

Varimax Orthogonal Rotation

Standalone verified Python analysis

Test: Varimax Orthogonal Rotation

Design: Orthogonal simple-structure rotation of two principal-axis factors.

Variables: G1, G2, G3, famrel, freetime, goout

Null hypothesis: Varimax does not increase simple structure while preserving orthogonal factors.

Formula: Maximize $\sum_j [\sum_i l_{ij}^4 - (\sum_i l_{ij}^2)^2 / p]$ subject to $T'T = I$.

Source rows: 649

Calculated metrics:

orthogonality_error: 2.220446049250313e-16

maximum_rotated_loading: 0.982458749894515

cross_loading_items: 0

factors: 2

Independent reference values:

orthogonality_error: 2.220446049250313e-16

maximum_rotated_loading: 0.982458749894515

cross_loading_items: 0

factors: 2

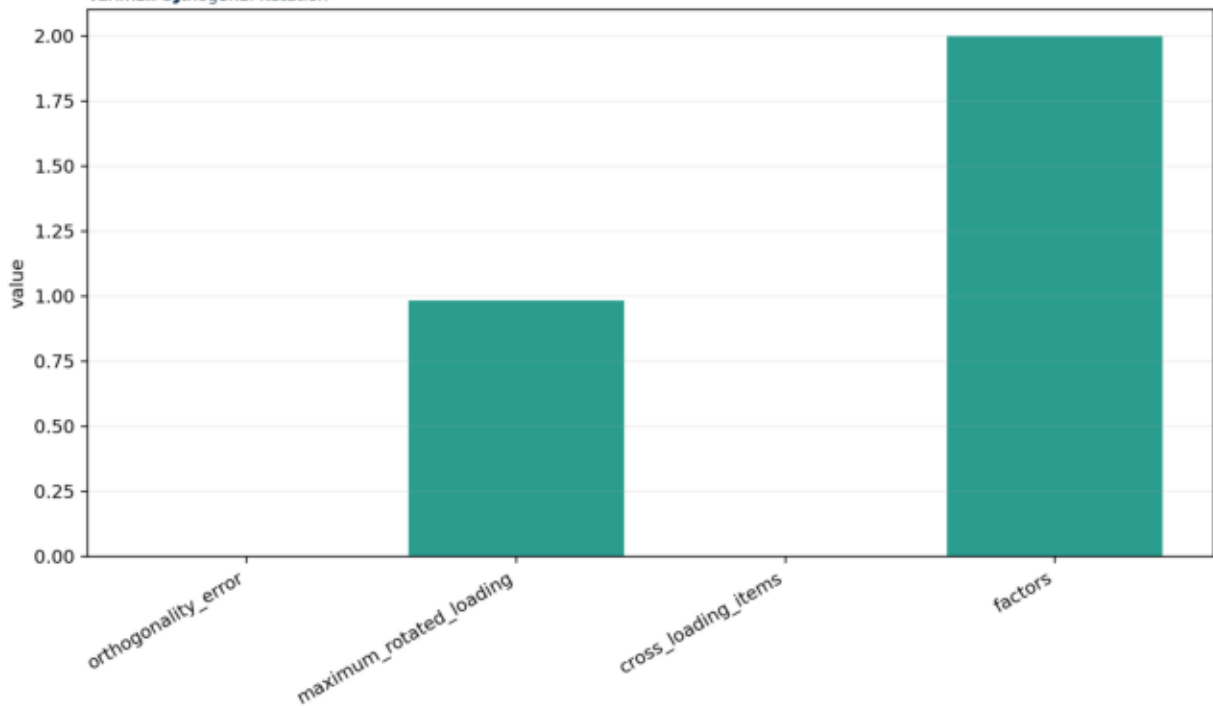
Interpretation:

Varimax preserves orthogonality while maximizing variance of squared loadings.

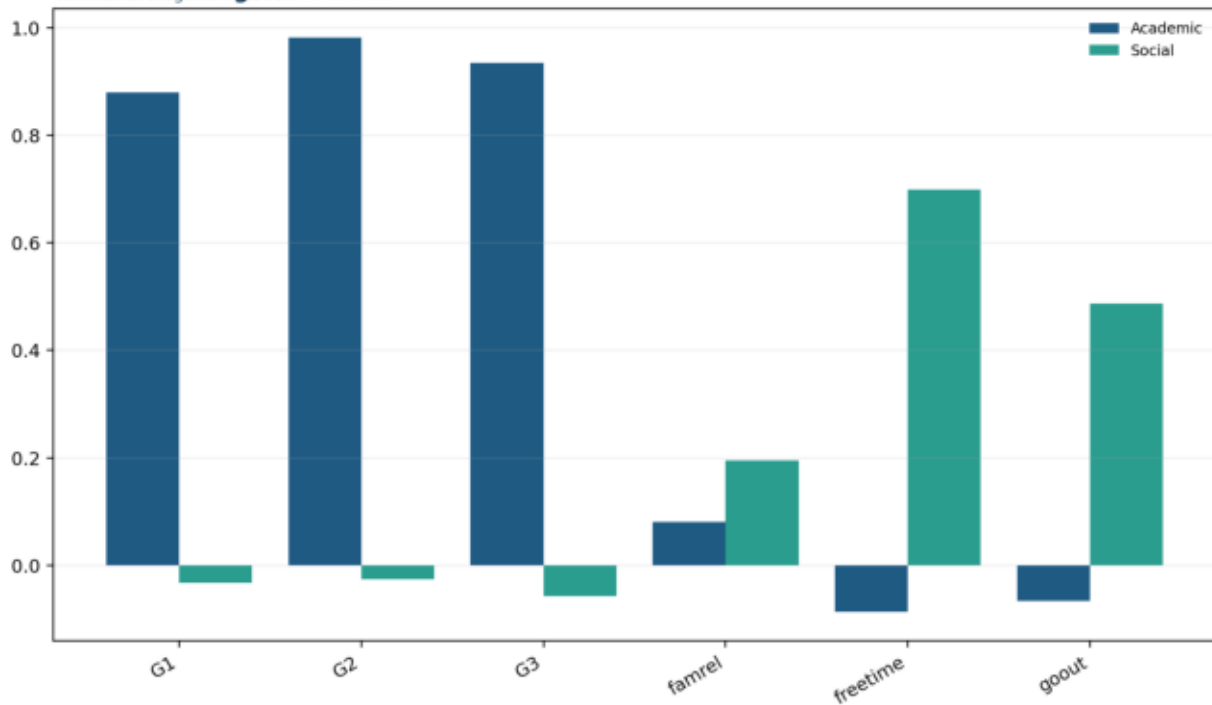
Orthogonality error=2.220e-16.

Primary Metrics

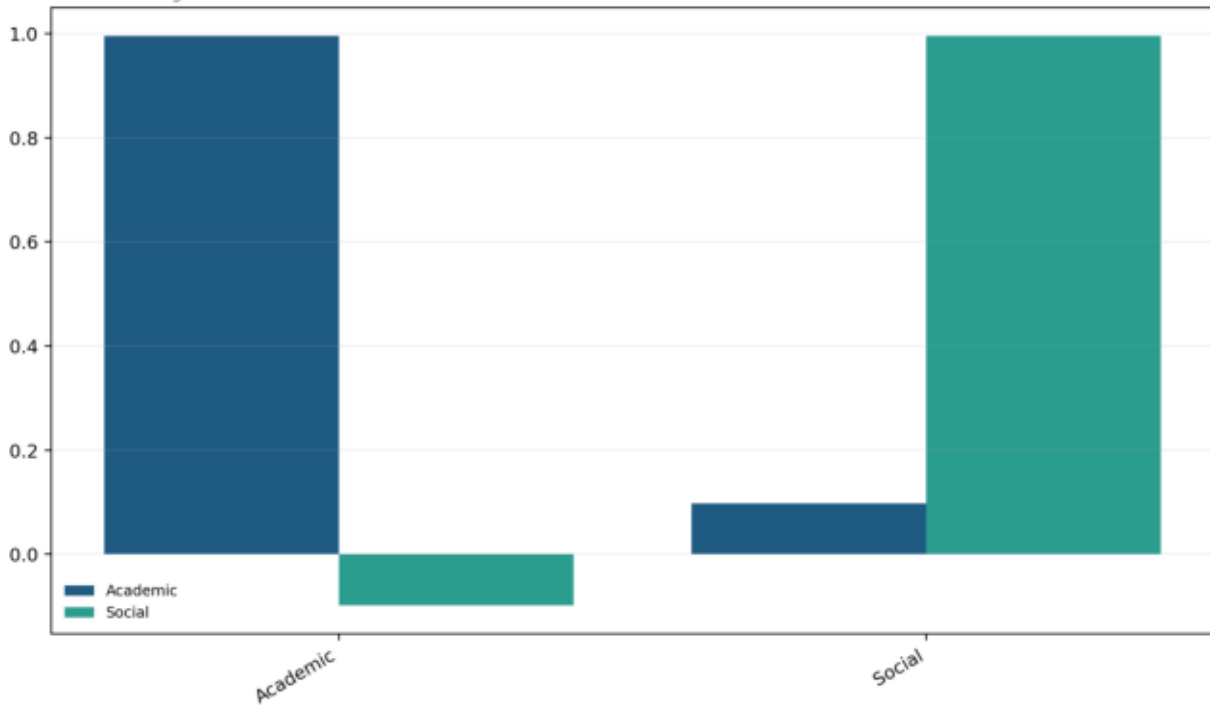
Orthogonalization



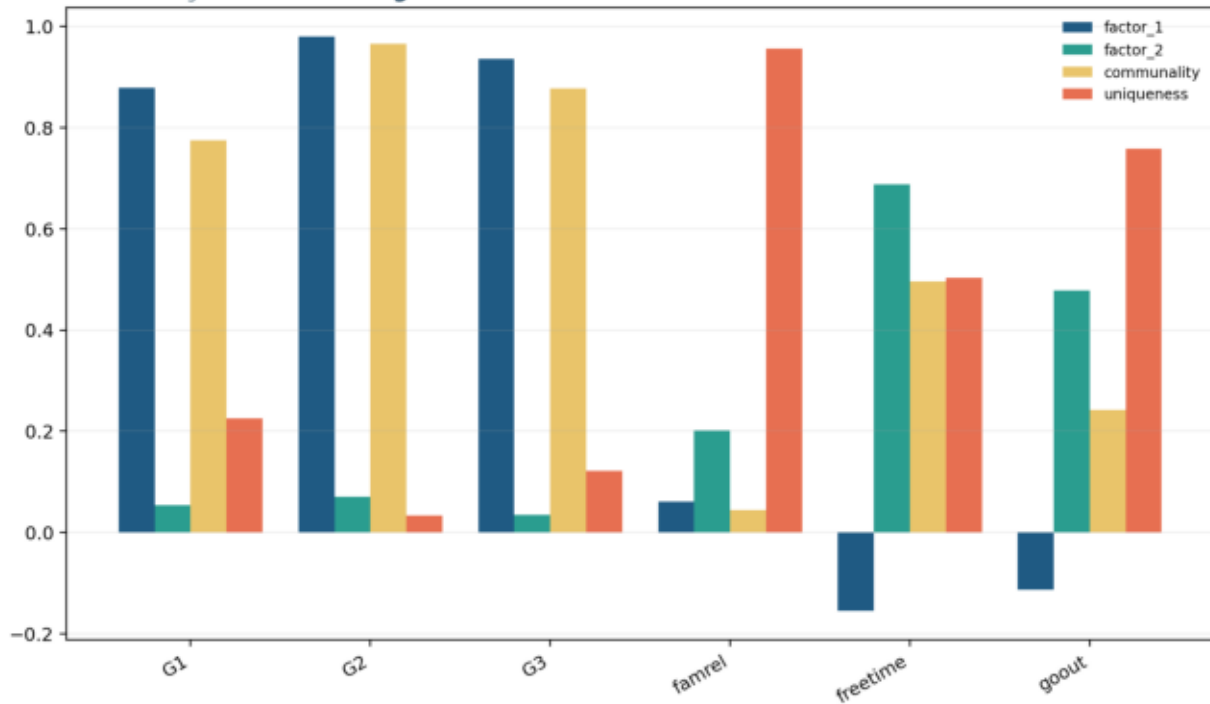
Varimax Orthogonal Matrix



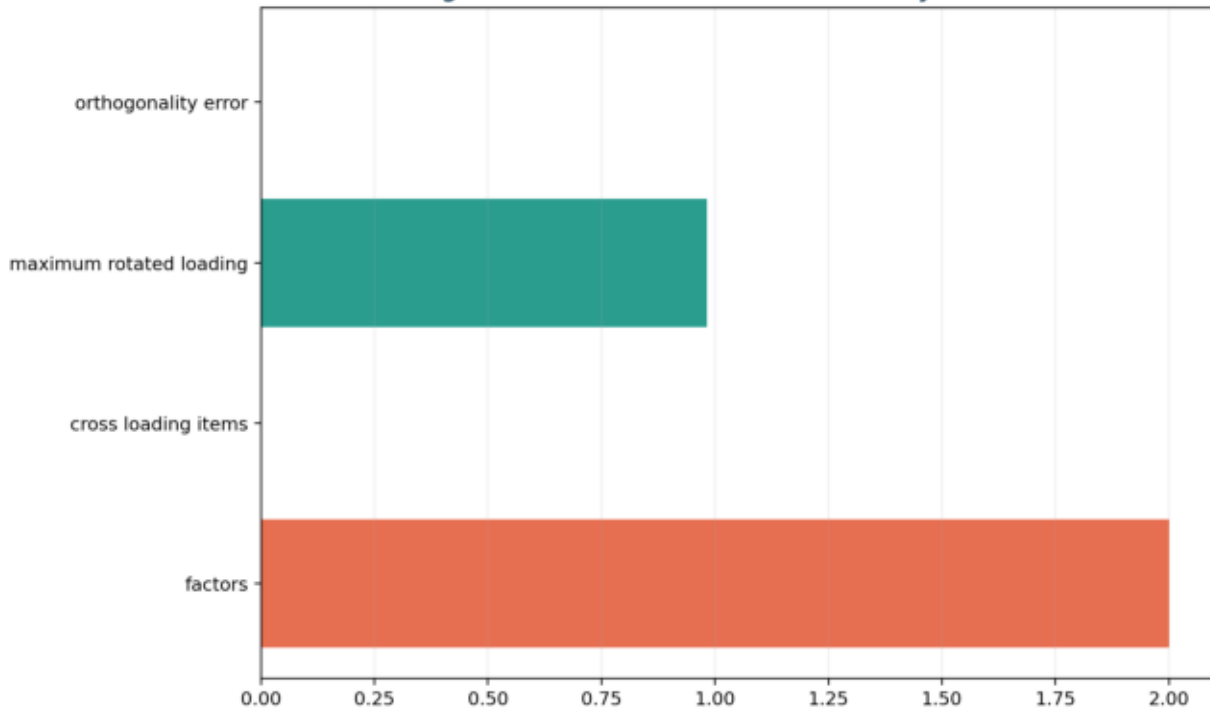
Varimax Rotation Matrix



Varimax Unrotated Loadings



Varimax Orthogonal Rotation verified result summary



Primary Metrics

metric	value
orthogonality_error	2.22045e-16
maximum_rotated_loading	0.982459
cross_loading_items	0
factors	2

Varimax Orthogonal Matrix

item	Academic	Social
G1	0.879691	-0.0325404
G2	0.982459	-0.0260739
G3	0.935067	-0.0575854
famrel	0.0808553	0.195209
freetime	-0.0869079	0.699155
goout	-0.0660198	0.487027

Varimax Rotation Matrix

factor	Academic	Social
Academic	0.995187	-0.0979978
Social	0.0979978	0.995187

Varimax Unrotated Loadings

item	factor_1	factor_2	communality	uniqueness
G1	0.878645	0.053824	0.774915	0.225085
G2	0.980285	0.0703304	0.965905	0.034095
G3	0.936209	0.0343263	0.877666	0.122334
famrel	0.061336	0.202193	0.0446442	0.955356
freetime	-0.155005	0.687273	0.496371	0.503629
goout	-0.11343	0.478213	0.241554	0.758446