

```
1417 0 OUTPUT ACTIVATE HTMTRatioOutput.  
1417 0 M> OUTPUT ACTIVATE HTMTRatioOutput.  
1418 0 TITLE 'Heterotrait-Monotrait Ratio'.  
1418 0 M> TITLE 'Heterotrait-Monotrait Ratio'.
```

Heterotrait-Monotrait Ratio

```

1419 0
1419 0 M>
1420 0 GET DATA
1420 0 M> GET DATA
1421 0 /TYPE=TXT /FILE='D:\DATA ANALYSIS\L Validity Factor Analysis and Scale Testing\HTMT Ratio\dataset.csv' /ENCODING='UTF8' /D
      ELCASE=LINE /DELIMITERS=', ' /QUALIFIER='"'
1421 0 M> /TYPE=TXT /FILE='D:\DATA ANALYSIS\L Validity Factor Analysis and Scale Testing\HTMT Ratio\dataset.csv' /ENCODING='UTF8'
      /DELCASE=LINE /DELIMITERS=', ' /QUALIFIER='"'
1422 0 /ARRANGEMENT=DELIMITED /FIRSTCASE=2
1422 0 M> /ARRANGEMENT=DELIMITED /FIRSTCASE=2
1423 0 /VARIABLES=
1423 0 M> /VARIABLES=
1424 0 school A8 sex A8 age F8.0 address A8 famsize A8 Pstatus A8 Medu F8.0
      Fedu F8.0
1424 0 M> school A8 sex A8 age F8.0 address A8 famsize A8 Pstatus A8 Medu F
      8.0 Fedu F8.0
1425 0 Mjob A16 Fjob A16 reason A16 guardian A16 traveltime F8.0 studytime
      F8.0 failures F8.0
1425 0 M> Mjob A16 Fjob A16 reason A16 guardian A16 traveltime F8.0 studyti
      me F8.0 failures F8.0
1426 0 schoolsup A8 famsup A8 paid A8 activities A8 nursery A8 higher A8 in
      ternet A8 romantic A8
1426 0 M> schoolsup A8 famsup A8 paid A8 activities A8 nursery A8 higher A8
      internet A8 romantic A8
1427 0 famrel F8.0 freetime F8.0 goout F8.0 Dalc F8.0 Walc F8.0 health F8.0
      absences F8.0 G1 F8.0 G2 F8.0 G3 F8.0.
1427 0 M> famrel F8.0 freetime F8.0 goout F8.0 Dalc F8.0 Walc F8.0 health F
      8.0 absences F8.0 G1 F8.0 G2 F8.0 G3 F8.0.
1428 0 DATASET NAME HTMTRatioData.
1428 0 M> DATASET NAME HTMTRatioData.
1429 0 COMPUTE subject_id=$CASENUM.
1429 0 M> COMPUTE subject_id=$CASENUM.
1430 0 COMPUTE Dalc_R=6-Dalc.
1430 0 M> COMPUTE Dalc_R=6-Dalc.
1431 0 COMPUTE Walc_R=6-Walc.
1431 0 M> COMPUTE Walc_R=6-Walc.

```

Heterotrait-Monotrait Ratio

```
1432  0  RECODE schoolsup famsup paid activities higher internet ('no'=0) ('yes'=1)
1432  0 M> RECODE schoolsup famsup paid activities higher internet ('no'=0) ('yes'=1)
1433  0  INTO schoolsup_b famsup_b paid_b activities_b higher_b internet_b.
1433  0 M> INTO schoolsup_b famsup_b paid_b activities_b higher_b internet_b
.
1434  0  EXECUTE.
1434  0 M> EXECUTE.
1435  0
1435  0 M>
1436  0  * BEGIN METHOD-SPECIFIC SPSS WORKFLOW.
1436  0 M> * BEGIN METHOD-SPECIFIC SPSS WORKFLOW.
1437  0  TITLE 'Heterotrait Monotrait Ratio'.
1437  0 M> TITLE 'Heterotrait Monotrait Ratio'.
```

Heterotrait Monotrait Ratio

```
1438 0 SUBTITLE 'Cross-construct association normalized by within-construct correlations'.
```

```
1438 0 M> SUBTITLE 'Cross-construct association normalized by within-construct correlations'.
```

```
>Warning # 2004 on line 1438. Command name: SUBTITLE
```

```
>The subtitle given exceeds 60 characters in length. The first 60 characters  
>will be used.
```

Heterotrait Monotrait Ratio
Cross-construct association normalized by within-construct c

```

1439  0  FACTOR /VARIABLES=G1 G2 G3 famrel freetime goout /MISSING=LISTWISE /A
NALYSIS=G1 G2 G3 famrel freetime goout
1439  0 M>  FACTOR /VARIABLES=G1 G2 G3 famrel freetime goout /MISSING=LISTWISE
 /ANALYSIS=G1 G2 G3 famrel freetime goout
1440  0  /PRINT=INITIAL EXTRACTION KMO CORRELATION /PLOT=EIGEN
1440  0 M>  /PRINT=INITIAL EXTRACTION KMO CORRELATION /PLOT=EIGEN
1441  0  /CRITERIA=FACTORS(2) ITERATE(500) /EXTRACTION=PAF /ROTATION=NOROTATE
 /METHOD=CORRELATION.
1441  0 M>  /CRITERIA=FACTORS(2) ITERATE(500) /EXTRACTION=PAF /ROTATION=NOROT
ATE /METHOD=CORRELATION.

```

Factor Analysis

Notes

Output Created		18-JUL-2026 10:56:27
Comments		
Input	Data	D:\DATA ANALYSIS\L Validity Factor Analysis and Scale Testing\HTMT Ratio\dataset.csv
	Active Dataset	HTMTRatioData
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	649
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.

Heterotrait Monotrait Ratio
Cross-construct association normalized by within-construct c

Notes

Syntax		FACTOR /VARIABLES=G1 G2 G3 famrel freetime goout /MISSING=LISTWISE /ANALYSIS=G1 G2 G3 famrel freetime goout /PRINT=INITIAL EXTRACTION KMO CORRELATION /PLOT=EIGEN /CRITERIA=FACTORS(2) ITERATE(500) /EXTRACTION=PAF /ROTATION=NOROTATE /METHOD=CORRELATIO N.
Resources	Processor Time	00:00:00.42
	Elapsed Time	00:00:00.51
	Maximum Memory Required	5704 (5.570K) bytes

[HTMTRatioData]

Correlation Matrix

		G1	G2	G3	famrel	freetime	goout
Correlation	G1	1.000	.865	.826	.049	-.094	-.074
	G2	.865	1.000	.919	.090	-.107	-.079
	G3	.826	.919	1.000	.063	-.123	-.088
	famrel	.049	.090	.063	1.000	.129	.090
	freetime	-.094	-.107	-.123	.129	1.000	.346
	goout	-.074	-.079	-.088	.090	.346	1.000

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.732
Bartlett's Test of Sphericity	Approx. Chi-Square	2220.632
	df	15
	Sig.	.000

Heterotrait Monotrait Ratio
Cross-construct association normalized by within-construct c

Communalities

	Initial	Extraction
G1	.755	.775
G2	.880	.966
G3	.849	.878
famrel	.034	.045
freetime	.140	.474
goout	.125	.252

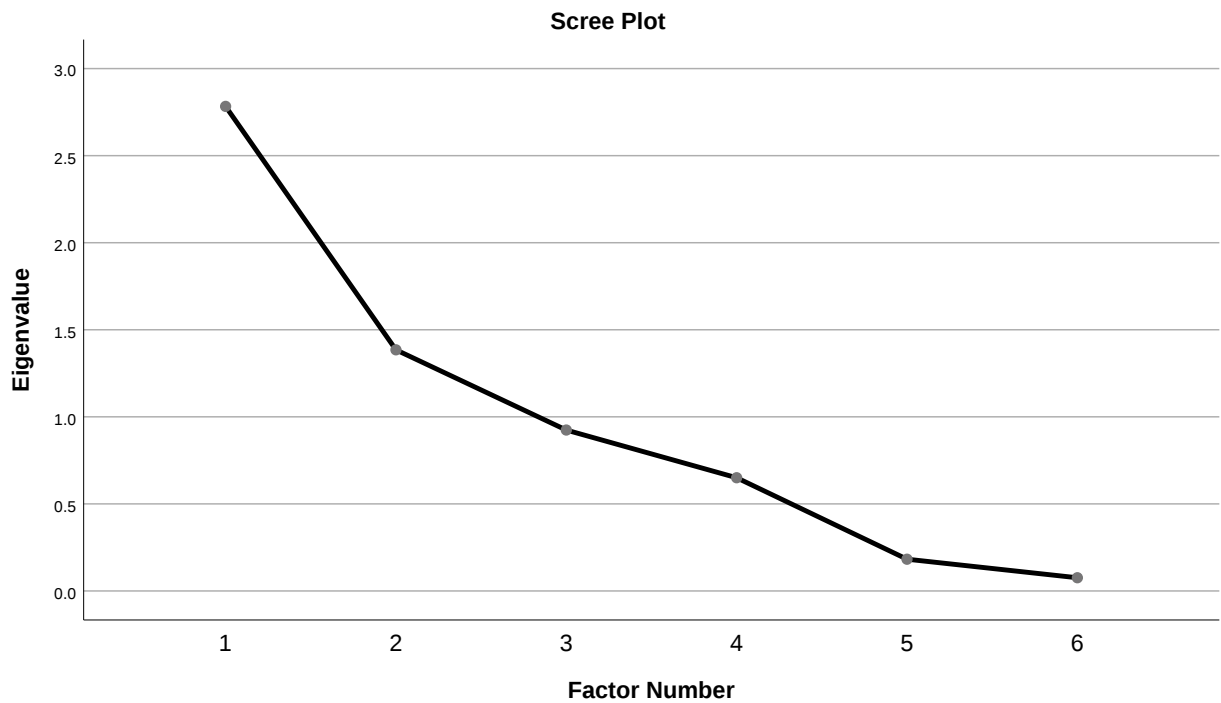
Extraction Method: Principal Axis Factoring.

Total Variance Explained

Factor	Total	Initial Eigenvalues		Extraction Sums of Squared Loadings		
		% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.783	46.381	46.381	2.650	44.166	44.166
2	1.385	23.080	69.461	.740	12.337	56.503
3	.924	15.402	84.863			
4	.650	10.835	95.698			
5	.182	3.038	98.736			
6	.076	1.264	100.000			

Extraction Method: Principal Axis Factoring.

Heterotrait Monotrait Ratio
Cross-construct association normalized by within-construct c



Factor Matrix^a

	Factor	
	1	2
G1	.879	.053
G2	.980	.070
G3	.936	.033
famrel	.061	.204
freetime	-.153	.671
goout	-.114	.489

Extraction Method: Principal Axis Factoring.

a. 2 factors extracted. 41 iterations required.

```
1442 0 RELIABILITY /VARIABLES=G1 G2 G3 /SCALE('Academic measurement block')
ALL /MODEL=ALPHA /STATISTICS=DESCRIPTIVE SCALE CORR.
1442 0 M> RELIABILITY /VARIABLES=G1 G2 G3 /SCALE('Academic measurement block
') ALL /MODEL=ALPHA /STATISTICS=DESCRIPTIVE SCALE CORR
```

Heterotrait Monotrait Ratio
Cross-construct association normalized by within-construct c

Reliability

Notes

Output Created		18-JUL-2026 10:56:27
Comments		
Input	Data	D:\DATA ANALYSIS\L Validity Factor Analysis and Scale Testing\HTMT Ratio\dataset.csv
	Active Dataset	HTMTRatioData
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	649
	Matrix Input	D:\DATA ANALYSIS\L Validity Factor Analysis and Scale Testing\HTMT Ratio\htmt_ratio_spss_syn tax.sps
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=G1 G2 G3 /SCALE('Academic measurement block') ALL /MODEL=ALPHA /STATISTICS=DESCRIPT IVE SCALE CORR.
Resources	Processor Time	00:00:00.05
	Elapsed Time	00:00:00.06

Scale: Academic measurement block

Heterotrait Monotrait Ratio
Cross-construct association normalized by within-construct c

Case Processing Summary

		N	%
Cases	Valid	649	100.0
	Excluded ^a	0	.0
	Total	649	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.951	.953	3

Item Statistics

	Mean	Std. Deviation	N
G1	11.40	2.745	649
G2	11.57	2.914	649
G3	11.91	3.231	649

Inter-Item Correlation Matrix

	G1	G2	G3
G1	1.000	.865	.826
G2	.865	1.000	.919
G3	.826	.919	1.000

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
34.88	72.251	8.500	3

```
1443 0 RELIABILITY /VARIABLES=famrel freetime goout /SCALE('Social measureme
nt block') ALL /MODEL=ALPHA /STATISTICS=DESCRIPTIVE SC
ALE CORR.
```

Heterotrait Monotrait Ratio
Cross-construct association normalized by within-construct c

```
1443  0 M>  RELIABILITY /VARIABLES=famrel freetime goout /SCALE('Social measur
ement block') ALL /MODEL=ALPHA /STATISTICS=DESCRIPTIVE
SCALE CORR.
```

Reliability

Notes

Output Created		18-JUL-2026 10:56:27
Comments		
Input	Data	D:\DATA ANALYSIS\L Validity Factor Analysis and Scale Testing\HTMT Ratio\dataset.csv
	Active Dataset	HTMTRatioData
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	649
	Matrix Input	D:\DATA ANALYSIS\L Validity Factor Analysis and Scale Testing\HTMT Ratio\htmt_ratio_spss_syn tax.sps
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=famrel freetime goout /SCALE ('Social measurement block') ALL /MODEL=ALPHA /STATISTICS=DESCRIPT IVE SCALE CORR.
Resources	Processor Time	00:00:00.06
	Elapsed Time	00:00:00.05

Heterotrait Monotrait Ratio
Cross-construct association normalized by within-construct c

Scale: Social measurement block

Case Processing Summary

		N	%
Cases	Valid	649	100.0
	Excluded ^a	0	.0
	Total	649	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.419	.411	3

Item Statistics

	Mean	Std. Deviation	N
famrel	3.93	.956	649
freetime	3.18	1.051	649
goout	3.18	1.176	649

Inter-Item Correlation Matrix

	famrel	freetime	goout
famrel	1.000	.129	.090
freetime	.129	1.000	.346
goout	.090	.346	1.000

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
10.30	4.718	2.172	3

Heterotrait Monotrait Ratio
Cross-construct association normalized by within-construct c

```
1444 0 CORRELATIONS /VARIABLES=G1 G2 G3 famrel freetime goout /PRINT=TWOTAIL
      NOSIG /MISSING=PAIRWISE.
1444 0 M> CORRELATIONS /VARIABLES=G1 G2 G3 famrel freetime goout /PRINT=TWOT
      AIL NOSIG /MISSING=PAIRWISE.
```

Correlations

Notes

Output Created		18-JUL-2026 10:56:27
Comments		
Input	Data	D:\DATA ANALYSIS\L Validity Factor Analysis and Scale Testing\HTMT Ratio\dataset.csv
	Active Dataset	HTMTRatioData
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	649
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		CORRELATIONS /VARIABLES=G1 G2 G3 famrel freetime goout /PRINT=TWOTAIL NOSIG /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.06
	Elapsed Time	00:00:00.05

Heterotrait Monotrait Ratio
Cross-construct association normalized by within-construct c

Correlations

		G1	G2	G3	famrel	freetime	goout
G1	Pearson Correlation	1	.865**	.826**	.049	-.094*	-.074
	Sig. (2-tailed)		.000	.000	.214	.016	.059
	N	649	649	649	649	649	649
G2	Pearson Correlation	.865**	1	.919**	.090*	-.107**	-.079*
	Sig. (2-tailed)	.000		.000	.022	.007	.043
	N	649	649	649	649	649	649
G3	Pearson Correlation	.826**	.919**	1	.063	-.123**	-.088*
	Sig. (2-tailed)	.000	.000		.107	.002	.026
	N	649	649	649	649	649	649
famrel	Pearson Correlation	.049	.090*	.063	1	.129**	.090*
	Sig. (2-tailed)	.214	.022	.107		.001	.022
	N	649	649	649	649	649	649
freetime	Pearson Correlation	-.094*	-.107**	-.123**	.129**	1	.346**
	Sig. (2-tailed)	.016	.007	.002	.001		.000
	N	649	649	649	649	649	649
goout	Pearson Correlation	-.074	-.079*	-.088*	.090*	.346**	1
	Sig. (2-tailed)	.059	.043	.026	.022	.000	
	N	649	649	649	649	649	649

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

```

1445 0 * END METHOD-SPECIFIC SPSS WORKFLOW.
1445 0 M> * END METHOD-SPECIFIC SPSS WORKFLOW.
1446 0
1446 0 M>
1447 0 SAVE OUTFILE='D:\DATA ANALYSIS\L Validity Factor Analysis and Scale T
esting\HTMT Ratio\SPSS_Output\sav\htmt-ratio_spss_read
y_data.sav' /COMPRESSED.
1447 0 M> SAVE OUTFILE='D:\DATA ANALYSIS\L Validity Factor Analysis and Scal
e Testing\HTMT Ratio\SPSS_Output\sav\htmt-ratio_spss_r
eady_data.sav' /COMPRESSED.
1448 0
1448 0 M>

```

Heterotrait Monotrait Ratio
Cross-construct association normalized by within-construct c

```

1449 0 ECHO '=====
====='.
1449 0 M> ECHO '=====
====='.
=====
1450 0 ECHO 'HETEROTRAIT-MONOTRAIT RATIO'.
1450 0 M> ECHO 'HETEROTRAIT-MONOTRAIT RATIO'.
HETEROTRAIT-MONOTRAIT RATIO
1451 0 ECHO 'Design: Observed-correlation HTMT for academic and social indic
ator blocks.'.
1451 0 M> ECHO 'Design: Observed-correlation HTMT for academic and social in
dicator blocks.'.
Design: Observed-correlation HTMT for academic and social indicator blocks.
1452 0 ECHO 'Null hypothesis: HTMT is at or above the declared discriminant-
validity limit.'.
1452 0 M> ECHO 'Null hypothesis: HTMT is at or above the declared discrimina
nt-validity limit.'.
Null hypothesis: HTMT is at or above the declared discriminant-validity limit.
1453 0 ECHO 'Formula: HTMT=mean|r_AS|/sqrt(mean|r_AA| mean|r_SS|)'.
1453 0 M> ECHO 'Formula: HTMT=mean|r_AS|/sqrt(mean|r_AA| mean|r_SS|)'.
Formula: HTMT=mean|r_AS|/sqrt(mean|r_AA| mean|r_SS|).
1454 0 ECHO 'Variables: G1, G2, G3, famrel, freetime, goout'.
1454 0 M> ECHO 'Variables: G1, G2, G3, famrel, freetime, goout'.
Variables: G1, G2, G3, famrel, freetime, goout
1455 0 ECHO 'Rows analyzed: 649'.
1455 0 M> ECHO 'Rows analyzed: 649'.
Rows analyzed: 649
1456 0 ECHO 'academic_monotrait_mean = 0.8699722528859932'.
1456 0 M> ECHO 'academic_monotrait_mean = 0.8699722528859932'.
academic_monotrait_mean = 0.8699722528859932
1457 0 ECHO 'construct_pairs = 1'.
1457 0 M> ECHO 'construct_pairs = 1'.
construct_pairs = 1
1458 0 ECHO 'heterotrait_mean = 0.08519839136285395'.
1458 0 M> ECHO 'heterotrait_mean = 0.08519839136285395'.
heterotrait_mean = 0.08519839136285395
1459 0 ECHO 'htmt = 0.21043104090296003'.
1459 0 M> ECHO 'htmt = 0.21043104090296003'.
htmt = 0.21043104090296003

```

Heterotrait Monotrait Ratio
Cross-construct association normalized by within-construct c

```
1460 0 ECHO 'social_monotrait_mean = 0.18842467791168493'.
1460 0 M> ECHO 'social_monotrait_mean = 0.18842467791168493'.
social_monotrait_mean = 0.18842467791168493
1461 0 ECHO 'Cross-check status: pass'.
1461 0 M> ECHO 'Cross-check status: pass'.
Cross-check status: pass
1462 0 ECHO '=====
====='.
1462 0 M> ECHO '=====
====='.
=====
1463 0
1463 0 M>
1464 0 OUTPUT SAVE OUTFILE='D:\DATA ANALYSIS\L Validity Factor Analysis and
Scale Testing\HTMT Ratio\SPSS_Output\spv\htmt-ratio_sp
ss_output.spv'.
1464 0 M> OUTPUT SAVE OUTFILE='D:\DATA ANALYSIS\L Validity Factor Analysis a
nd Scale Testing\HTMT Ratio\SPSS_Output\spv\htmt-ratio
_spss_output.spv'.
1465 0 OUTPUT EXPORT /CONTENTS EXPORT=ALL LAYERS=PRINTSETTING MODELVIEWS=PRI
NTSETTING
1465 0 M> OUTPUT EXPORT /CONTENTS EXPORT=ALL LAYERS=PRINTSETTING MODELVIEWS=
PRINTSETTING
```