | -0.03803 | 0.000415 | -91.64 | <.0001 |
| **Modularity** | -0.01196 | 0.001466 | -8.16 | <.0001 |
| **GE\*AUH** | 0.000239 | 0.001031 | 0.23 | 0.8163 |
| **CC\*AUH** | 0.001310 | 0.001416 | 0.92 | 0.3550 |
| **AUH\*SN** | 0.003206 | 0.002052 | 1.56 | 0.1181 |
| **GE\*SN** | 0.1035 | 0.002406 | 43.03 | <.0001 |
| **CC\*SN** | -0.04155 | 0.002138 | -19.43 | <.0001 |
| **GE\*AUH\*SN** | -0.00159 | 0.003394 | -0.47 | 0.6385 |
| **CC\*AUH\*SN** | 0.002278 | 0.003099 | 0.73 | 0.4624 |
| **Dist** | -0.03804 | 0.000417 | -91.13 | <.0001 |
| **Dist2** | 0.02813 | 0.000224 | 125.80 | <.0001 |
| **Site A** | 0.007410 | 0.004301 | 1.72 | 0.0849 |
| **Site B** | -0.00676 | 0.004285 | -1.58 | 0.1150 |
| **Site C** | 0.000920 | 0.004457 | 0.21 | 0.8364 |
| **Site D** | 0.01004 | 0.004603 | 2.18 | 0.0292 |
| **Site E** | 0 | . | . | . |

**Table S19:** Alcohol use history (AUH): A binary variable representing alcohol use history group (0- no/low, 1- hazardous). Adjusted using the adaptive FDR procedure described in (Benjamini & Hochberg, 2000).

Abbreviations: AUH, alcohol use history; GE, global efficiency; CC, clustering coefficient; Dist, distance; SE, standard error; SN, salience network.

**Supplemental Table 20-** **Full mixed-effects results for Visual Network (VN) Connection Probability Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Intercept** | -0.2629 | 0.01409 | -18.65 | <.0001 |
| **AUH** | 0.007542 | 0.01384 | 0.54 | 0.5858 |
| **VN** | 1.2654 | 0.01862 | 67.97 | <.0001 |
| **GE** | 0.1901 | 0.01373 | 13.84 | <.0001 |
| **CC** | -0.2442 | 0.01666 | -14.65 | <.0001 |
| **Degree** | -0.08374 | 0.005419 | -15.45 | <.0001 |
| **Modularity** | 0.03576 | 0.006828 | 5.24 | <.0001 |
| **GE\*AUH** | -0.02992 | 0.01942 | -1.54 | 0.1234 |
| **CC\*AUH** | 0.02984 | 0.02357 | 1.27 | 0.2055 |
| **AUH\*VN** | -0.1095 | 0.02560 | -4.28 | <.0001 |
| **GE\*VN** | -0.09679 | 0.03739 | -2.59 | 0.0096 |
| **CC\*VN** | 0.5976 | 0.03350 | 17.84 | <.0001 |
| **GE\*AUH\*VN** | 0.1504 | 0.05072 | 2.97 | 0.0030 |
| **CC\*AUH\*VN** | -0.2611 | 0.04617 | -5.65 | <.0001 |
| **Dist** | -0.2110 | 0.003918 | -53.87 | <.0001 |
| **Dist2** | 0.1789 | 0.002270 | 78.78 | <.0001 |
| **Site A** | 0.007287 | 0.02006 | 0.36 | 0.7164 |
| **Site B** | 0.008636 | 0.01998 | 0.43 | 0.6656 |
| **Site C** | -0.01312 | 0.02078 | -0.63 | 0.5279 |
| **Site D** | -0.00554 | 0.02147 | -0.26 | 0.7962 |
| **Site E** | 0 | . | . | . |

**Table S20:** Alcohol use history (AUH): A binary variable representing alcohol use history group (0- no/low, 1- hazardous). Adjusted using the adaptive FDR procedure described in (Benjamini & Hochberg, 2000).

Abbreviations: AUH, alcohol use history; GE, global efficiency; CC, clustering coefficient; Dist, distance; SE, standard error; VN, visual network.

**Supplemental Table 21-** **Full mixed-effects results for Visual Network (VN) Connection Strength Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Estimate** | **SE** | **t Value** | **P-Value** |
| **Intercept** | 0.1891 | 0.003033 | 62.34 | <.0001 |
| **AUH** | 0.004898 | 0.002981 | 1.64 | 0.1003 |
| **VN** | 0.1997 | 0.001258 | 158.82 | <.0001 |
| **GE** | 0.02995 | 0.000679 | 44.13 | <.0001 |
| **CC** | 0.06548 | 0.000968 | 67.67 | <.0001 |
| **Degree** | -0.03746 | 0.000421 | -89.06 | <.0001 |
| **Modularity** | -0.01159 | 0.001472 | -7.87 | <.0001 |
| **GE\*AUH** | -0.00104 | 0.000961 | -1.08 | 0.2784 |
| **CC\*AUH** | 0.002881 | 0.001370 | 2.10 | 0.0355 |
| **AUH\*VN** | -0.00342 | 0.001757 | -1.94 | 0.0519 |
| **GE\*VN** | 0.01731 | 0.002503 | 6.91 | <.0001 |
| **CC\*VN** | 0.06129 | 0.002029 | 30.21 | <.0001 |
| **GE\*AUH\*VN** | 0.03491 | 0.003501 | 9.97 | <.0001 |
| **CC\*AUH\*VN** | -0.00537 | 0.002965 | -1.81 | 0.0700 |
| **Dist** | -0.03575 | 0.000409 | -87.41 | <.0001 |
| **Dist2** | 0.02661 | 0.000220 | 120.73 | <.0001 |
| **Site A** | 0.007339 | 0.004318 | 1.70 | 0.0892 |
| **Site B** | -0.00686 | 0.004303 | -1.59 | 0.1107 |
| **Site C** | 0.001008 | 0.004475 | 0.23 | 0.8218 |
| **Site D** | 0.009904 | 0.004622 | 2.14 | 0.0321 |
| **Site E** | 0 | . | . | . |

**Table S21:** Alcohol use history (AUH): A binary variable representing alcohol use history group (0- no/low, 1- hazardous). Adjusted using the adaptive FDR procedure described in (Benjamini & Hochberg, 2000).

Abbreviations: AUH, alcohol use history; GE, global efficiency; CC, clustering coefficient; Dist, distance; SE, standard error; VN, visual network.

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