NTNU

Quantitative Methods
Seminar Series in Psychology

Introduction to JASP for Data Analysis

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Personal website

Plan for today

- JASP: Downloading, installing, and opening JASP
- Reading data into JASP
- Variables/Data transformations
  - (Re)Naming Variables
  - Setting levels of measurement
  - Computing (Recoding) new variables
- Selecting and filtering cases

- Example Analyses
  - Exploratory and Confirmatory Factor Analyses
    - Multigroup analyses and measurement invariance
  - Mediation modelling

  - Advanced modeling in JASP
    - Longitudinal/Growth models – SEM

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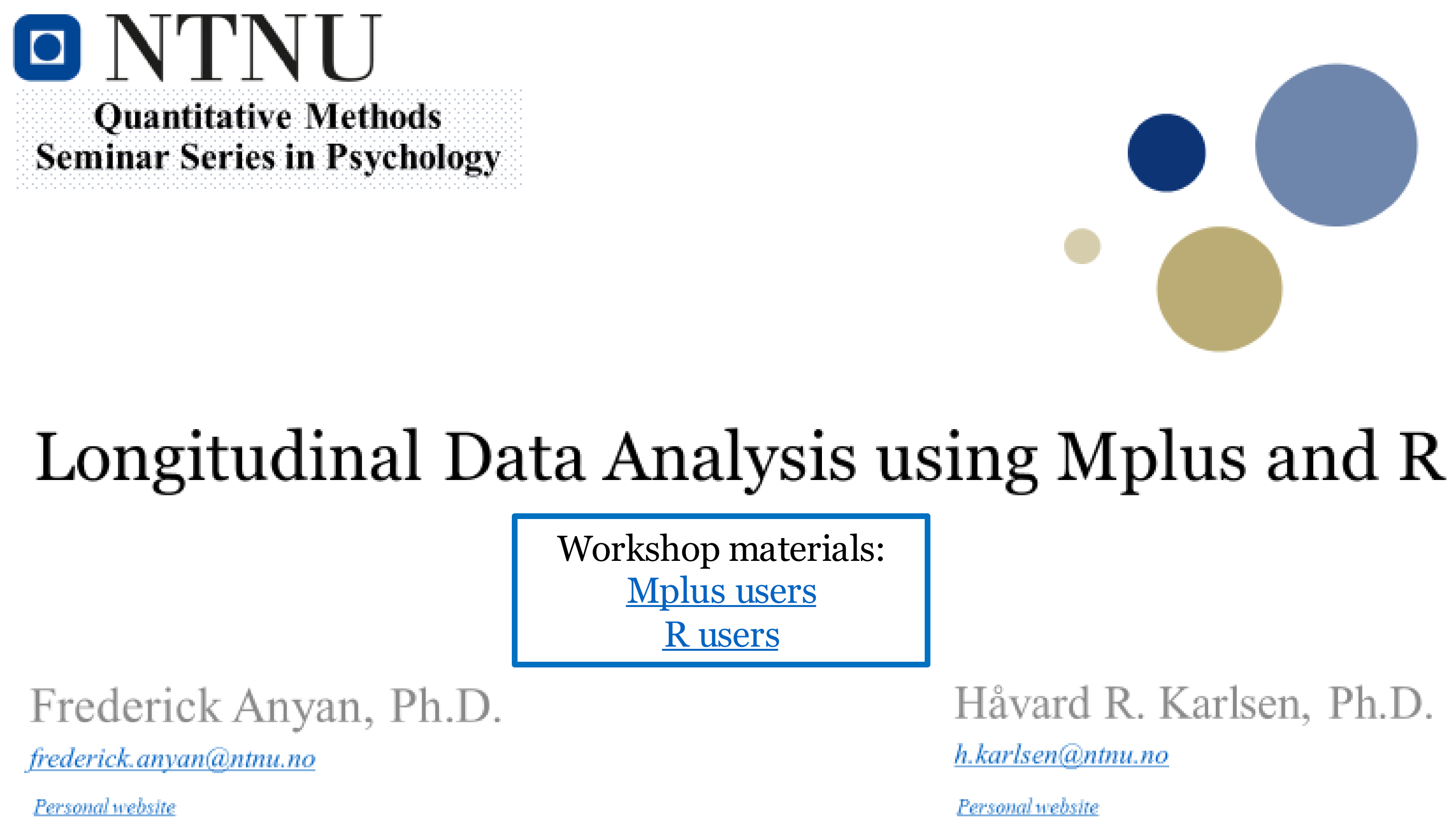

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  - Advanced modeling in JASP

What does JASP stand for?

In recognition of Bayesian pioneer Sir Harold Jeffreys, JASP stands for Jeffreys's Amazing Statistics Program.

• JASP: Downloading, installing, and opening JASP

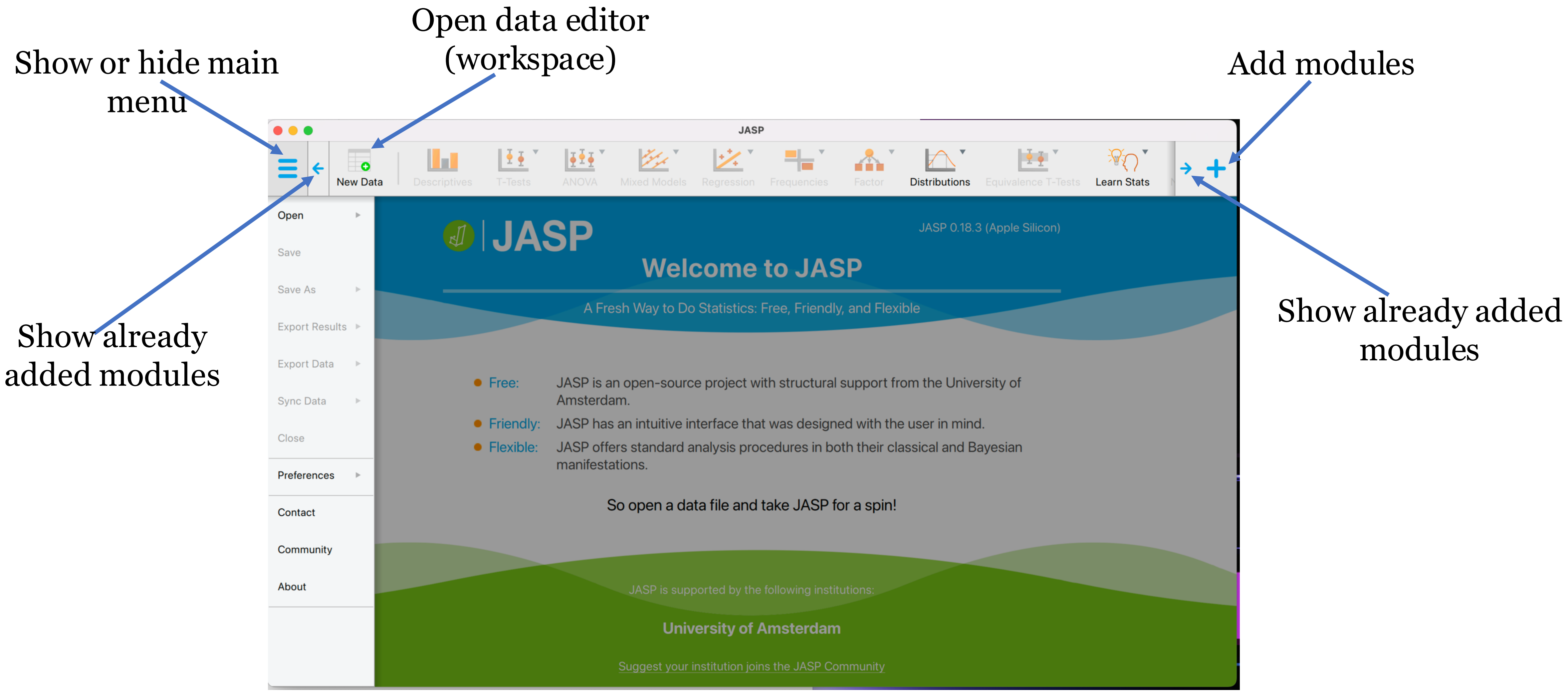
1. JASP: Downloading, installing, and opening JASP
   - https://jasp-stats.org/download/
     - Windows
     - macOS
       - Installation guide: https://jasp-stats.org/installation-guide/
     - Linux

2. Support, support and support materials…
   - How to use JASP: Explanatory articles, videos and GIFs
   - JASP Materials: Manual, Online resources, Books, Papers, workshops, etc

3. FAQS…?
   - Here…

- Open Science Framework with JASP

- # JASP: Downloading, installing, and opening JASP



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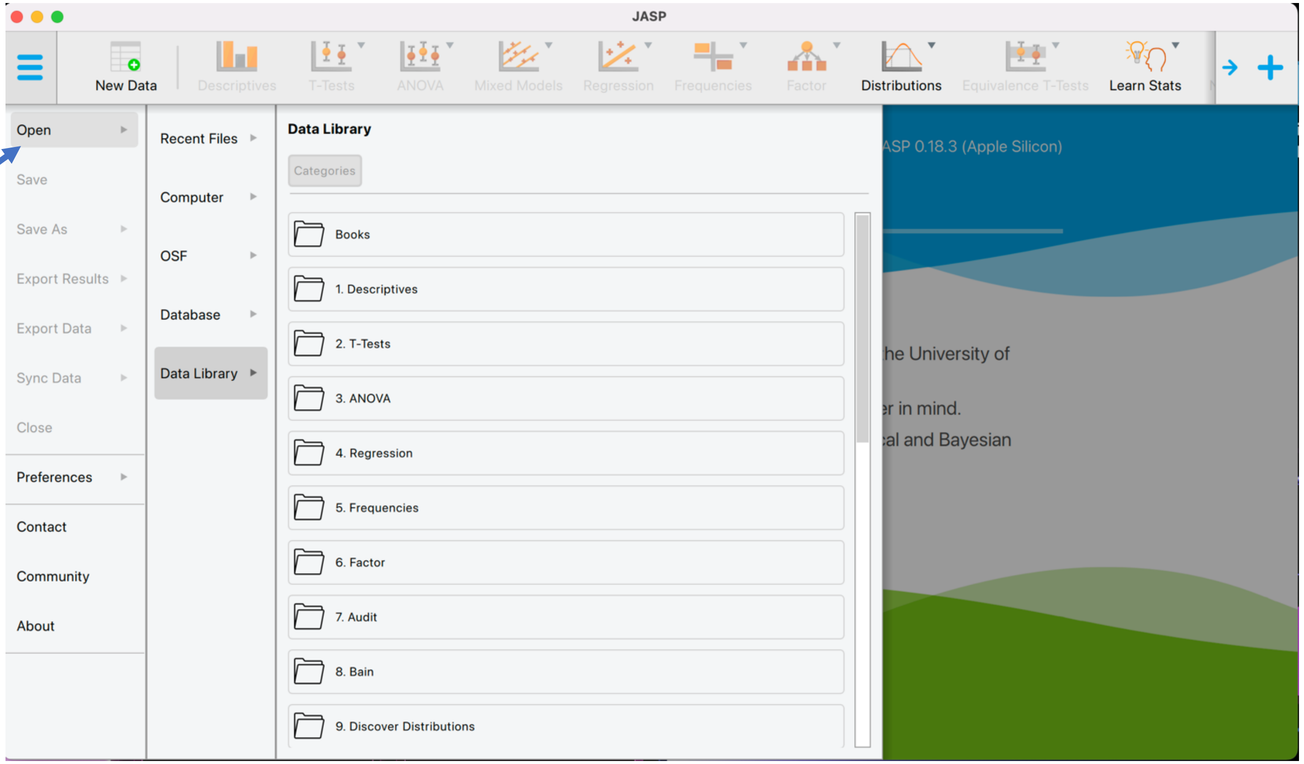
• Reading data into JASP

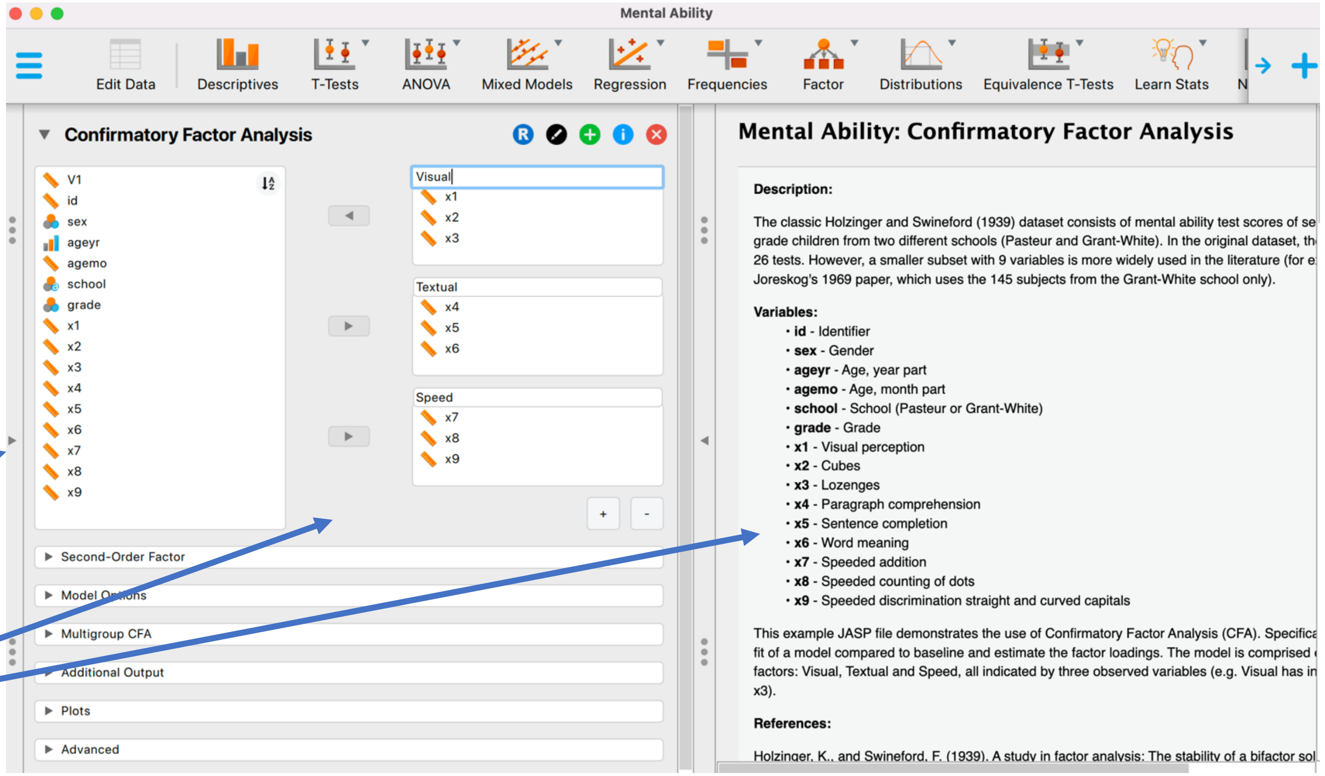


Click Open on the main menu

- Recent files
- Computer
- OSF
- Database
- Data library

JASP currently reads the following formats: *.csv, .txt, .tsv, .ods, .dta, .sav, .zsav, .por, .sas7bdat, .sas7bcat, .xpt* and of course the .jasp format.

• Reading data into JASP



Click arrow/triangle to reveal data view or use slider to resize the data, analysis and output panes

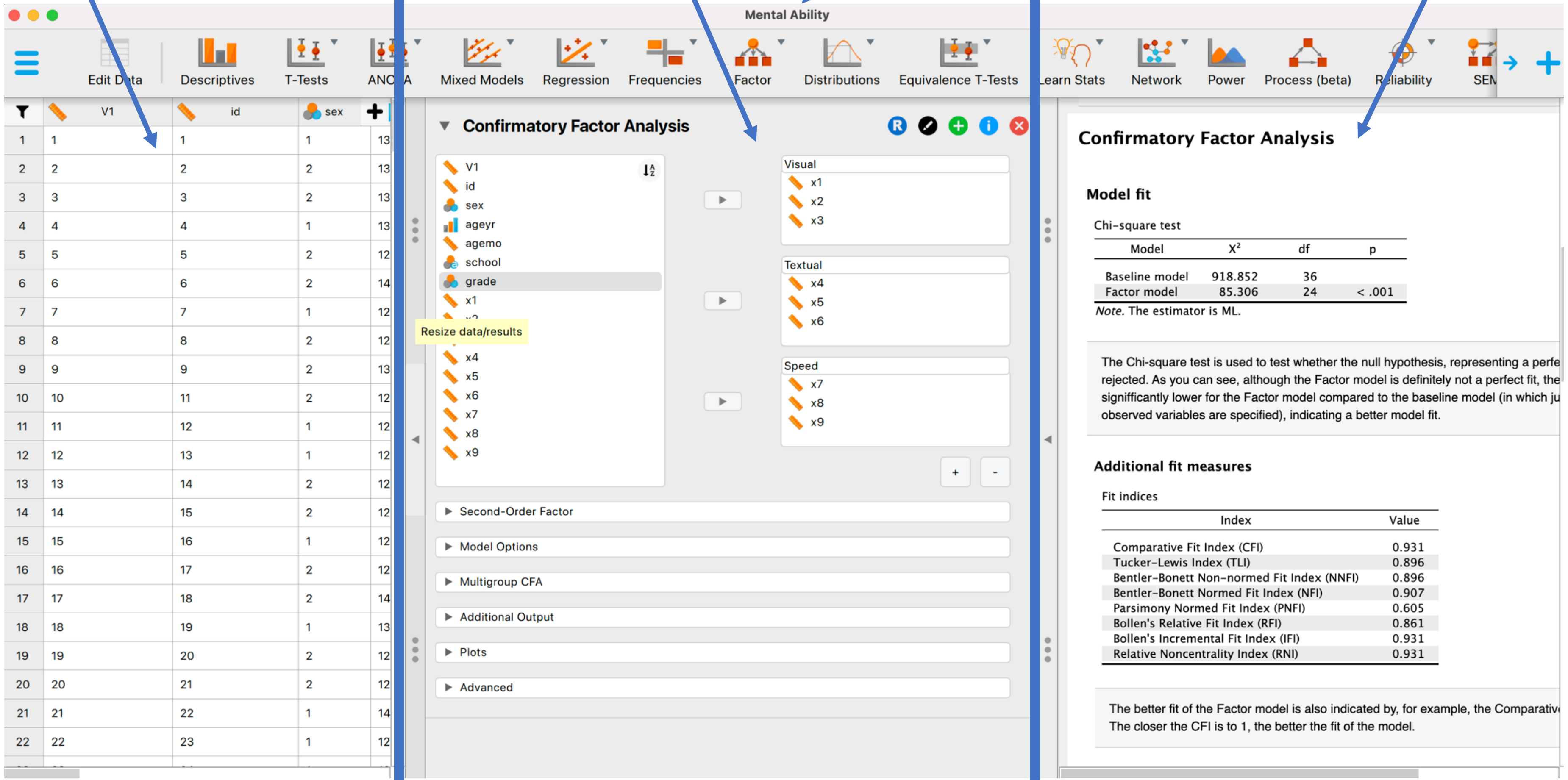
• Reading data into JASP

Data/variable view

Analyses

Name of data file

Results/Output



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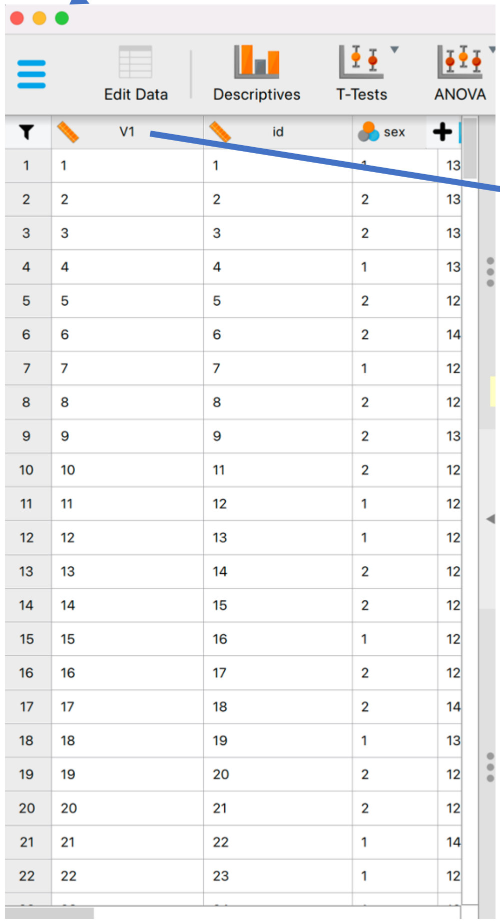
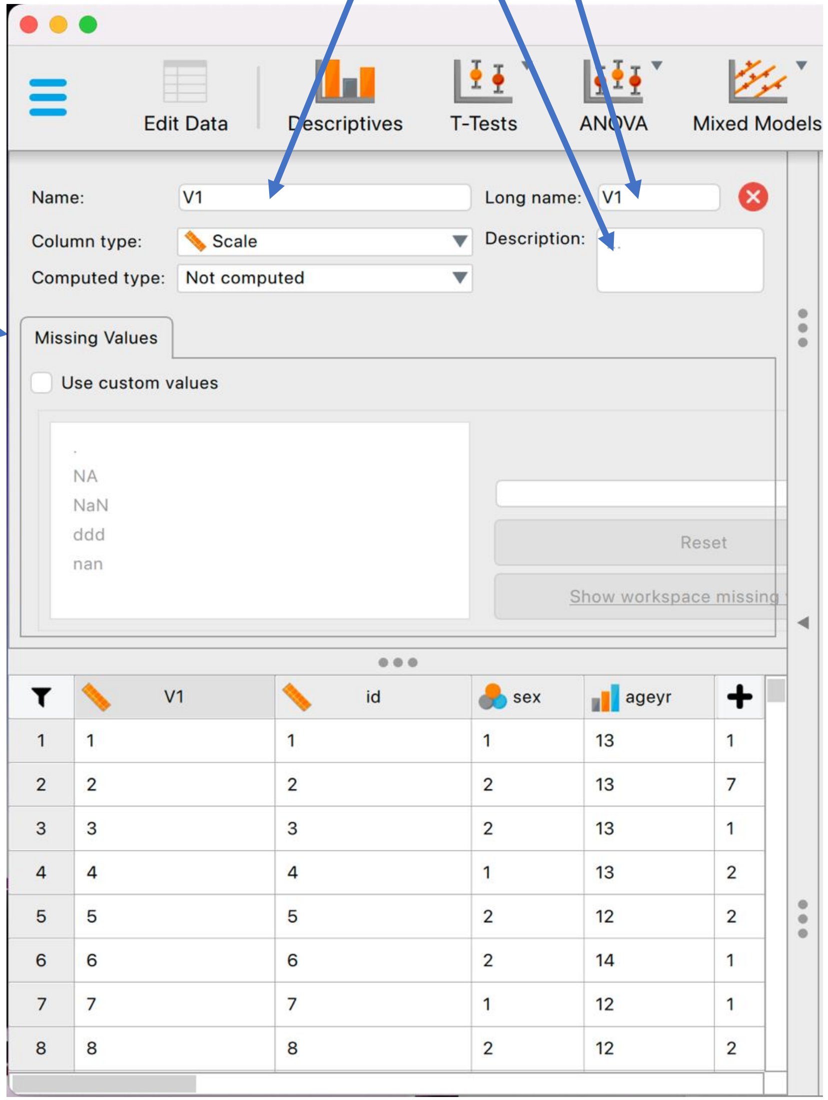
• (Re)Naming variables

Data/variable view



Double click for Variable setting

(Re)Name and describe variables



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• Set level of measurement

(Re)Name and describe variables

Categorical variable types in JASP

Nominal
(1 = Females; 2 = Males)

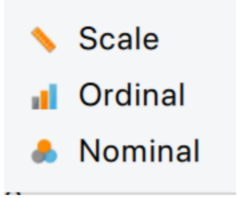
Nominal text (string)
(F = Females; M = Males)

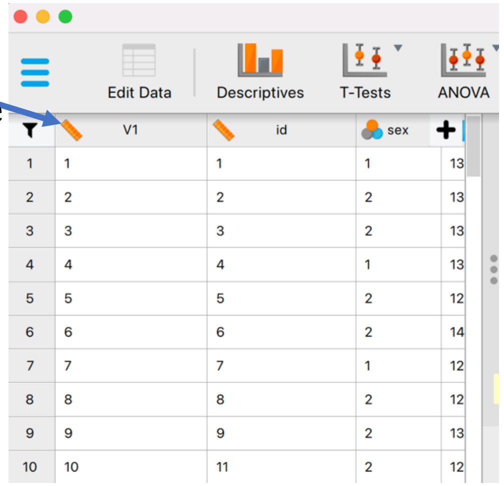
Ordinal
(1 = Mild, 2 = Moderate; 3 = Severe)

Continuous
Scale data

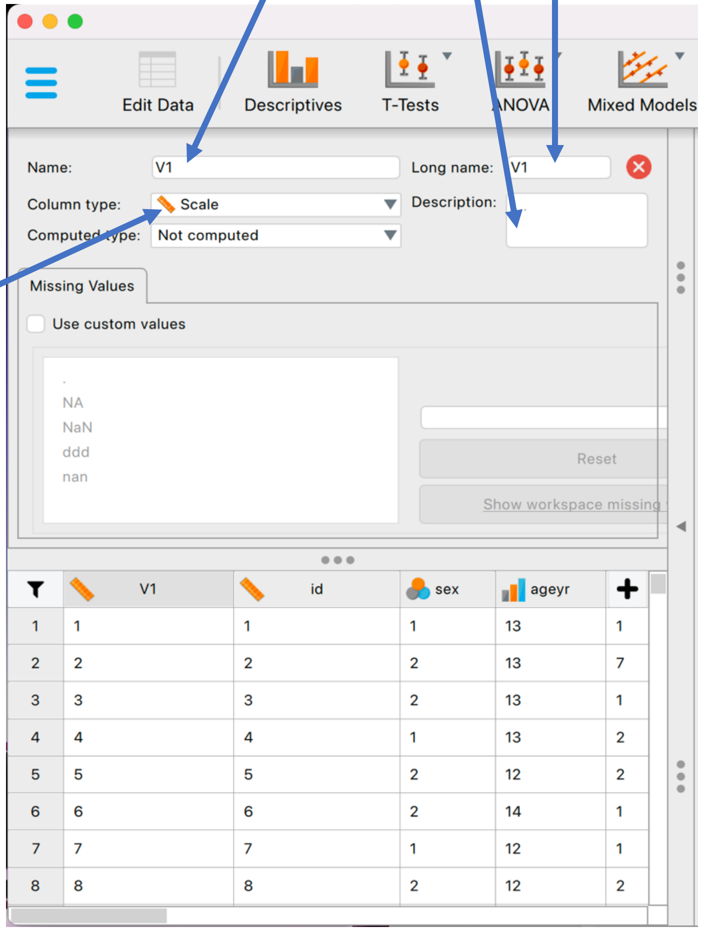
Factors/Groupings
Can set value labels that will show in results

Set level of measurement or Change column type





Set level of measurement or Change column type



• Set level of measurement

Categorical variable types in JASP

Nominal
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Ordinal
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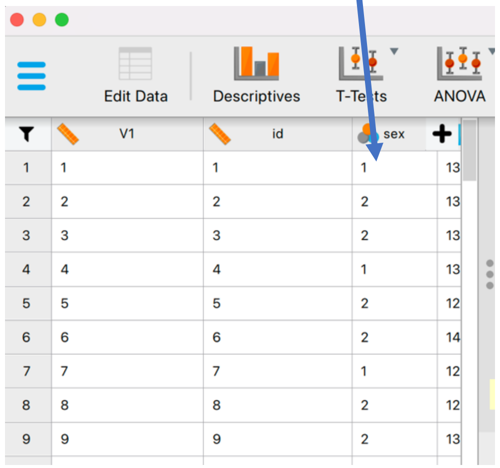
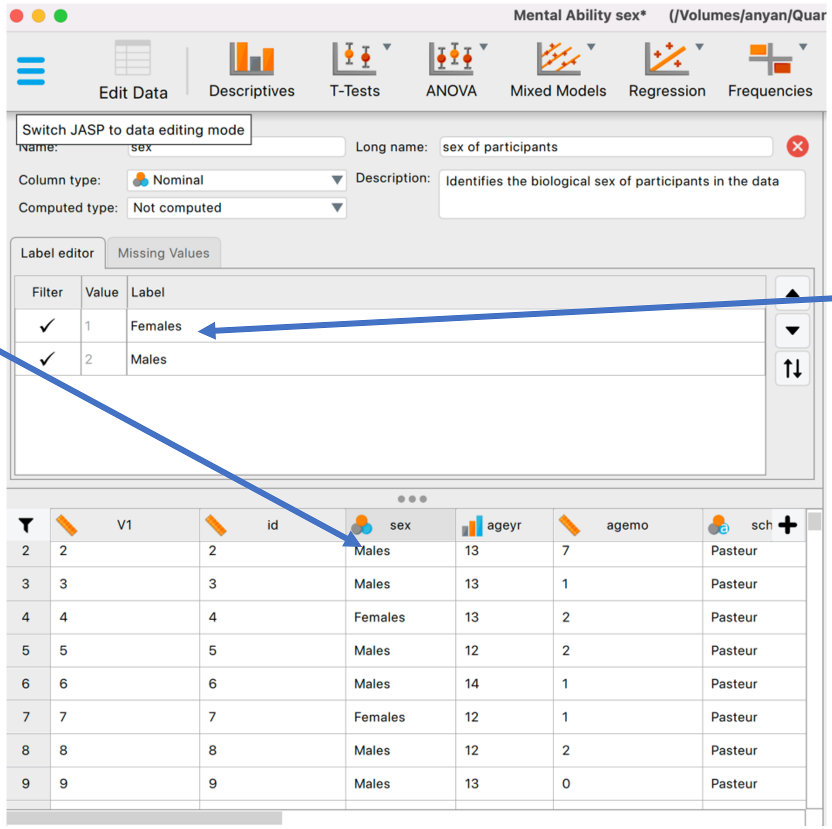
Continuous
Scale data

Numbers or labels…?



Value labels



Double click to set labels under 'label'

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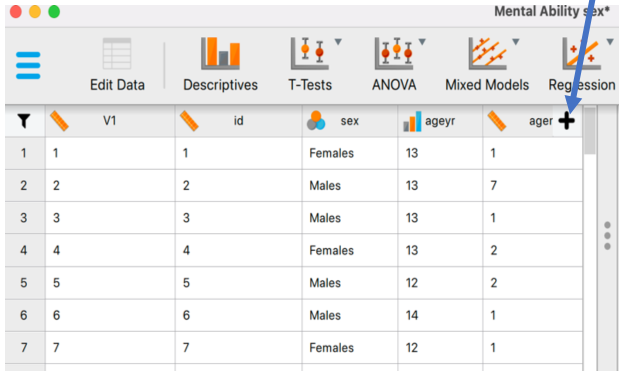
- # Computing/creating/Recoding new variables

Mean and sum scores

• Computing/creating/Recoding new variables

Mean and sum scores

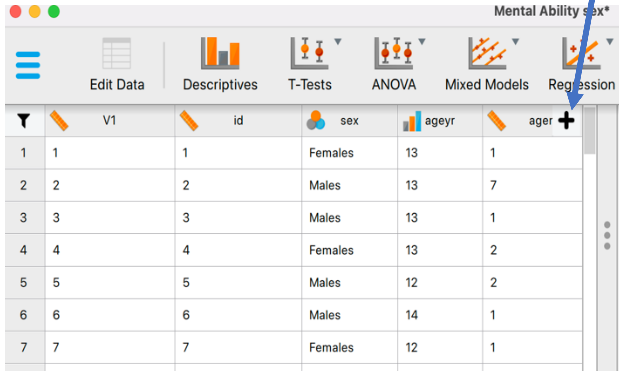
Compute/create/recode into new variables



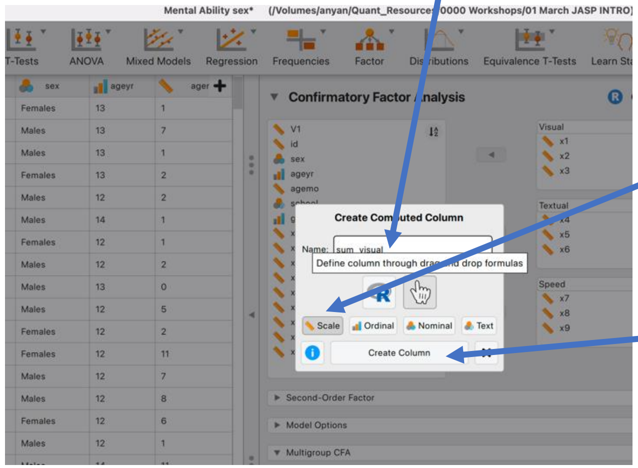
• Computing/creating/Recoding new variables

Mean and sum scores

Compute/create new variables



Name new variable



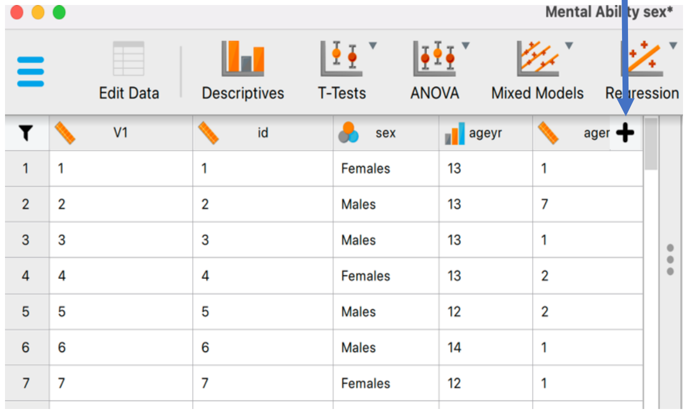
Set level of measurement to scale

Click compute

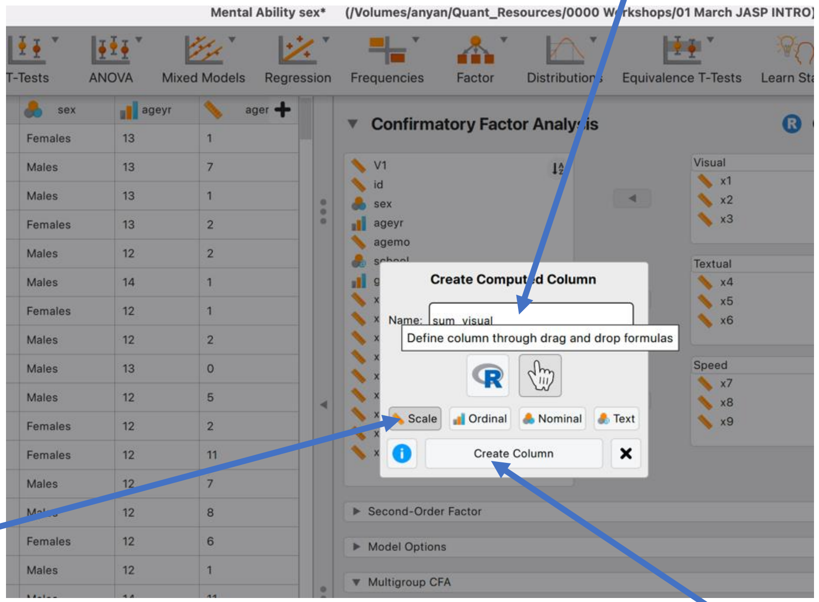
• Computing/creating/Recoding new variables

Mean and sum scores

Compute/create new variables



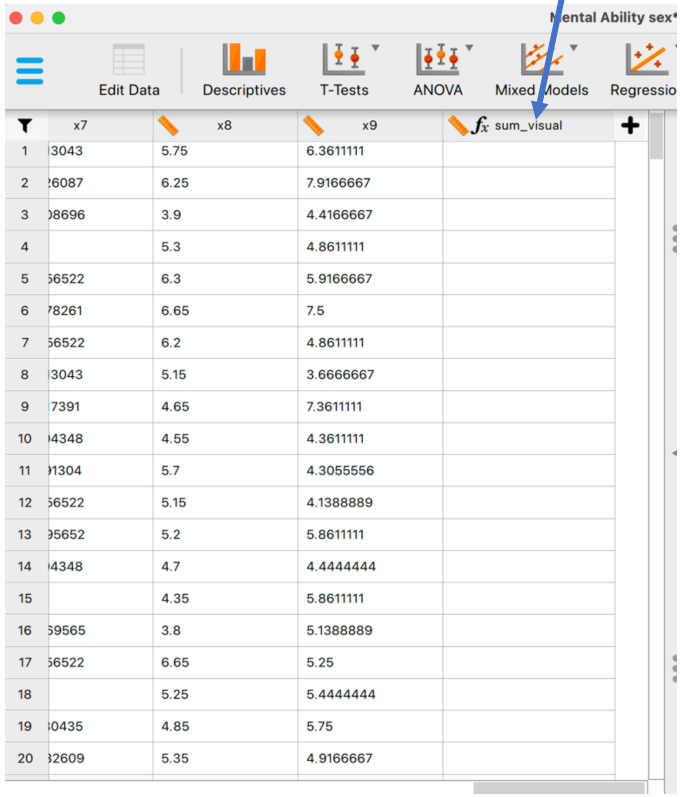
Name the new variable



Set level of measurement to scale

Click compute

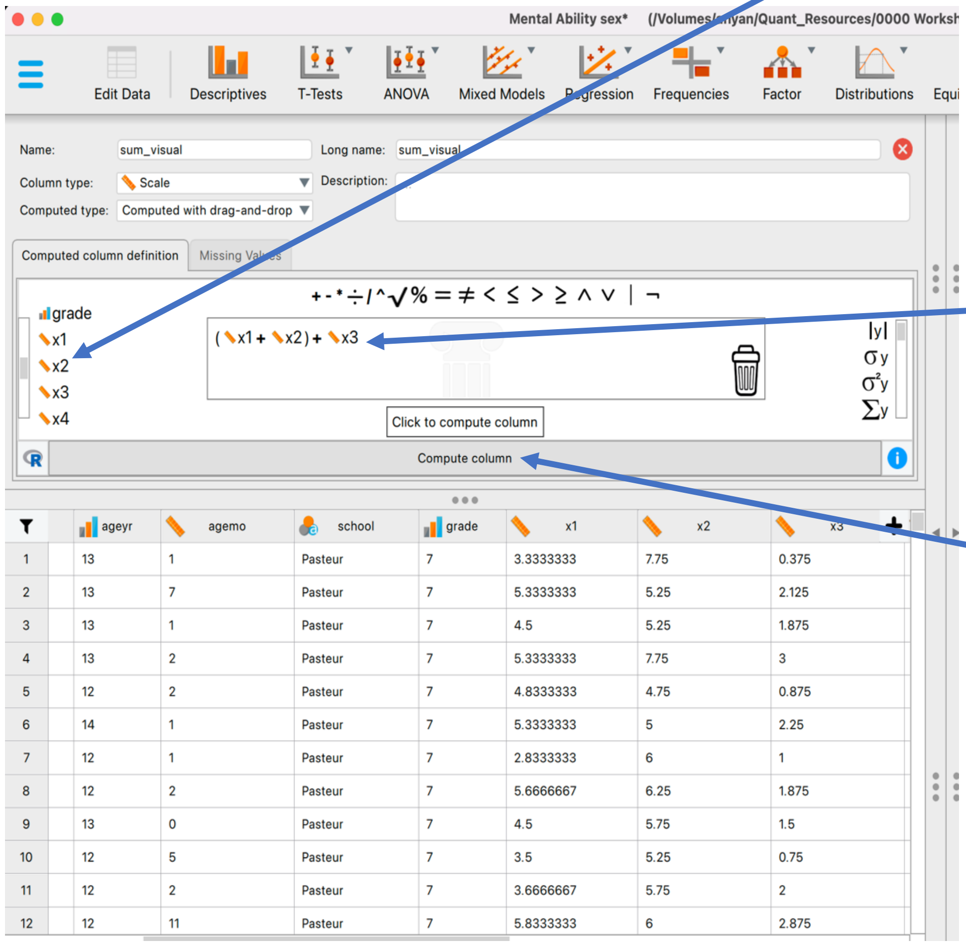
New variable appears in the data pane



• Computing/creating/Recoding new variables

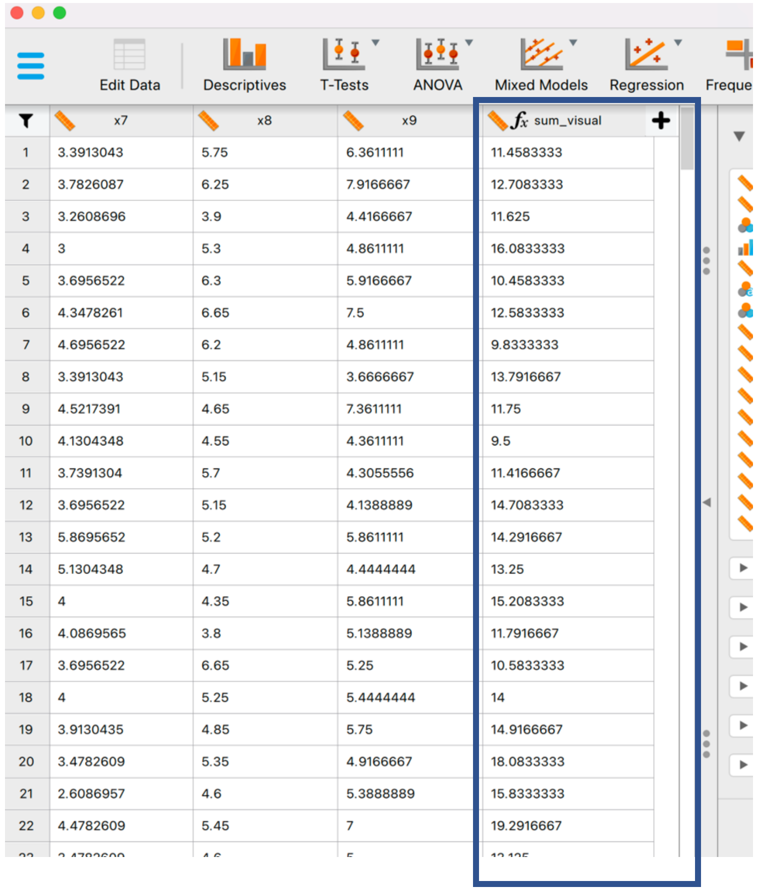
Mean and sum scores

Select variables from the list into the drag and drop constructor



Apply function to create new variable in drag and drop constructor

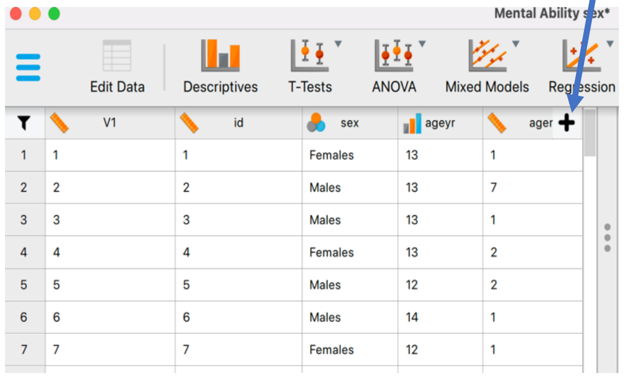
Compute column to apply function



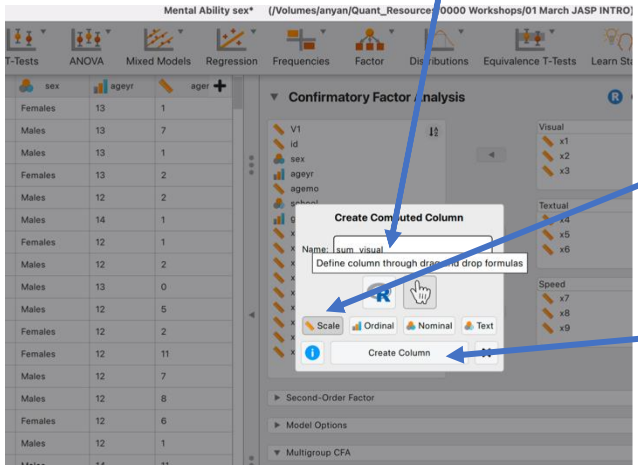
• Computing/creating/Recoding new variables

Mean and sum scores

Compute/create new variables



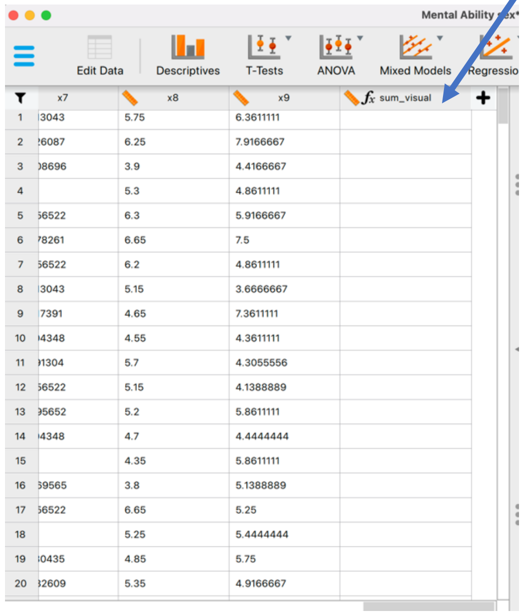
Name new variable



Set level of measurement to scale

Click compute

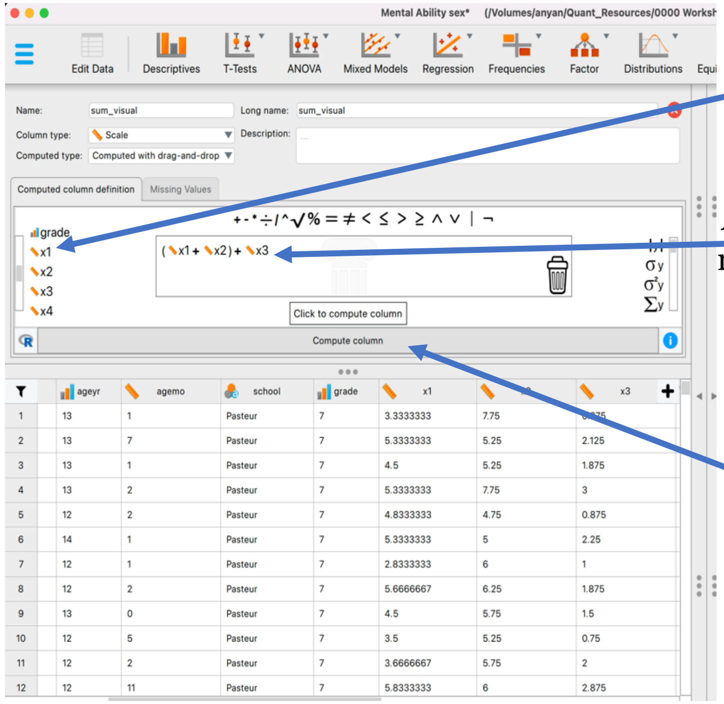
New variable appears in the data pane

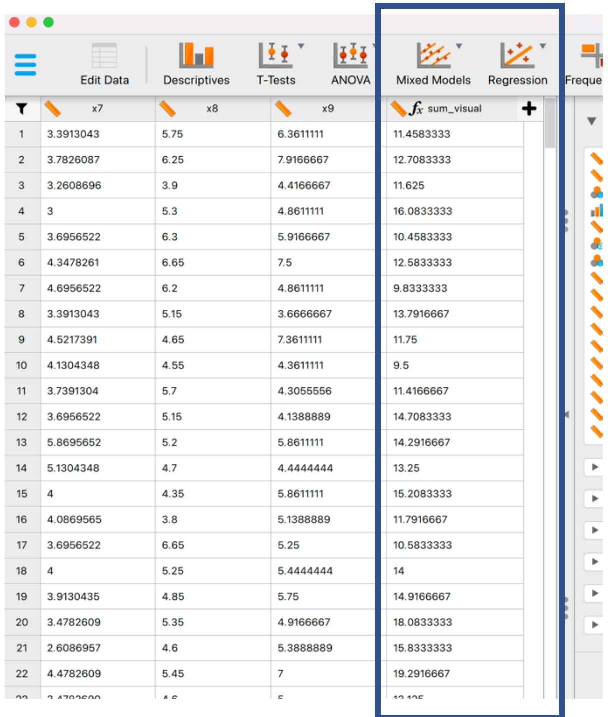


Select variables

Apply function to create new variable in drag and drop constructor

Compute column to apply function





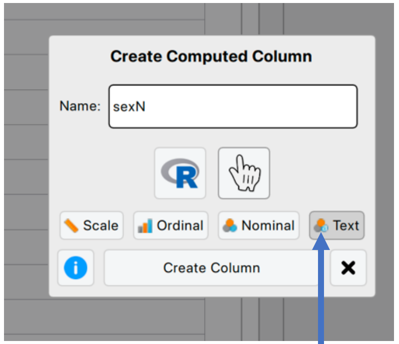
Try it for the mean of x1-x3

- **Computing/creating/Recoding new variables**

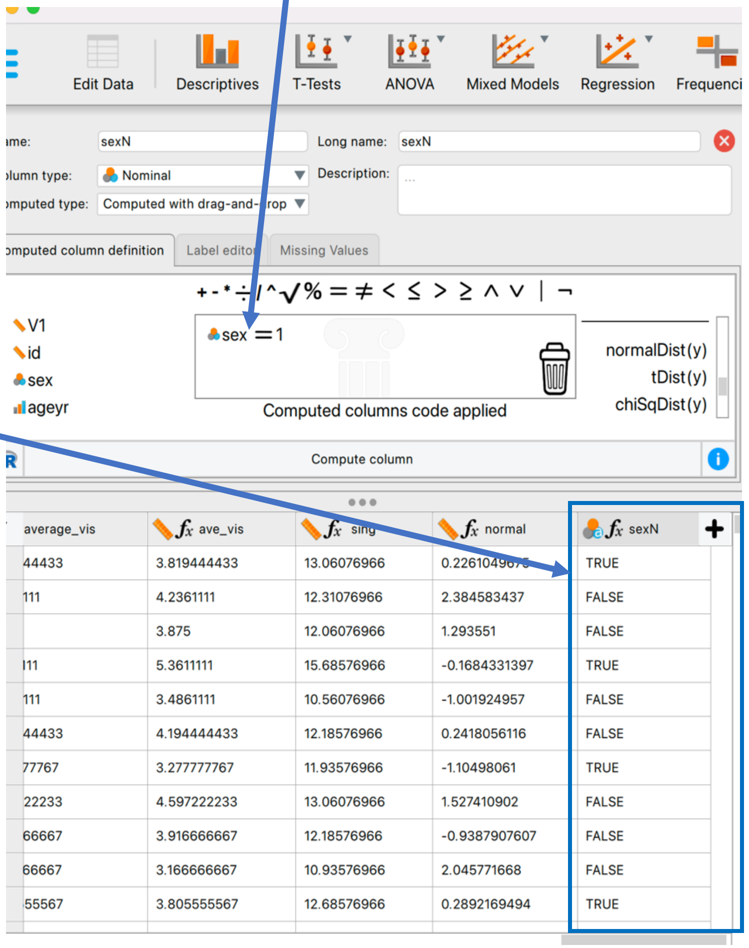
Logical values and numbers

• Computing/creating/Recoding new variables

Logical values and numbers



Function in the drag and drop constructor



Nominal text

• Computing/creating/Recoding new variables

Split sum_visual **at the mean** (mean = 13.27; ranges from 5.92 – 20.37)

Nominal
(0 = Low; 1 = High)

Nominal text (string)
(Low; High)

Ordinal
(1 = Low, 2 = medium, 3 = High)

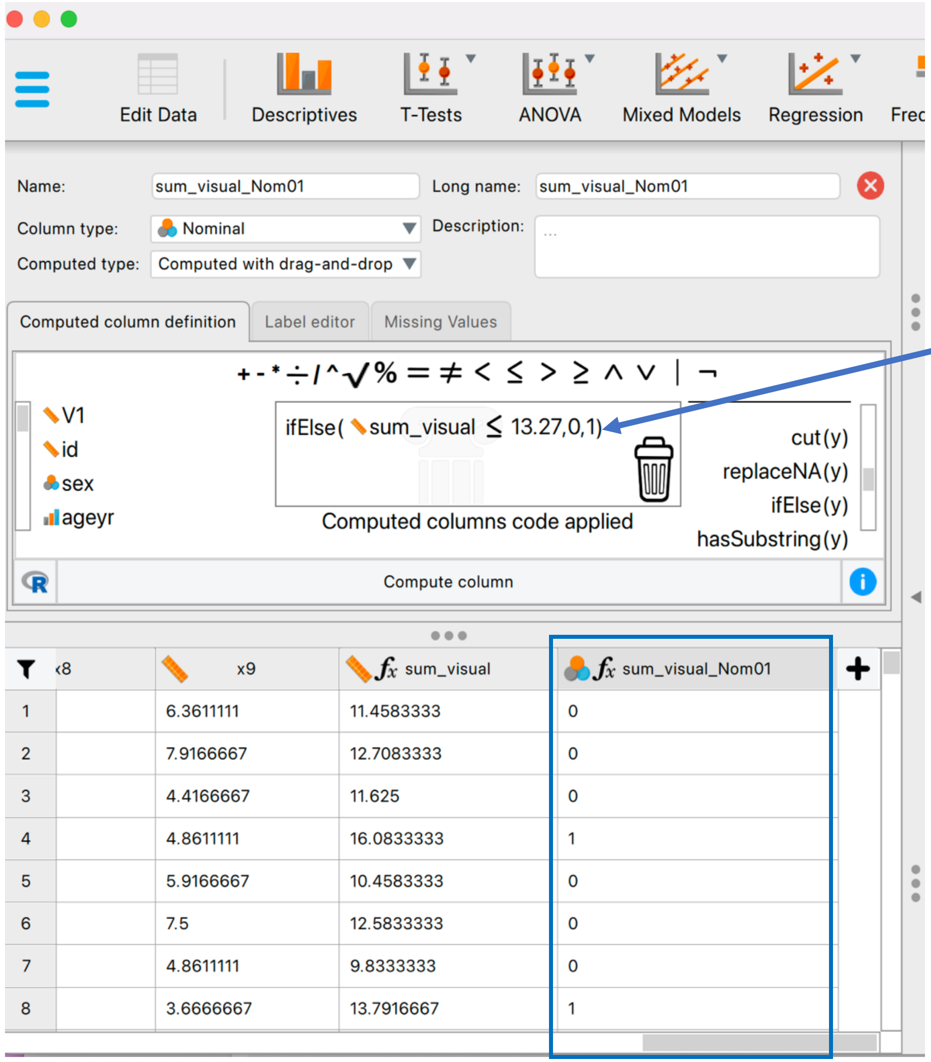
Continuous

• Computing/creating/Recoding new variables

Split sum_visal at the mean (mean = 13.27; ranges from 5.92 – 20.37)

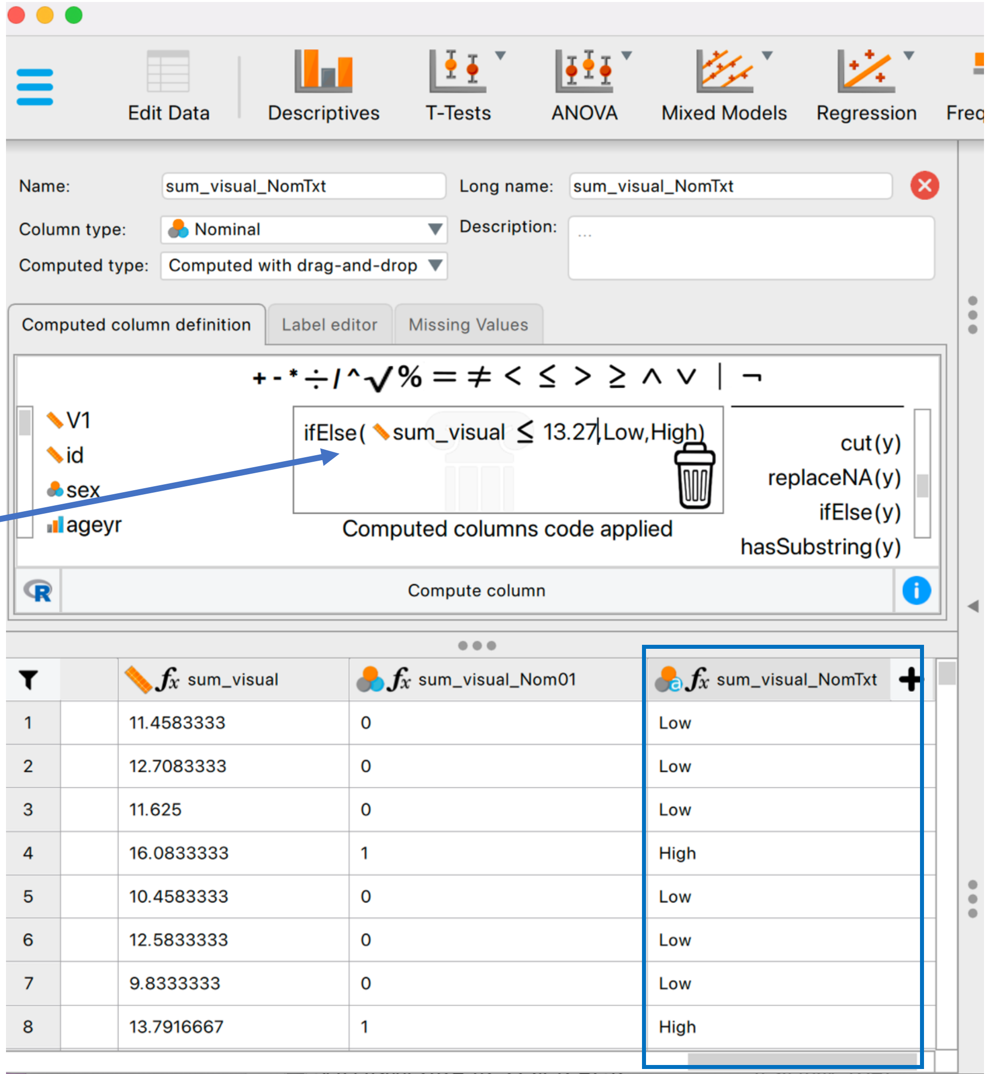
Nominal
(0 = Low; 1 = High)

Nominal text (string)
(Low; High)



If sum_visual ≤ 13.27, then = 0, but if untrue (else) then = 1

If sum_visual ≤ 13.27, then = Low, but if untrue (else) then = High

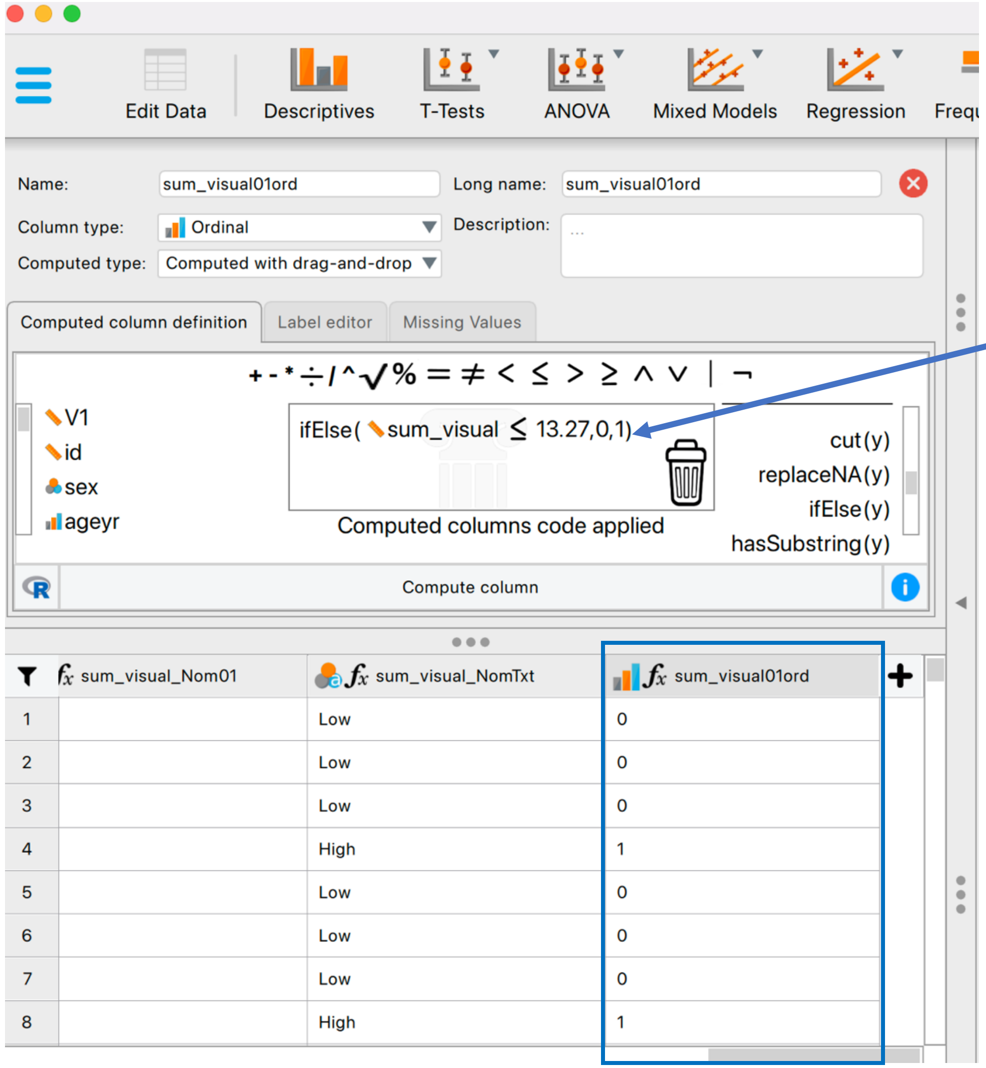


• Computing/creating/Recoding new variables

Split sum_visal **at the mean** (mean = 13.27; ranges from 5.92 – 20.37)

Ordinal
(1 = Low, 2 = High)

If sum_visual ≤ 13.27, then = 0, but
if untrue (else) then = 1



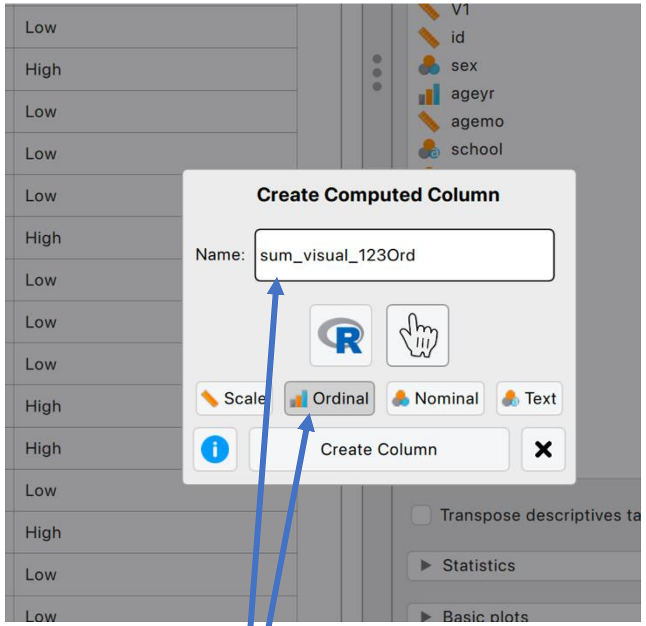
	sum_visual_Nom01	sum_visual_NomTxt	sum_visual01ord
1		Low	0
2		Low	0
3		Low	0
4		High	1
5		Low	0
6		Low	0
7		Low	0
8		High	1

• Computing/creating/Recoding new variables

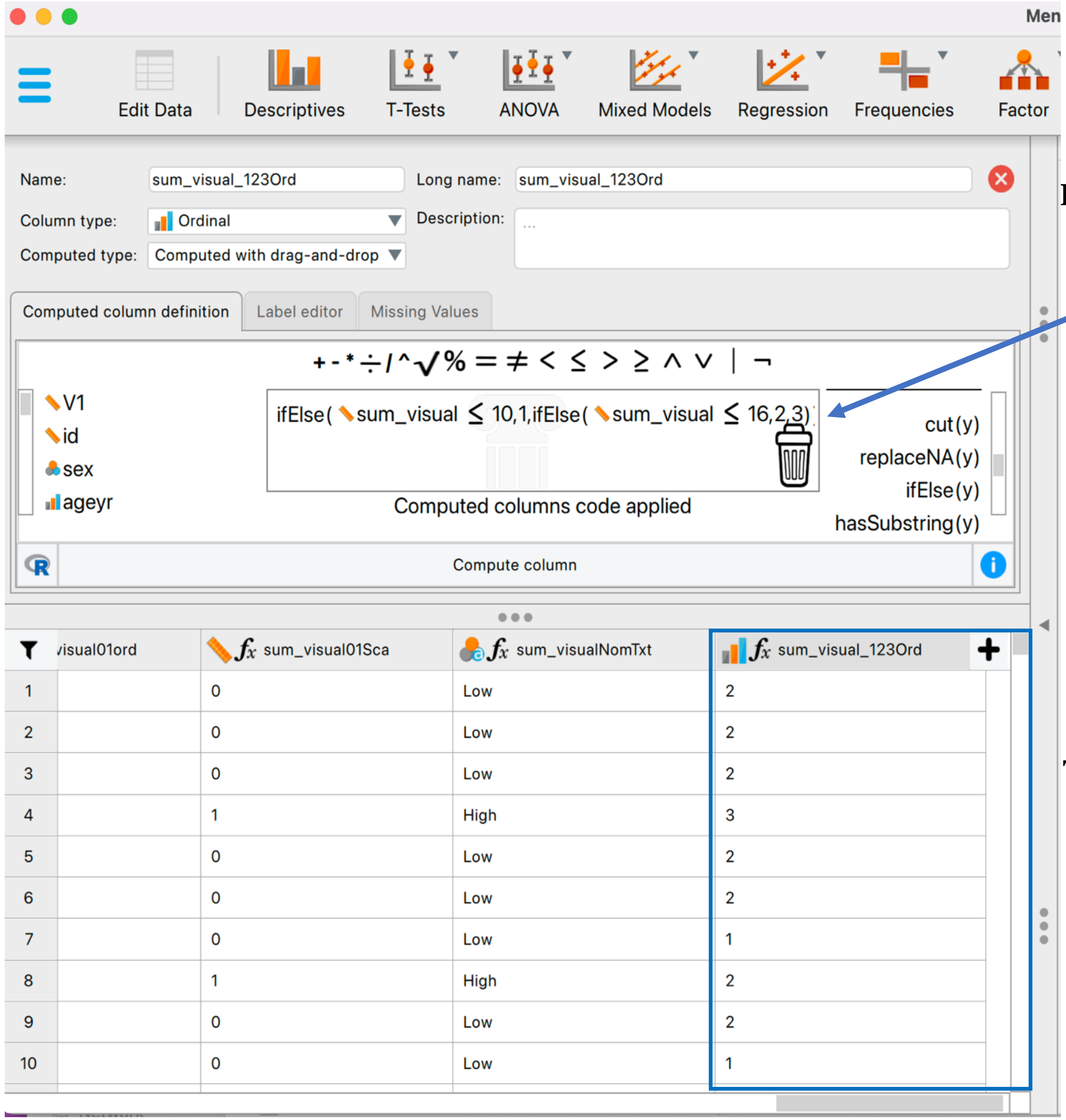
Split sum_visal into three (3) categories (mean = 13.27; SD = 2.63; ranges from 5.92 – 20.37)

- 5.92 – 10.00 = 1 (Low)
- 10.01 – 16.00 = 2 (Medium)
- 16.01 – 20.37 = 3 (High)

Ordinal
(1 = Low, 2 = medium, 3 = High)



Name new variable and set level of measurement

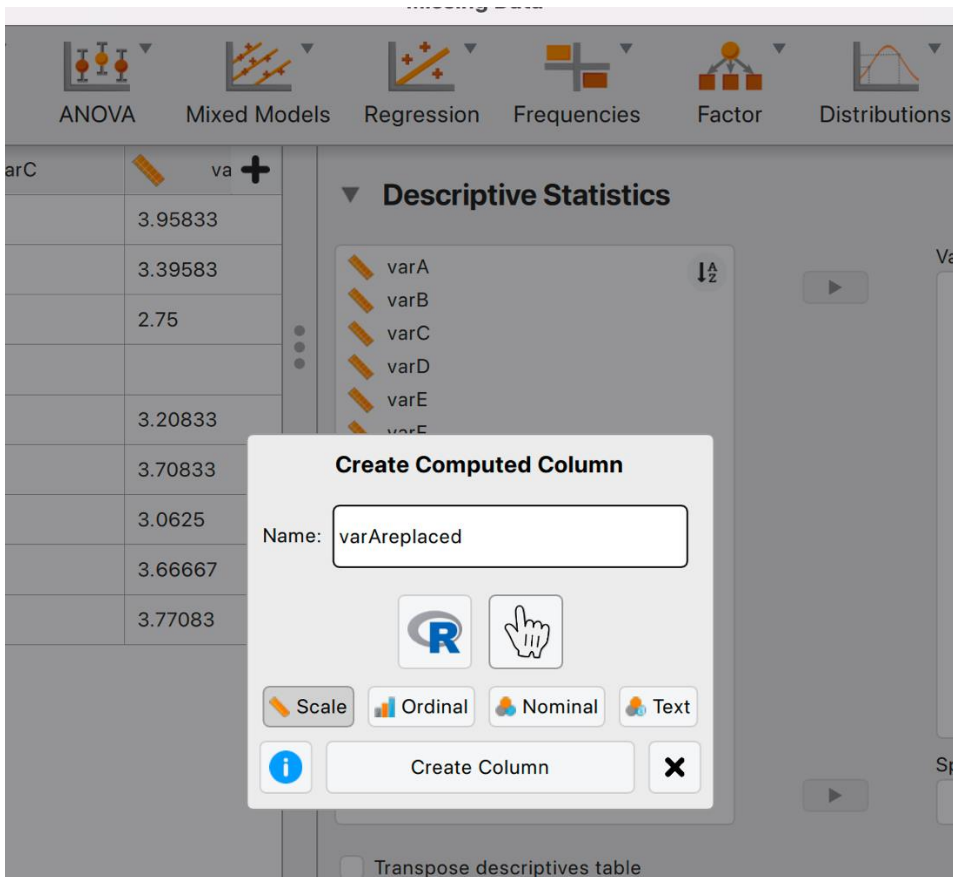


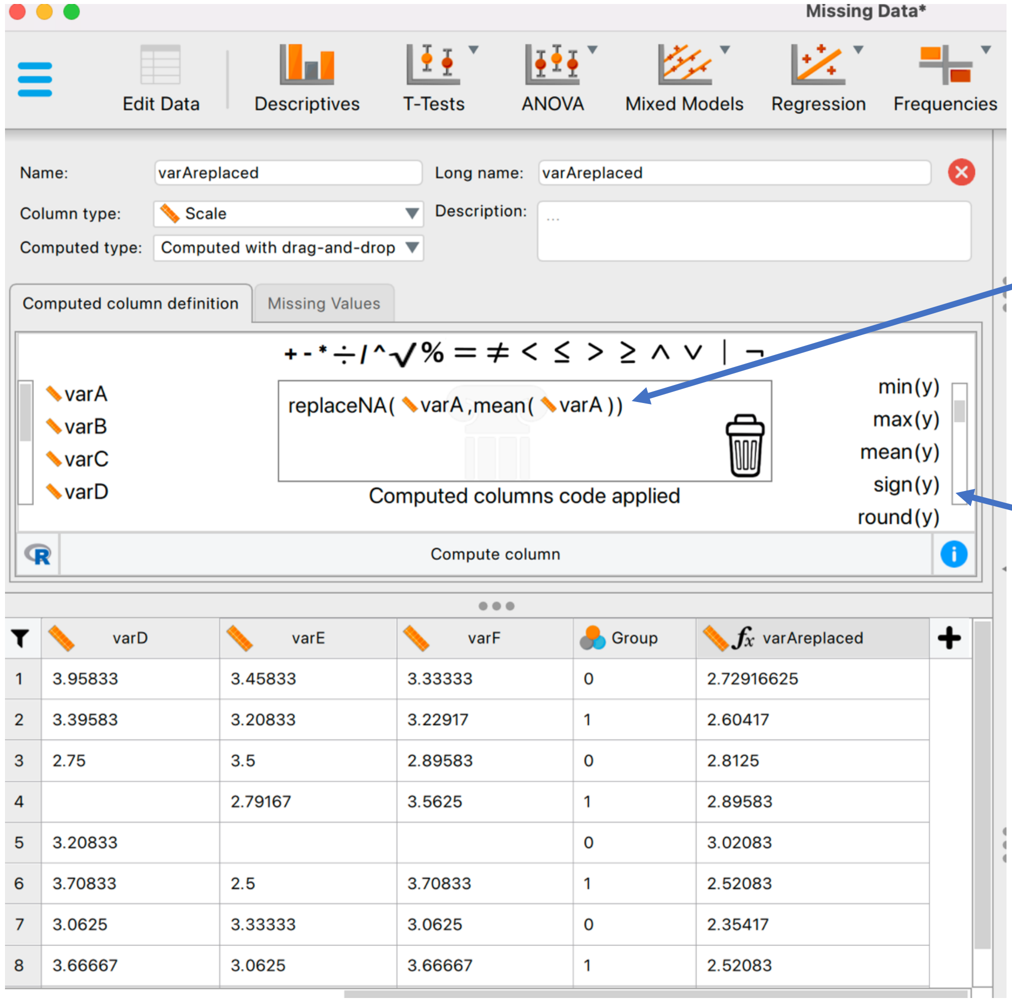
Function to create three groups

Try to change labels to Low, medium and high

• Computing/creating/Recoding new variables

Replace missing values





Create mean replacement function

Scroll down for pre-installed functions to find ***replaceNA*** and ***mean(y)*** functions

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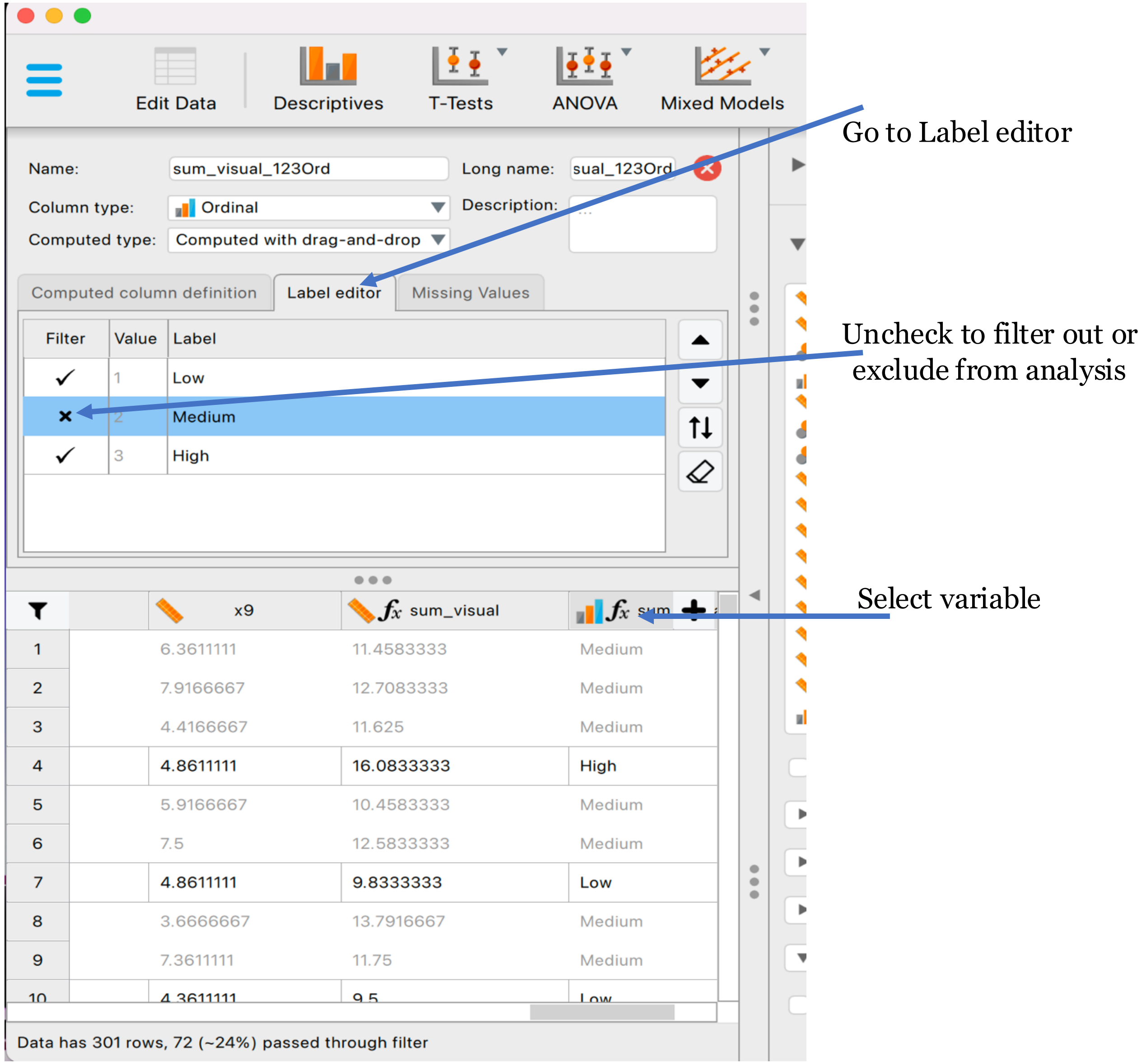
• Selecting and filtering cases

Use sum_visual_123Ord



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• Principal Components Analysis

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	3,216	35,737	35,737	3,216	35,737	35,737	2,763
2	1,639	18,208	53,945	1,639	18,208	53,945	2,226
3	1,365	15,168	69,114	1,365	15,168	69,114	2,088
4	,699	7,766	76,879				
5	,584	6,493	83,372				
6	,500	5,552	88,924				
7	,473	5,257	94,181				
8	,286	3,178	97,359				
9	,238	2,641	100,000				

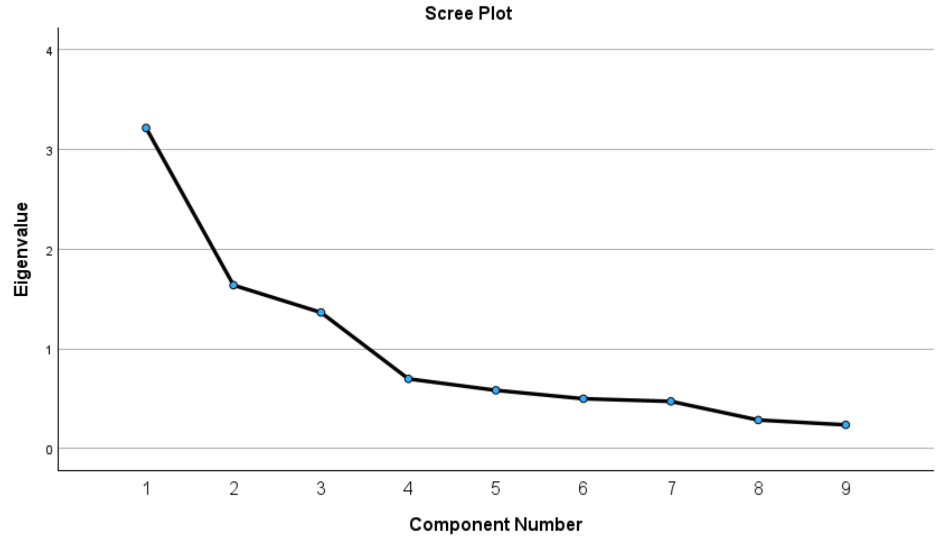
Extraction Method: Principal Component Analysis.

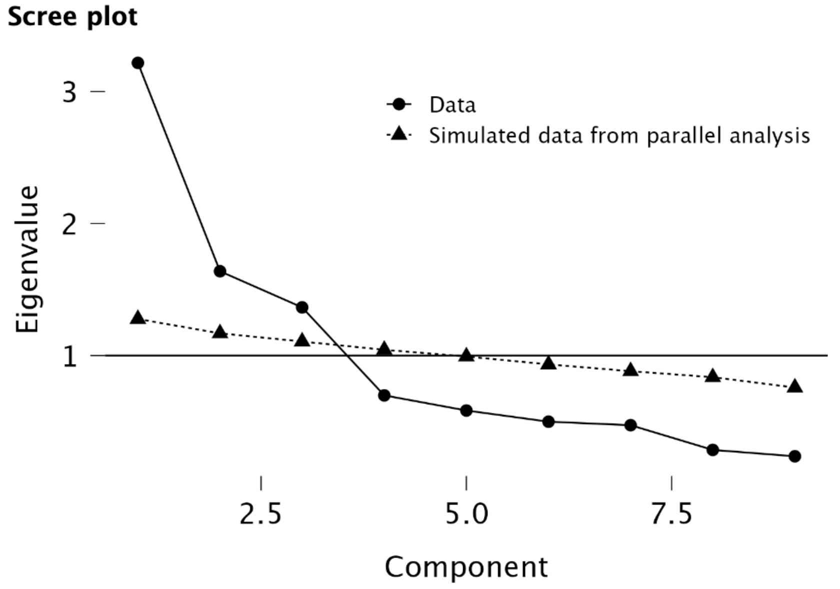
a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Component Characteristics ▼

	Unrotated solution			Rotated solution		
	Eigenvalue	Proportion var.	Cumulative	SumSq. Loadings	Proportion var.	Cumulative
Component 1	3.216	0.357	0.357	2.502	0.278	0.278
Component 2	1.639	0.182	0.539	1.899	0.211	0.489
Component 3	1.365	0.152	0.691	1.819	0.202	0.691

SPSS JASP





• Exploratory Factor Analysis

SPSS

Pattern Matrix[a]

	Component 1	Component 2	Component 3
x5	,928		
x4	,902		
x6	,874		
x3		,804	
x2		,770	
x1		,648	
x7			,873
x8			,828
x9			,596

Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Component Correlation Matrix

Component	1	2	3
1	1,000	,303	,223
2	,303	1,000	,265
3	,223	,265	1,000

Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.

JASP

Component Loadings ▼

	RC1	RC2	RC3	Uniqueness
x5	0.930			0.175
x4	0.903			0.186
x6	0.875			0.207
x3		0.814		0.369
x2		0.774		0.455
x1		0.655		0.413
x7			0.876	0.278
x8			0.822	0.308
x9			0.581	0.389

Note. Applied rotation method is promax.

Component Correlations ▼

	Component 1	Component 2	Component 3
Component 1	1.000	0.319	0.218
Component 2	0.319	1.000	0.274
Component 3	0.218	0.274	1.000

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• Confirmatory Factor Analysis

Mplus

```
MODEL FIT INFORMATION

Number of Free Parameters                         30

Loglikelihood

          H0 Value                         -3737.745
          H1 Value                         -3695.092

Information Criteria

          Akaike (AIC)                      7535.490
          Bayesian (BIC)                    7646.703
          Sample-Size Adjusted BIC          7551.560
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                               85.306
          Degrees of Freedom                      24
          P-Value                             0.0000

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                             0.092
          90 Percent C.I.                      0.071  0.114
          Probability RMSEA <= .05             0.001

CFI/TLI

          CFI                                  0.931
          TLI                                  0.896

Chi-Square Test of Model Fit for the Baseline Model

          Value                              918.852
          Degrees of Freedom                      36
          P-Value                             0.0000

SRMR (Standardized Root Mean Square Residual)

          Value                                0.060
```

JASP

Model fit ▼

Chi-square test

Model	X^2	df	p
Baseline model	918.852	36	
Factor model	85.306	24	< .001

Note. The estimator is ML.

Additional fit measures ▼

Fit indices

Index	Value
Comparative Fit Index (CFI)	0.931
Tucker–Lewis Index (TLI)	0.896
Bentler–Bonett Non-normed Fit Index (NNFI)	0.896
Bentler–Bonett Normed Fit Index (NFI)	0.907
Parsimony Normed Fit Index (PNFI)	0.605
Bollen's Relative Fit Index (RFI)	0.861
Bollen's Incremental Fit Index (IFI)	0.931
Relative Noncentrality Index (RNI)	0.931

Information criteria

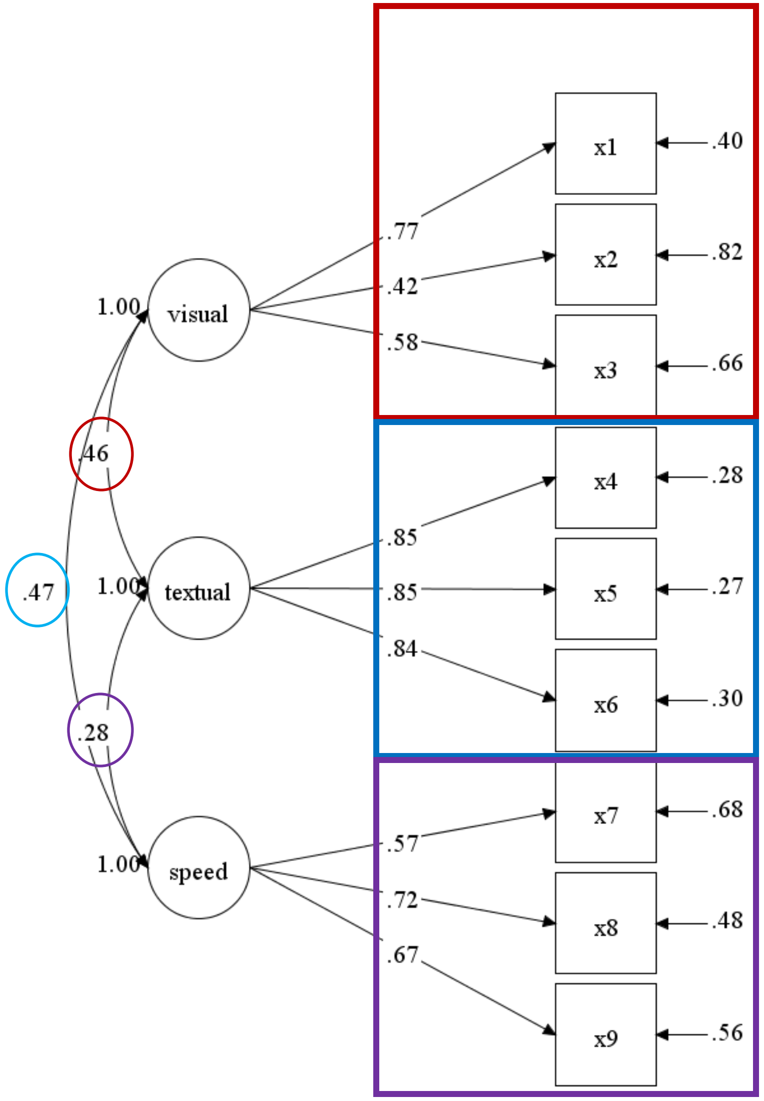
	Value
Log–likelihood	−3737.745
Number of free parameters	30.000
Akaike (AIC)	7535.490
Bayesian (BIC)	7646.703
Sample–size adjusted Bayesian (SSABIC)	7551.560

Other fit measures ▼

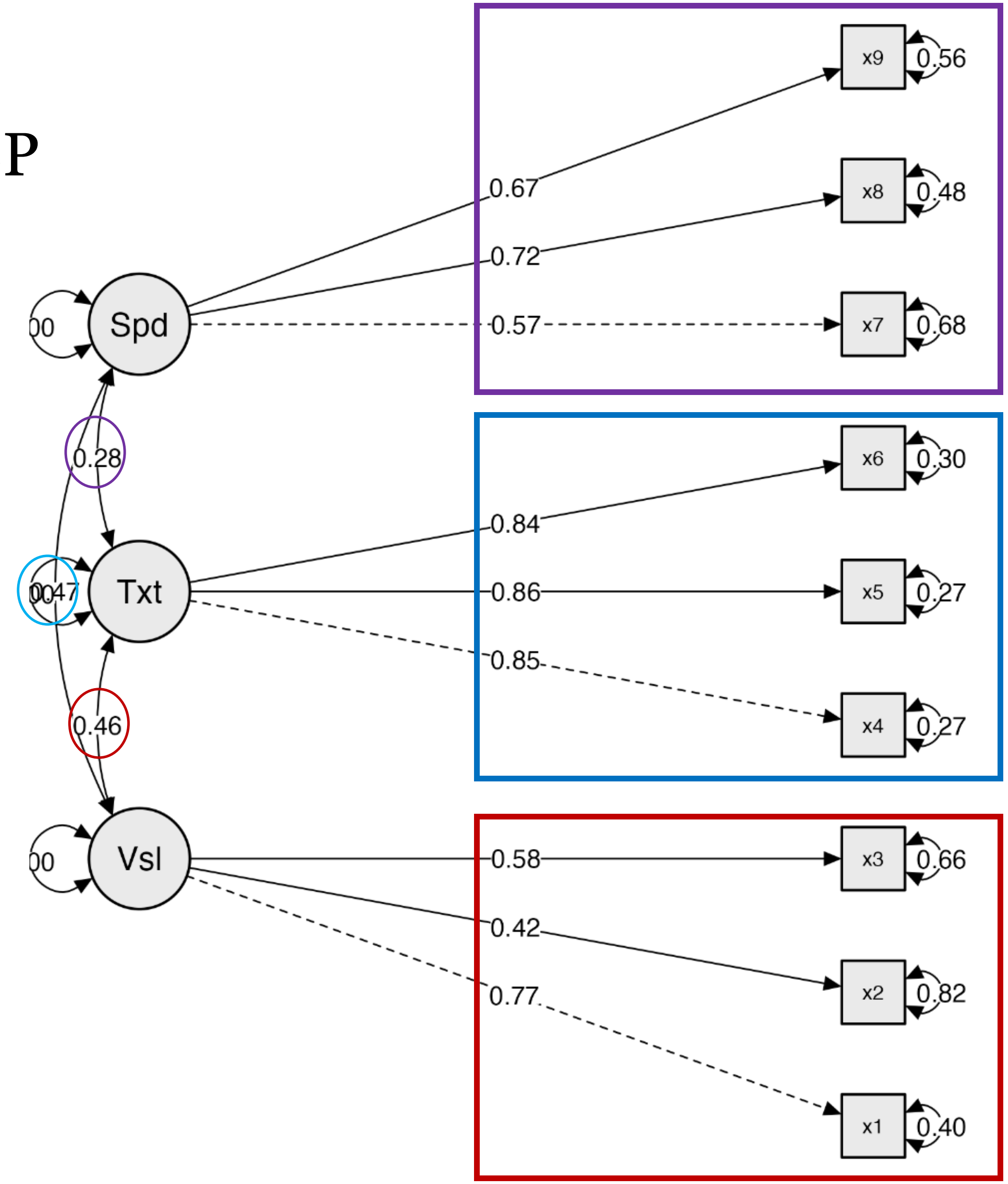
Metric	Value
Root mean square error of approximation (RMSEA)	0.092
RMSEA 90% CI lower bound	0.071
RMSEA 90% CI upper bound	0.114
RMSEA p-value	6.612×10^{-4}
Standardized root mean square residual (SRMR)	0.060
Hoelter's critical N (α = .05)	129.490
Hoelter's critical N (α = .01)	152.654
Goodness of fit index (GFI)	0.996
McDonald fit index (MFI)	0.903
Expected cross validation index (ECVI)	0.483

• Confirmatory Factor Analysis

Mplus



JASP



Plan for today

- JASP: Downloading, installing, and opening JASP
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  - (Re)Naming Variables
  - Setting levels of measurement
  - Computing (Recoding) new variables
- Selecting and filtering cases

- Example Analyses
  - Principal Components and Exploratory
  - Confirmatory Factor Analyses
    - Multigroup analyses and measurement invariance
  - Mediation modelling

  - Advanced modeling in JASP
    - Longitudinal/Growth models – SEM

• Mediation modelling

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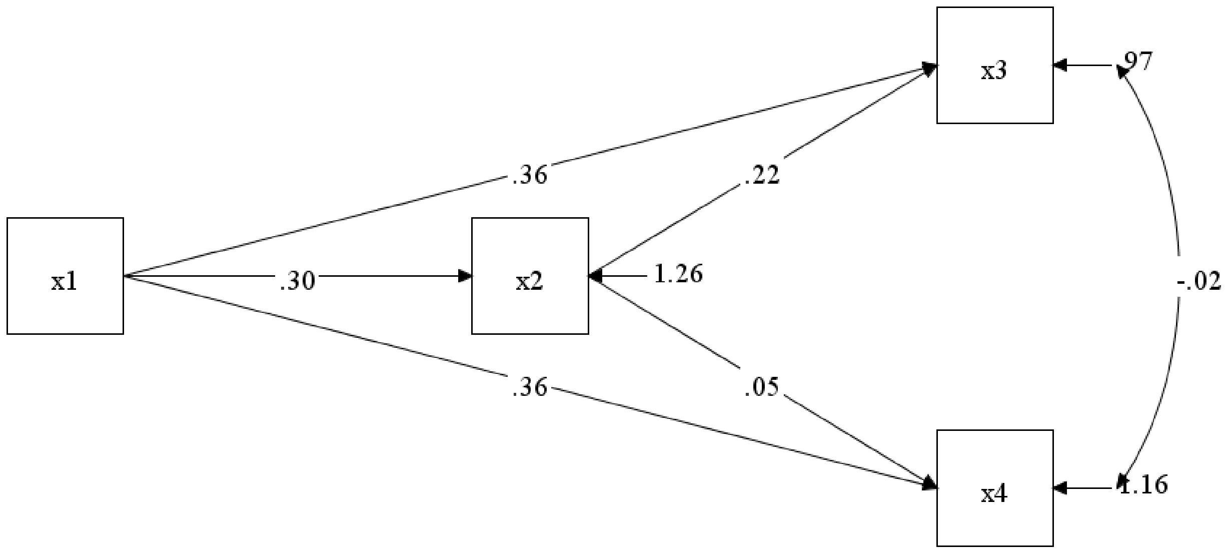
MODEL RESULTS

		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
X3 ON					
	X1	0.361	0.049	7.337	0.000
	X2	0.220	0.056	3.962	0.000
X4 ON					
	X1	0.358	0.065	5.548	0.000
	X2	0.046	0.071	0.640	0.522
X2 ON					
	X1	0.300	0.057	5.262	0.000
X4 WITH					
	X3	-0.020	0.058	-0.347	0.729

CONFIDENCE INTERVALS OF TOTAL, TOTAL INDIRECT, SPECIFIC INDIRECT, AND DIRECT EFFECTS

	Lower .5%	Lower 2.5%	Lower 5%	Estimate	Upper 5%	Upper 2.5%	Upper .5%
Effects from X1 to X4							
Indirect	-0.051	-0.030	-0.023	0.014	0.044	0.051	0.066
Effects from X1 to X3							
Indirect	0.022	0.031	0.037	0.066	0.107	0.113	0.124



JASP

Path coefficients ▼

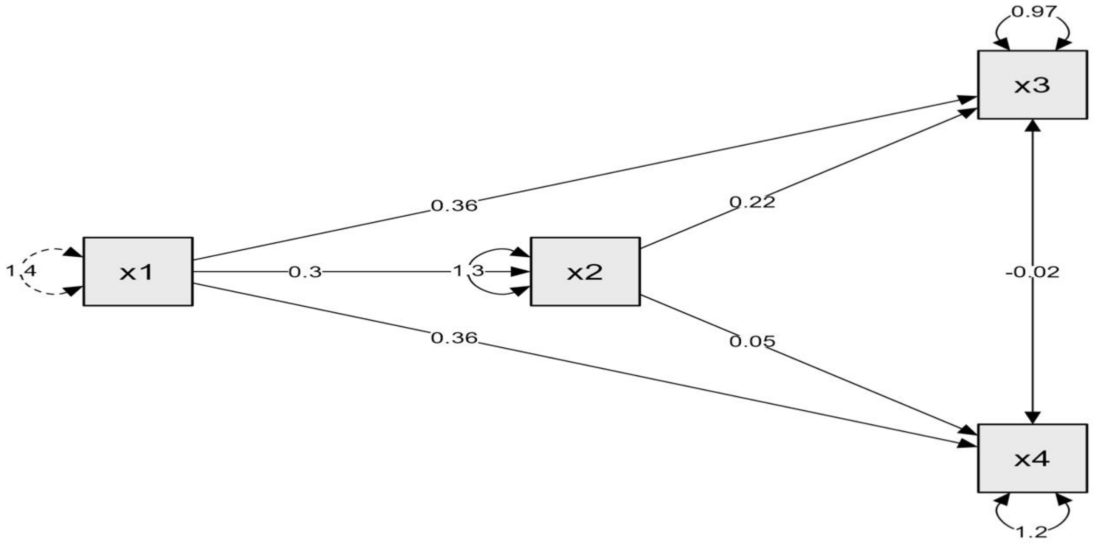
			Estimate	Std. Error	z-value	p	95% Confidence Interval Lower	Upper
x2	→	x3	0.220	0.050	4.358	< .001	0.111	0.326
x1	→	x3	0.361	0.051	7.088	< .001	0.258	0.457
x2	→	x4	0.046	0.055	0.825	0.409	−0.082	0.185
x1	→	x4	0.358	0.056	6.415	< .001	0.247	0.499
x1	→	x2	0.300	0.056	5.403	< .001	0.195	0.418

Note. Delta method standard errors, bias-corrected percentile bootstrap confidence intervals, ML estimator.

Indirect effects

					Estimate	Std. Error	z-value	p	95% Confidence Interval Lower	Upper
x1	→	x2	→	x3	0.066	0.019	3.392	< .001	0.032	0.115
x1	→	x2	→	x4	0.014	0.017	0.816	0.414	−0.026	0.055

Note. Delta method standard errors, bias-corrected percentile bootstrap confidence intervals, ML estimator.



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• Longitudinal Growth Models – SEM

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MODEL FIT INFORMATION

Number of Free Parameters                        12

Loglikelihood

          H0 Value                        -7952.058
          H1 Value                        -7866.567

Information Criteria

          Akaike (AIC)                    15928.116
          Bayesian (BIC)                  15986.164
          Sample-Size Adjusted BIC        15948.053
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                             170.982
          Degrees of Freedom                     23
          P-Value                            0.0000

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                            0.083
          90 Percent C.I.                     0.072  0.095
          Probability RMSEA <= .05            0.000

CFI/TLI

          CFI                                 0.824
          TLI                                 0.839

Chi-Square Test of Model Fit for the Baseline Model

          Value                             862.101
          Degrees of Freedom                     21
          P-Value                            0.0000

SRMR (Standardized Root Mean Square Residual)

          Value                               0.120
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JASP

Additional Fit measures

Fit indices

Index	Value
Comparative Fit Index (CFI)	0.824
Tucker–Lewis Index (TLI)	0.839
Bentler–Bonett Non–normed Fit Index (NNFI)	0.839
Bentler–Bonett Normed Fit Index (NFI)	
Parsimony Normed Fit Index (PNFI)	0.878
Bollen's Relative Fit Index (RFI)	
Bollen's Incremental Fit Index (IFI)	0.823
Relative Noncentrality Index (RNI)	0.824

Information criteria

	Value
Log–likelihood	−7952.058
Number of free parameters	12.000
Akaike (AIC)	15928.116
Bayesian (BIC)	15986.164
Sample–size adjusted Bayesian (SSABIC)	15948.053

Other fit measures

Metric	Value
Root mean square error of approximation (RMSEA)	0.083
RMSEA 90%% CI lower bound	0.072
RMSEA 90%% CI upper bound	0.095
RMSEA p–value	1.598×10^{-6}
Standardized root mean square residual (SRMR)	0.108
Hoelter's critical N (α = .05)	192.460
Hoelter's critical N (α = .01)	227.657
Goodness of fit index (GFI)	0.989
McDonald fit index (MFI)	0.924
Expected cross validation index (ECVI)	0.209

• Longitudinal Growth Models – SEM

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S WITH				
I	4.020	1.458	2.758	0.006

Means				
I	35.736	0.384	93.114	0.000
S	4.219	0.099	42.764	0.000

Variances				
I	47.598	6.538	7.280	0.000
S	0.031	0.419	0.074	0.941

Residual Variances				
MATH2	60.697	7.521	8.070	0.000
MATH3	50.842	5.025	10.118	0.000
MATH4	38.667	4.198	9.211	0.000
MATH5	27.675	3.664	7.554	0.000
MATH6	22.165	3.682	6.020	0.000
MATH7	32.152	6.168	5.212	0.000
MATH8	39.961	8.355	4.783	0.000

JASP

Parameter estimates

Latent curve

						95%% Confidence Interval	
Component	Parameter	Estimate	Std. Error	z-value	p	Lower	Upper
Intercept	Variance	47.603	6.538	7.281	< .001	34.788	60.417
	Mean	35.737	0.384	93.113	< .001	34.984	36.489
Linear slope	Variance	0.031	0.419	0.074	0.941	−0.789	0.852
	Mean	4.219	0.099	42.763	< .001	4.025	4.412

Latent covariances

							95%% Confidence Interval	
			Estimate	Std. Error	z-value	p	Lower	Upper
Intercept	↔	Linear slope	4.019	1.458	2.757	0.006	1.162	6.877

Residual variances

					95%% Confidence Interval	
Variable	Estimate	Std. Error	z-value	p	Lower	Upper
math2	60.694	7.521	8.070	< .001	45.954	75.434
math3	50.842	5.025	10.118	< .001	40.993	60.690
math4	38.666	4.198	9.211	< .001	30.439	46.894
math5	27.673	3.663	7.554	< .001	20.493	34.853
math6	22.166	3.682	6.020	< .001	14.949	29.382
math7	32.151	6.168	5.212	< .001	20.062	44.241
math8	39.956	8.354	4.783	< .001	23.583	56.330

• Longitudinal Growth Models – SEM

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R-SQUARE

Observed Variable	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
MATH2	0.440	0.056	7.855	0.000
MATH3	0.523	0.038	13.893	0.000
MATH4	0.623	0.031	20.069	0.000
MATH5	0.722	0.030	24.464	0.000
MATH6	0.784	0.033	24.070	0.000
MATH7	0.734	0.043	17.031	0.000
MATH8	0.708	0.053	13.402	0.000

JASP

R–Squared ▼

Variable	R^2
math2	0.440
math3	0.523
math4	0.623
math5	0.722
math6	0.784
math7	0.734
math8	0.708