

## Supplementary Materials

**Supplementary Table 1. Power atlas ROI network nodes (n=216) used in the analysis**

Network	Talarach Daemon Label	Brodmann_Area	MNI Coordinates		
			X	Y	Z
Auditory	Insula	13	32	-28	12
Auditory	Insula	13	64	-32	20
Auditory	Transverse Temporal	41	56	-16	8
Auditory	STG	42	-40	-32	16
Auditory	STG	41	-60	-24	12
Auditory	STG	41	-48	-28	4
Auditory	Insula	13	44	-24	20
Auditory	Insula	13	-48	-36	24
Auditory	Insula	13	-52	-20	24
Auditory	PreCent	43	-56	-8	12
Auditory	PreCent	43	56	-4	12
Auditory	PostCent	2	60	-16	28
Auditory	Insula	13	-32	-28	12
CON	mFG	6	-4	4	52
CON	IPL	40	56	-28	32
CON	SFG	6	20	-8	64
CON	SFG	6	-16	-4	72
CON	CG	24	-12	-4	44
CON	LN	Putamen	36	0	-4
CON	SFG	6	12	0	68
CON	mFG	6	8	8	52
CON	Insula	13	-44	0	8
CON	Insula	13	48	8	0
CON	STG	22	-52	8	-4
CON	CG	32	-4	16	36
CON	Clastrum	*	36	12	0
DMN	MTG	19	-40	-76	24
DMN	mFG	10	4	68	-4
DMN	mFG	10	8	48	-16
DMN	PHG	30	-12	-40	0
DMN	mFG	10	-16	64	-8
DMN	MTG	19	-44	-60	20
DMN	MTG	39	44	-72	28
DMN	STG	38	-44	12	-36
DMN	STG	38	44	16	-32
DMN	MTG	21	-68	-24	-16
DMN	MTG	39	-44	-64	36

DMN	PrCu	19	-40	-76	44
DMN	PostCing	31	-8	-56	28
DMN	PrCu	7	4	-60	36
DMN	PostCing	30	-12	-56	16
DMN	PostCing	29	-4	-48	12
DMN	CG	31	8	-48	32
DMN	PrCu	31	16	-64	24
DMN	CG	31	-4	-36	44
DMN	PostCing	30	12	-52	16
DMN	STG	39	52	-60	36
DMN	SFG	8	24	32	48
DMN	SFG	6	-12	40	52
DMN	SFG	6	-16	28	52
DMN	MFG	6	-36	20	52
DMN	MFG	8	24	40	40
DMN	SFG	8	12	56	40
DMN	SFG	8	-12	56	40
DMN	SFG	8	-20	44	40
DMN	mFG	9	4	56	16
DMN	SFG	9	8	64	20
DMN	mFG	10	-8	52	0
DMN	mFG	10	8	56	4
DMN	ACC	32	-4	44	-8
DMN	ACC	32	8	44	-4
DMN	mFG	9	-12	44	8
DMN	mFG	8	-4	36	36
DMN	ACC	32	-4	40	16
DMN	SFG	9	-20	64	20
DMN	mFG	9	-8	48	24
DMN	ITG	21	64	-12	-20
DMN	MTG	21	-56	-12	-12
DMN	MTG	21	-56	-28	-4
DMN	MTG	21	64	-32	-8
DMN	MTG	21	-68	-40	-4
DMN	SFG	6	12	28	60
DMN	ACC	32	12	36	20
DMN	Sub-Gyral	21	52	-4	-16
DMN	PHG	36	-28	-40	-8
DMN	PHG	36	28	-36	-12
DMN	FFG	37	-32	-40	-16
DMN	STG	38	52	8	-28
DMN	MTG	21	-52	4	-28

DMN	STG	39	48	-52	28
DMN	MTG	21	-48	-44	0
DMN	IFG	47	-48	32	-12
DMN	MFG	47	48	36	-12
DMN	CG	31	-4	-36	32
DMN	PrCu	7	-8	-72	40
DMN	PrCu	7	12	-68	44
DMN	PrCu	7	4	-48	52
DMN	CG	23	0	-24	32
DAN	PrCu	7	8	-60	60
DAN	MTG	37	-52	-64	4
DAN	PrCu	7	20	-64	48
DAN	MTG	37	48	-60	4
DAN	SPL	7	24	-60	60
DAN	IPL	40	-32	-48	48
DAN	PrCu	19	-28	-72	36
DAN	MFG	6	-32	0	56
DAN	FFG	37	-44	-60	-8
DAN	SPL	7	-16	-60	64
DAN	MFG	6	28	-4	52
FPN	PreCent	6	-44	0	44
FPN	MFG	9	48	24	28
FPN	IFG	9	-48	12	24
FPN	IPL	40	-52	-48	44
FPN	SFG	6	-24	12	64
FPN	ITG	20	60	-52	-12
FPN	ACC	10	24	44	-16
FPN	MFG	10	32	56	-12
FPN	PreCent	6	48	8	32
FPN	PreCent	6	-40	4	32
FPN	MFG	46	-44	40	20
FPN	MFG	10	40	44	16
FPN	IPL	40	48	-44	44
FPN	SPL	7	-28	-56	48
FPN	IPL	40	44	-52	48
FPN	MFG	6	32	16	56
FPN	PrCu	39	36	-64	40
FPN	IPL	40	-44	-56	44
FPN	MFG	6	40	20	40
FPN	MFG	10	-36	56	4
FPN	IFG	10	-40	44	-4
FPN	SPL	7	32	-52	44

FPN	MFG	46	44	48	-4
FPN	MFG	9	-44	24	28
FPN	mFG	8	-4	28	44
Salience	PrCu	7	12	-40	52
Salience	Supramarginal	40	56	-44	36
Salience	MFG	6	44	0	48
Salience	MFG	9	32	32	28
Salience	IFG	45	48	24	8
Salience	Insula	13	-36	20	0
Salience	Insula	13	36	20	4
Salience	IFG	47	36	32	-4
Salience	Clastrum	*	32	16	-8
Salience	CG	32	-12	24	24
Salience	mFG	32	0	16	44
Salience	SFG	10	-28	52	20
Salience	CG	32	0	32	28
Salience	CG	32	4	24	36
Salience	CG	32	12	24	28
Salience	SFG	10	32	56	16
Salience	SFG	9	28	48	28
Salience	MFG	10	-40	52	16
SSM	PrCu	7	-8	-52	60
SSM	CG	24	-12	-16	40
SSM	ParaCent	31	0	-16	48
SSM	CG	24	8	0	44
SSM	mFG	6	-8	-20	64
SSM	ParaCent	4	-8	-32	72
SSM	ParaCent	4	12	-32	76
SSM	PostCent	2	-52	-24	44
SSM	PreCent	4	28	-16	72
SSM	PostCent	7	8	-44	72
SSM	PostCent	2	-24	-32	72
SSM	PostCent	3	-40	-20	56
SSM	Sub-Gyrat	40	28	-40	60
SSM	PostCent	2	52	-20	40
SSM	PostCent	2	-40	-28	68
SSM	ParaCent	4	20	-28	60
SSM	PreCent	4	44	-8	56
SSM	Sub-Gyrat	40	-28	-44	60
SSM	mFG	6	12	-16	76
SSM	SPL	7	24	-44	68
SSM	IPL	40	-44	-32	48

SSM	Sub-Gyrat	40	-20	-32	60
SSM	PreCent	6	-12	-16	76
SSM	PostCent	3	44	-20	56
SSM	PreCent	4	-40	-16	68
SSM	PostCent	7	-16	-44	72
SSM	ParaCent	5	4	-28	60
SSM	mFG	6	4	-16	60
SSM	PreCent	4	36	-16	44
SSM	IPL	40	48	-28	48
SSM	PreCent	6	-48	-12	36
SSM	Claustrum	*	36	-8	12
SSM	PreCent	6	52	-4	32
SSM	PreCent	4	64	-8	24
VAN	SFG	6	-8	12	68
VAN	STG	13	52	-44	20
VAN	STG	22	-56	-52	8
VAN	STG	22	-56	-40	12
VAN	STG	41	52	-32	8
VAN	STG	22	52	-28	-4
VAN	STG	22	56	-48	12
VAN	IFG	45	52	32	0
VAN	IFG	45	-48	24	0
Visual	Culmen	*	16	-48	-8
Visual	MOG	19	40	-72	16
Visual	Cu	30	8	-72	12
Visual	LG	18	-8	-80	8
Visual	MOG	19	-28	-80	20
Visual	LG	19	20	-64	0
Visual	MOG	18	-24	-92	20
Visual	FFG	19	28	-60	-8
Visual	LG	18	-16	-72	-8
Visual	LG	19	-16	-68	4
Visual	FFG	19	44	-80	-12
Visual	FFG	19	-48	-76	-8
Visual	Cu	19	-16	-92	32
Visual	Cu	19	16	-88	36
Visual	PrCu	31	28	-76	24
Visual	LG	18	20	-84	-4
Visual	Cu	18	16	-76	32
Visual	LG	18	-16	-52	0
Visual	ITG	19	40	-64	-8
Visual	Cu	18	24	-88	24

Visual	Cu	18	4	-72	24
Visual	ITG	37	-44	-72	0
Visual	MOG	19	24	-80	-16
Visual	Cu	18	-16	-76	32
Visual	Cu	18	-4	-80	20
Visual	IOG	18	-40	-88	-8
Visual	MOG	19	36	-84	12
Visual	LG	18	8	-80	8
Visual	MOG	18	-28	-92	4
Visual	FFG	19	-32	-80	-12
Visual	IOG	19	36	-80	0

Note. **Network:** CON = Cingulo-opercular Task Control; DMN = Default Mode Network; DAN = Dorsal Attention Network; FPN = Fronto-parietal Task Control Network; SSM = Sensory/Somatomotor Network. **Talaraich Daemon Label:** STG= Superior Temporal Gyrus, PreCent = Precentral Gyrus, mFG = medial frontal gyrus, IPL =inferior parietal lobule, SFG = superior frontal gyrus, LN = lentiform nucleus, MFG = middle frontal gyrus, CG = cingulate gyrus, MTG = middle temporal gyrus, PHG = parahippocampal gyrus, PrCu = precuneus, PostCing = posterior cingulate, ACC = anterior cingulate cortex, ITG = inferior temporal gyrus, FFG= fusiform gyrus, SPL = superior parietal lobule, ParaCent = paracentral gyrus, MOG = middle occipital gyrus, Cu = Cuneus, IOG = inferior occipital gyrus, IFG = inferior frontal gyrus, LG = lingual gyrus,

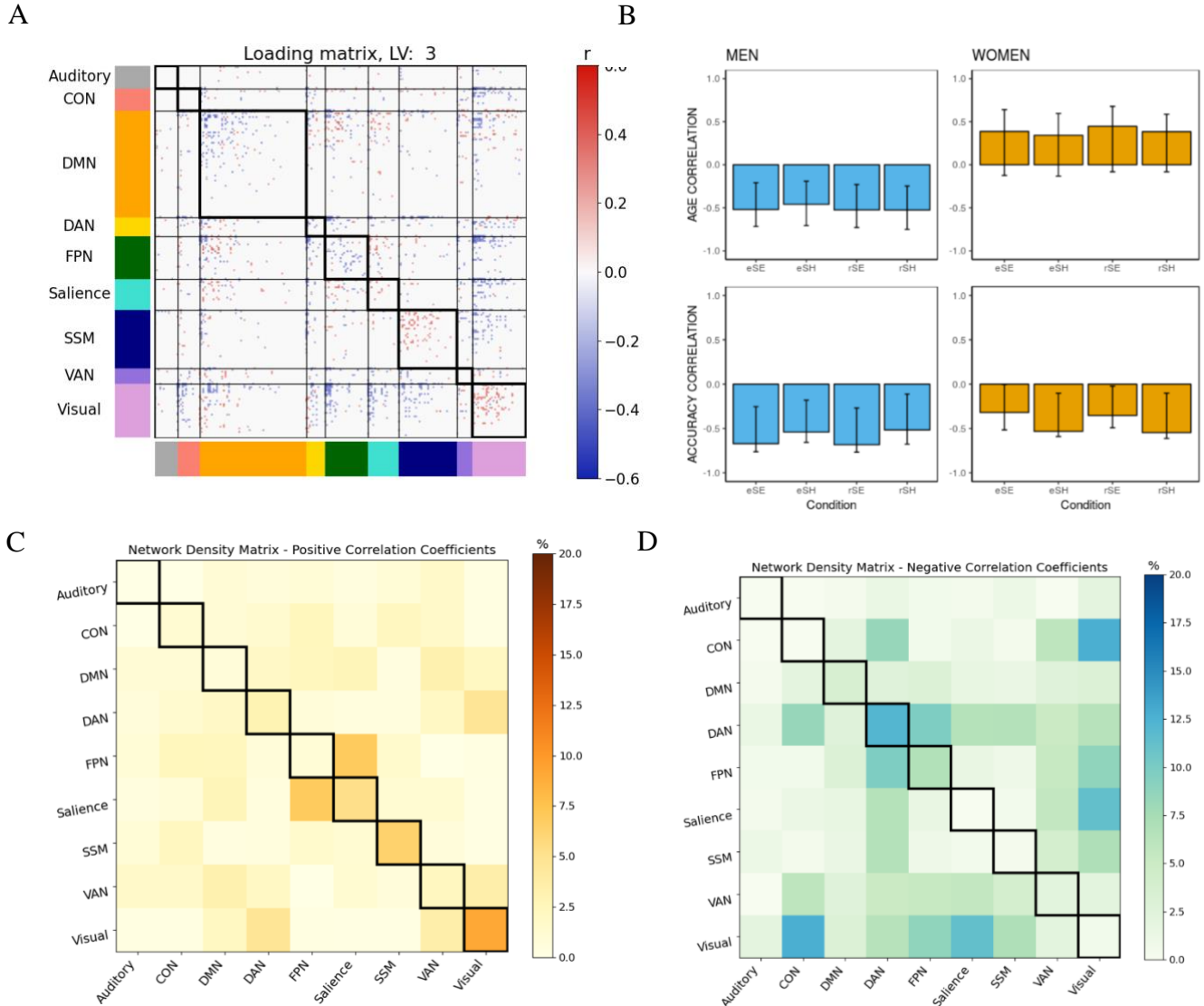
## **B-PLS2 Summary of Findings for LV3 and LV4**

*LV3: Sex similarities in accuracy-related, but differences in age-related, task connectivity.*

LV3 accounted for 11.45% of the cross-block covariance and identified significant positive correlation coefficients between several networks. The loading and density matrices (Suppl. Figure 1A and 1C, 1D) indicate that there was greatest density of positive correlations between the FPN and Salience networks. In addition, there were dense within-network positive correlations in the Salience and Visual networks. The loading matrix (Suppl. Figure 1A) and behavioral weights (Suppl. Figure 1B) indicate that in men, age was negatively correlated with increased connectivity in the aforementioned networks, and memory performance during both the SE and SH tasks was also negatively correlated with increased functional connectivity in these networks. In women, age was not significantly correlated with connectivity among these networks, and just like men memory performance for both SE and SH tasks was negatively correlated with increased functional connectivity in these networks. LV3 also identified negative correlations within DAN and between DAN, FPN and CON and Salience networks; and, between Visual-FPN, Salience and CON, and VAN-CON (Suppl. Figure 1D). These patterns of within- and between-network connectivity were correlated with advanced age in men, better memory performance both tasks in men and women.

# **Supplementary Figure 1. B-PLS2, LV3: Sex similarities in accuracy-related, but differences in age-related, task connectivity (Between-Sex Group B-PLS2 analysis)**

LV3 (11.45% cross-block covariance)



**Supplementary Figure 1.** (A) Thresholded 95th percentile of correlations between participants' task fMRI data and behavioral profile indicated in B. (B) Correlation between the behavioral vectors of age and accuracy with the task fMRI connectivity of participants (behavior correlation weights). Error bars represent bootstrapped standard deviations. (C) The density plot for the positive correlation coefficients (i.e., sum of the significant correlation coefficients after thresholding, divided by the total number of edges between any two networks). (D) The density matrix for the negative correlation coefficients. eSE = encoding spatial easy; eSH = encoding spatial hard; rSE = retrieval spatial easy; rSH = retrieval spatial hard; CON = cingulo-opercular network; DMN = default mode network; DAN = dorsal attention network; FPN = frontoparietal network; SSM = somatomotor network; VAN = ventral attention network.

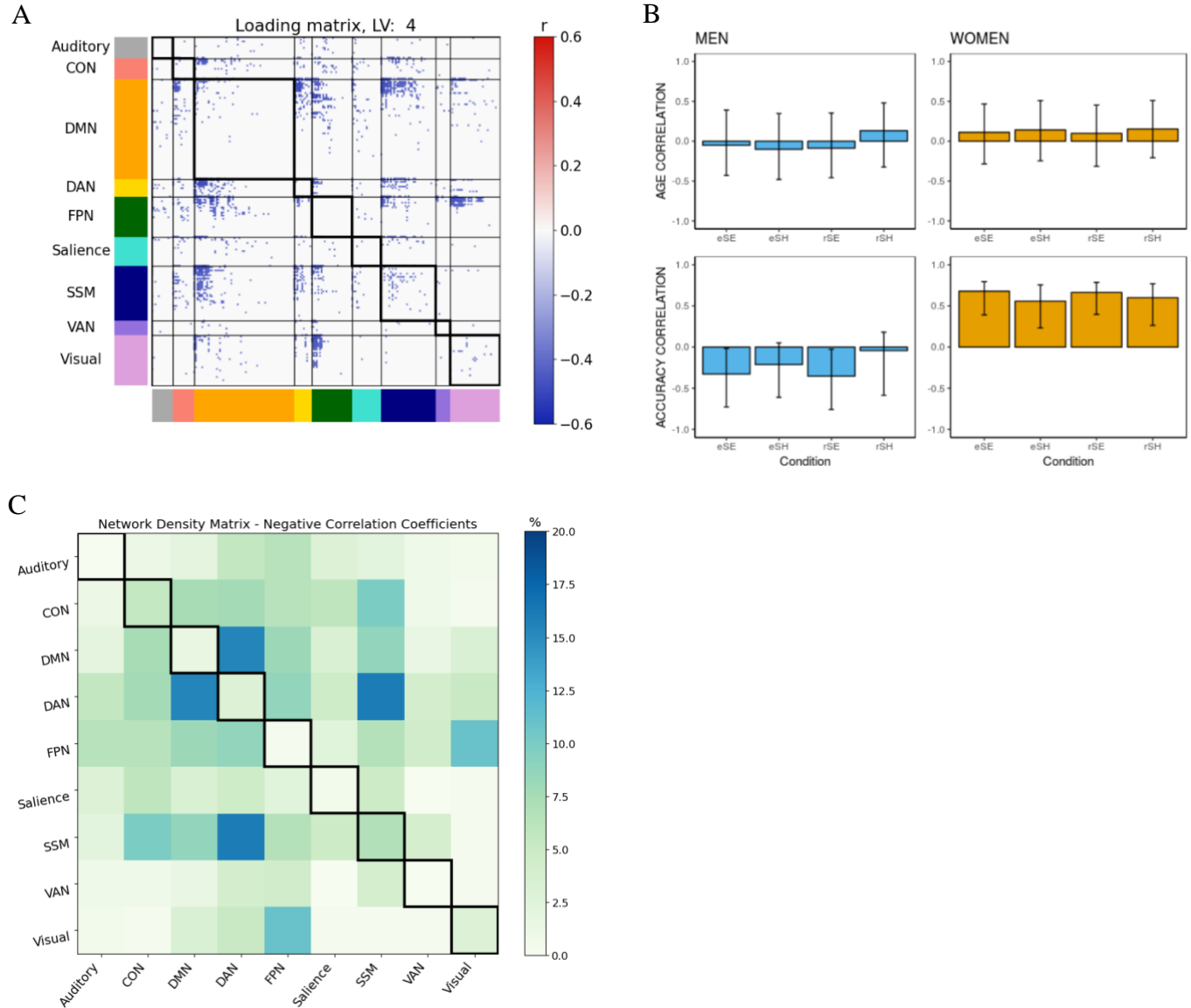


*LV4: Sex differences in accuracy, but no effects of age, in task connectivity.*

LV4 accounted for 5.23% of the cross-block covariance and showed only significant negative correlations. The loading and density matrices (Suppl. Figure 1E and 1G) show significant negative correlation connections between DAN-DMN and FPN, between SSM-CON, DMN and DAN and between Visual and FPN networks. Together with the brain-behavior plots (Suppl. Figure 1F), these networks show a strong positive correlation with memory performance on the task for the SE conditions in men. Conversely, women show a strong negative correlation between connectivity and performance on both SE and SH tasks in these same networks.

**Supplementary Figure 2. B-PLS2, LV4: Sex differences in accuracy, but no effects of age, in task connectivity (Between-Sex Group B-PLS2 analysis)**

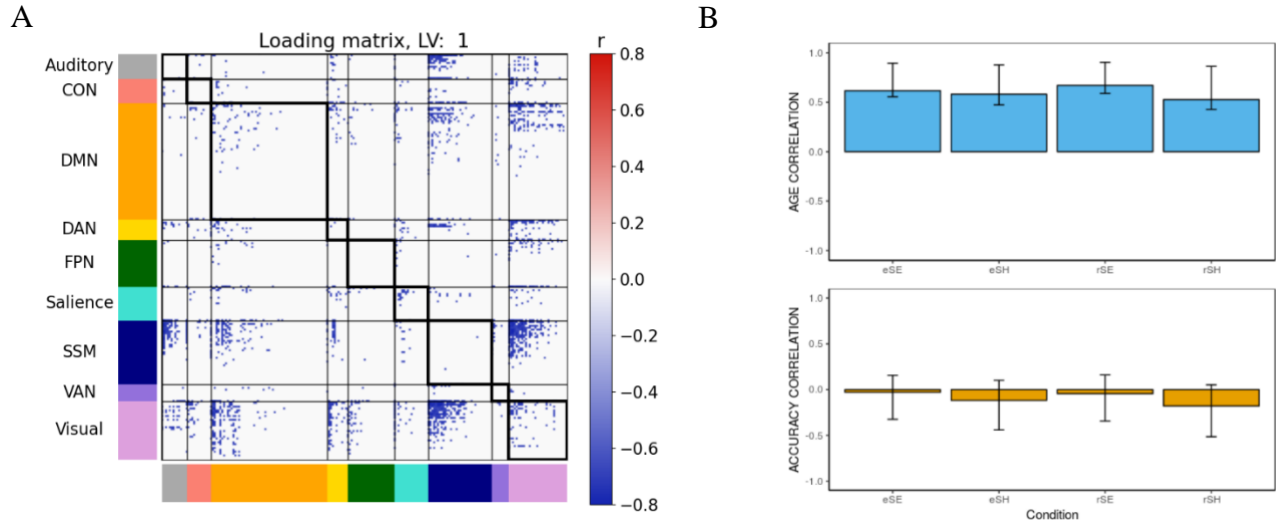
LV4 (5.23% cross-block covariance)



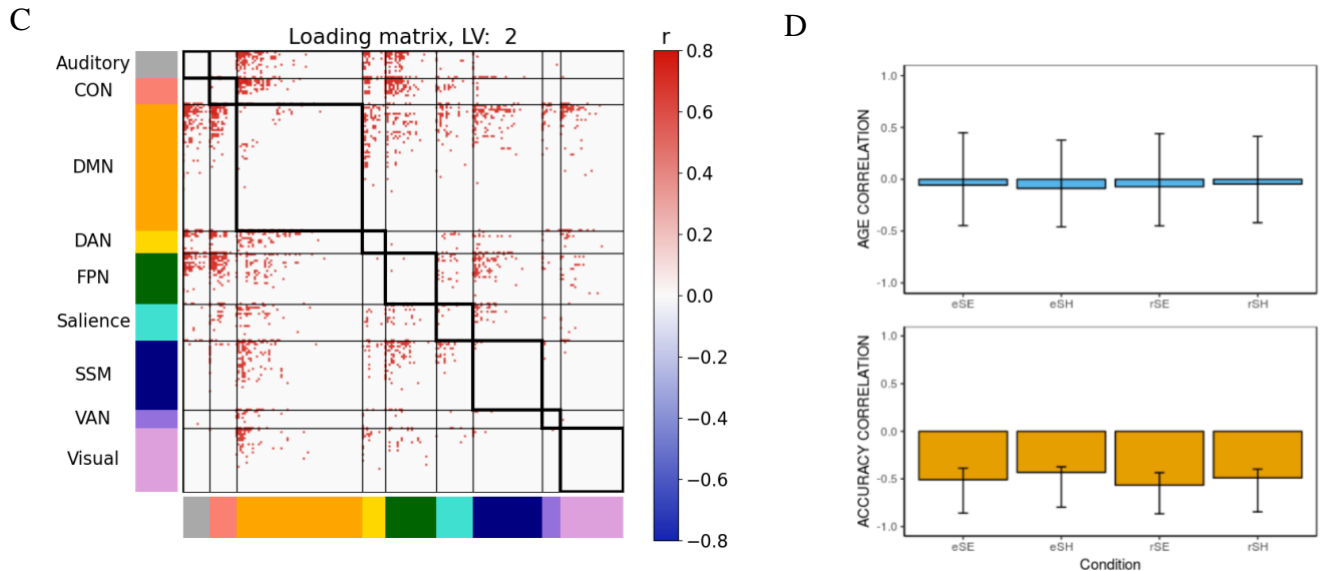
**Supplementary Figure 2. (A)** Thresholded 95th percentile of correlations between participants' task fMRI data and behavioral profile indicated in B. **(B)** Correlation between the behavioral vectors of age and accuracy with the task fMRI connectivity of participants (behavior correlation weights). Error bars represent bootstrapped standard deviations. **(C)** The density plot for the negative correlation coefficients (i.e., sum of the significant correlation coefficients after thresholding, divided by the total number of edges between any two networks). The density matrix for the positive correlation coefficients is not presented because there were no significant edges. eSE = encoding spatial easy; eSH = encoding spatial hard; rSE = retrieval spatial easy; rSH = retrieval spatial hard; CON = cingulo-opercular network; DMN = default mode network; DAN = dorsal attention network; FPN = frontoparietal network; SSM = somatomotor network; VAN = ventral attention network.

### Supplementary Figure 3. Matched-Sex cohort based on age, education, and intracranial volume (Full Group B-PLS1 Analysis)

LV1 (43.33% cross-block covariance)



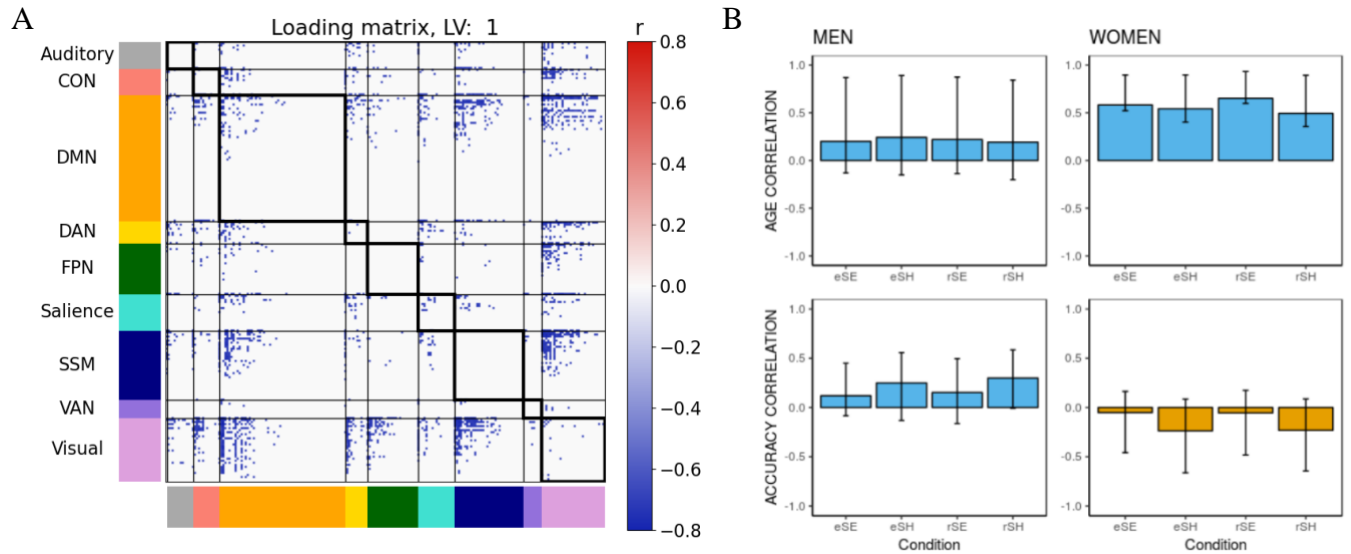
LV2 (19.17% cross-block covariance)



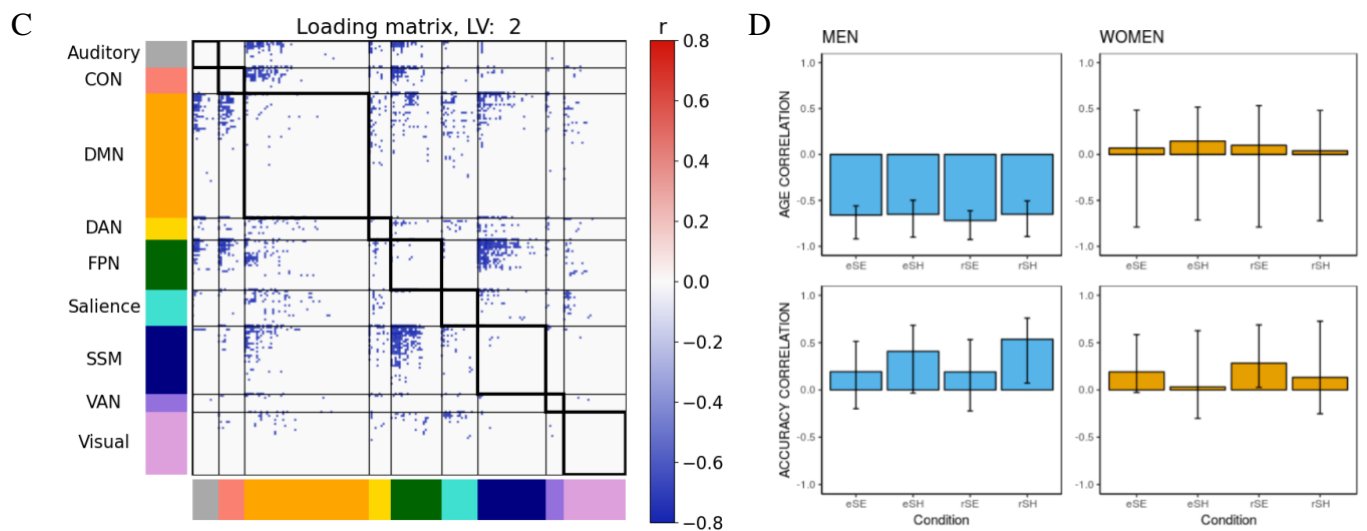
**Supplementary Figure 3.** (A, C) thresholded 95th percentile of correlations between participants' task fMRI data and behavioral profile for LV1 and LV2, respectively. (B, D) Behavioral profile of correlation between the behavioral vectors of age and accuracy with the task fMRI connectivity of participants (behavior correlation weights) for LV1 and LV2, respectively. Error bars represent bootstrapped standard deviations. eSE = encoding spatial easy; eSH = encoding spatial hard; rSE = retrieval spatial easy; rSH = retrieval spatial hard; CON = cingulo-opercular network; DMN = default mode network; DAN = dorsal attention network; FPN = frontoparietal network; SSM = somatomotor network; VAN = ventral attention network.

# Supplementary Figure 4. Matched-Sex cohort based on Age, Education, and Intracranial Volume (Between-Sex Group B-PLS2 Analysis)

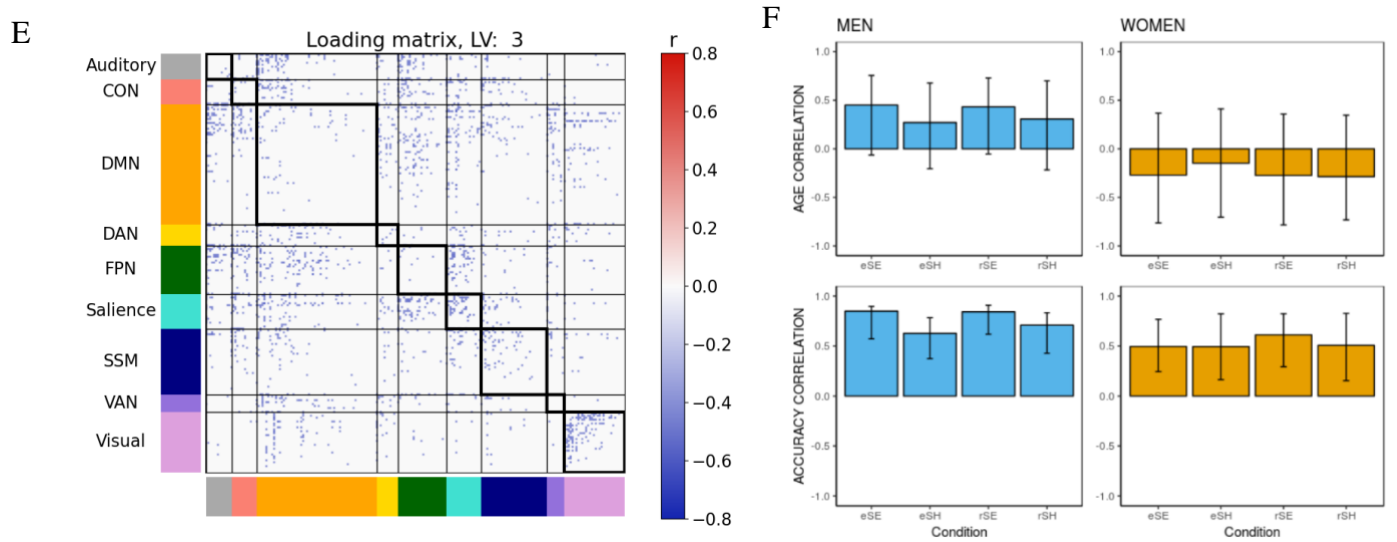
LV1 (43.33 % cross-block covariance)



LV2 (19.46 % cross-block covariance)



LV3 (10.33 % cross-block covariance)

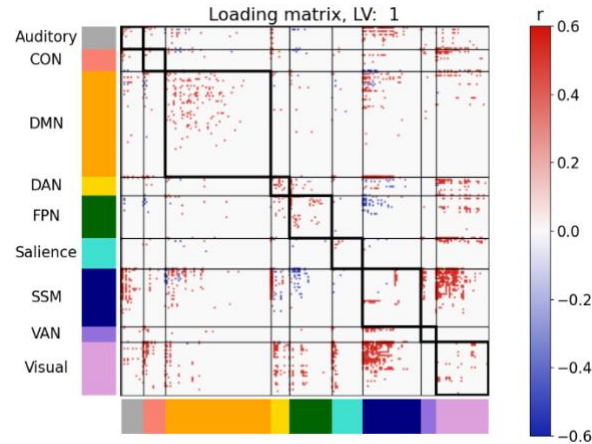


**Supplementary Figure 4.** The BPLS analysis with a subcohort of participants matched by intracranial volume, age, and education (24 men, 24 women) within group (N=48) and between group (M=24, F=24) determined findings similar to the original BPLS analyses described in the manuscript. **(A, C, E)** thresholded 95th percentile of correlations between participants' task fMRI data and behavioral profile for LV1, LV2, and LV3 respectively. **(B, D, F)** Behavioral profile of correlation between the behavioral vectors of age and accuracy with the task fMRI connectivity of participants (behavior correlation weights) for LV1, LV2, and LV3 respectively. Error bars represent bootstrapped standard deviations. eSE = encoding spatial easy; eSH = encoding spatial hard; rSE = retrieval spatial easy; rSH = retrieval spatial hard; CON = cingulo-opercular network; DMN = default mode network; DAN = dorsal attention network; FPN = frontoparietal network; SSM = somatomotor network; VAN = ventral attention network.

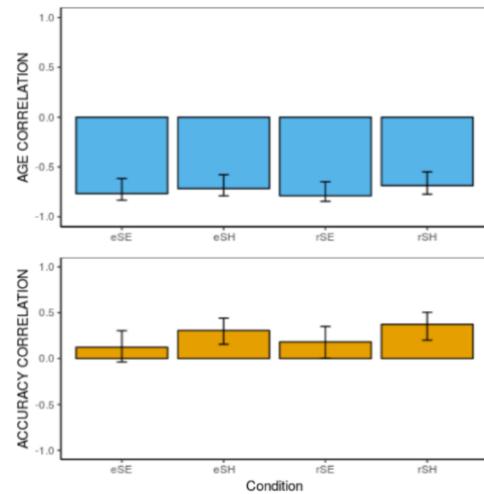
# Supplementary Figure 5. B-PLS1 without regressing mean task-related activity (Full Group B-PLS1 analysis)

LV1 (69.34% cross-block covariance)

A

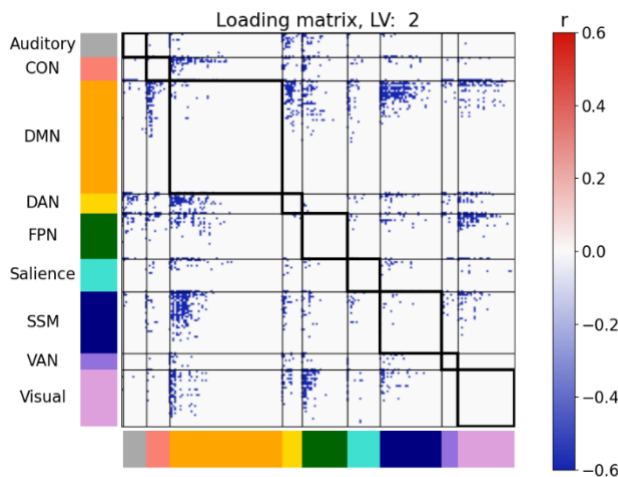


B

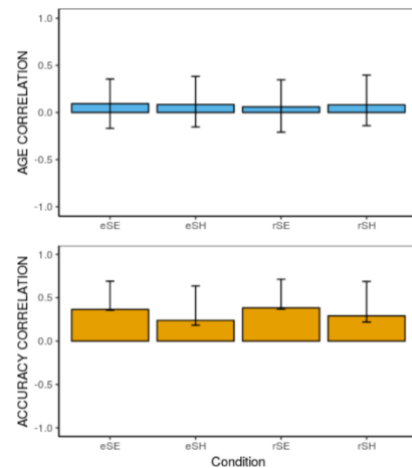


LV2 (17.81% cross-block covariance)

C



D

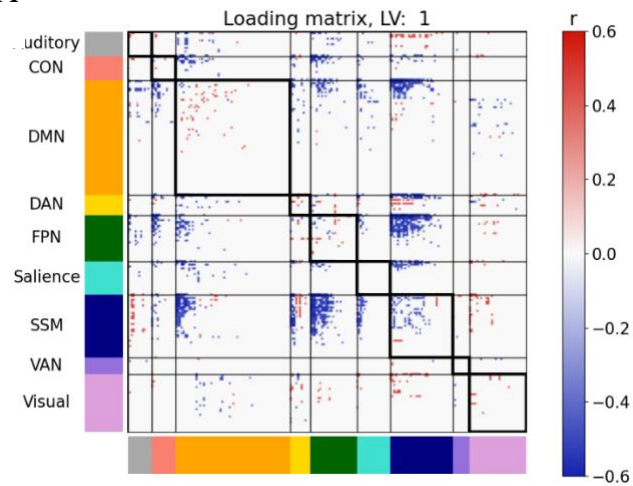


**Supplementary Figure 5.** (A, C) thresholded 95th percentile of correlations between participants' task fMRI data and behavioral profile for LV1 and LV2, respectively. (B, D) Behavioral profile of correlation between the behavioral vectors of age and accuracy with the task fMRI connectivity of participants (behavior correlation weights) for LV1 and LV2, respectively. Error bars represent bootstrapped standard deviations. eSE = encoding spatial easy; eSH = encoding spatial hard; rSE = retrieval spatial easy; rSH = retrieval spatial hard; CON = cingulo-opercular network; DMN = default mode network; DAN = dorsal attention network; FPN = frontoparietal network; SSM = somatomotor network; VAN = ventral attention network.

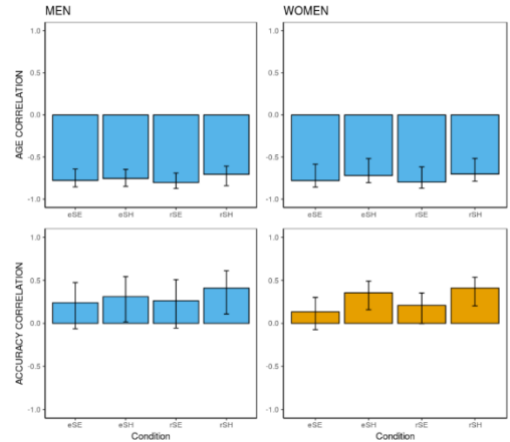
## Supplementary Figure 6. B-PLS2 without regressing mean task-related activity (Between-Sex Group B-PLS2 analysis)

LV1 (44.15% cross-block covariance)

A

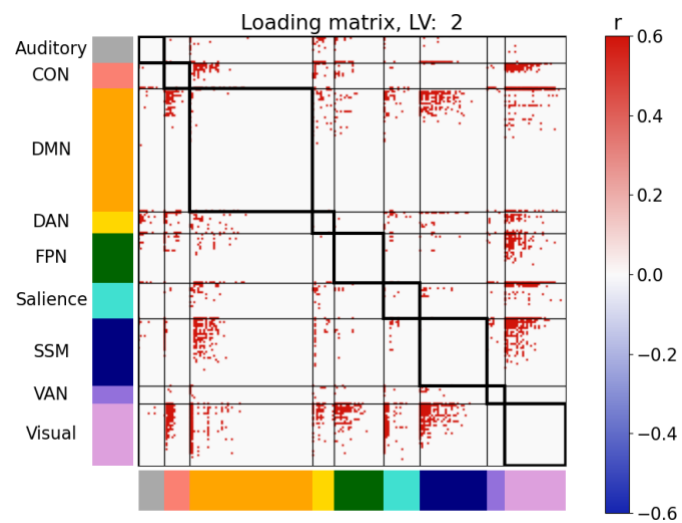


B

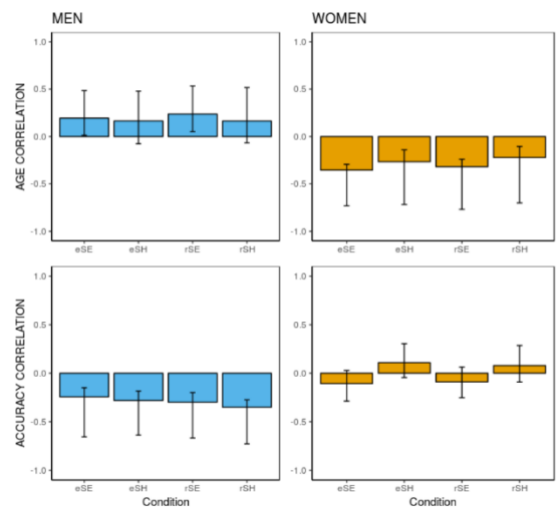


LV2 (21.79% cross-block covariance)

C

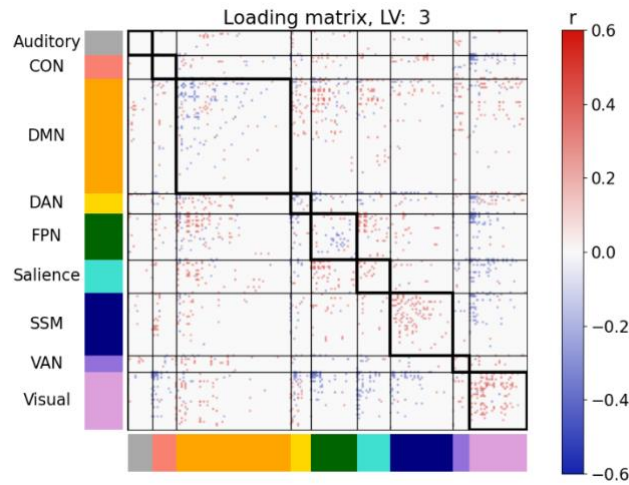


D

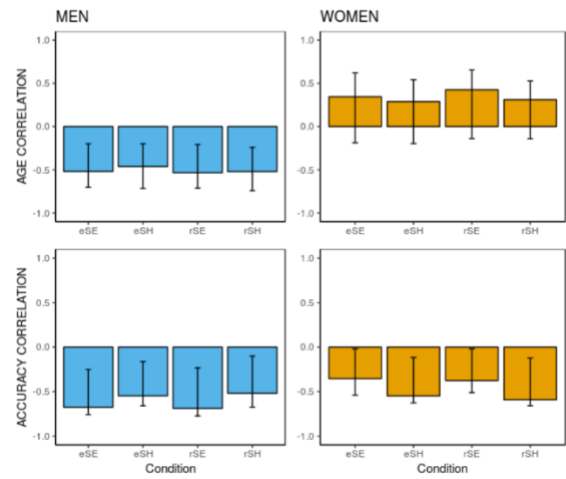


### LV3 (11.33% cross-block covariance)

E

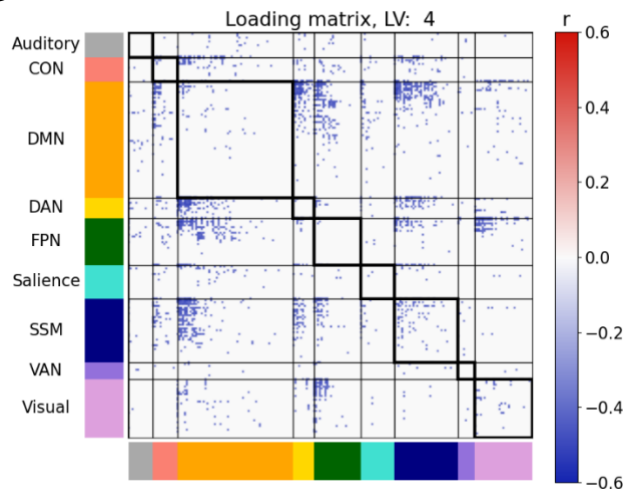


F

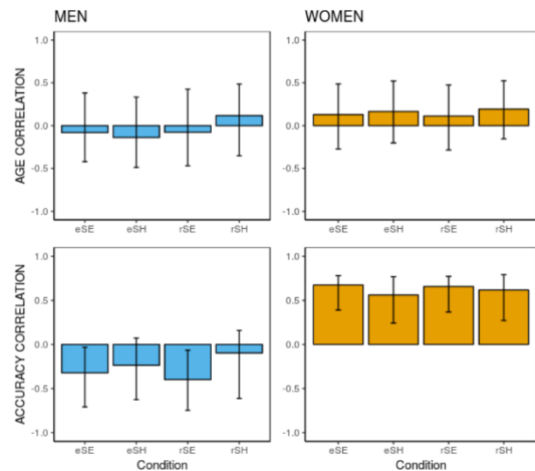


### LV4 (5.42% cross-block covariance)

G



H



**Note.** The B-PLS analysis using connectivity matrices that did not regress mean-task-related activity generated 2 significant LVs within group and 4 significant LVs between group, similar to the primary BPLS (Analyses 1 & 2) described in the manuscript. (A, C, E, G) thresholded 95th percentile of correlations between participants' task fMRI data and behavioral profile for LVs 1-4, respectively. (B, D, F, H) Behavioral profile of correlation between the behavioral vectors of age and accuracy with the task fMRI connectivity of participants (behavior correlation weights) for LVs 1-4 respectively. Error bars represent bootstrapped standard deviations. eSE = encoding spatial easy; eSH = encoding spatial hard; rSE = retrieval spatial easy; rSH = retrieval spatial hard; CON = cingulo-opercular network; DMN = default mode network; DAN = dorsal attention network; FPN = frontoparietal network; SSM = somatomotor network; VAN = ventral attention network.