

Discovering Statistics Using JASP



JASP

2025 Workshop

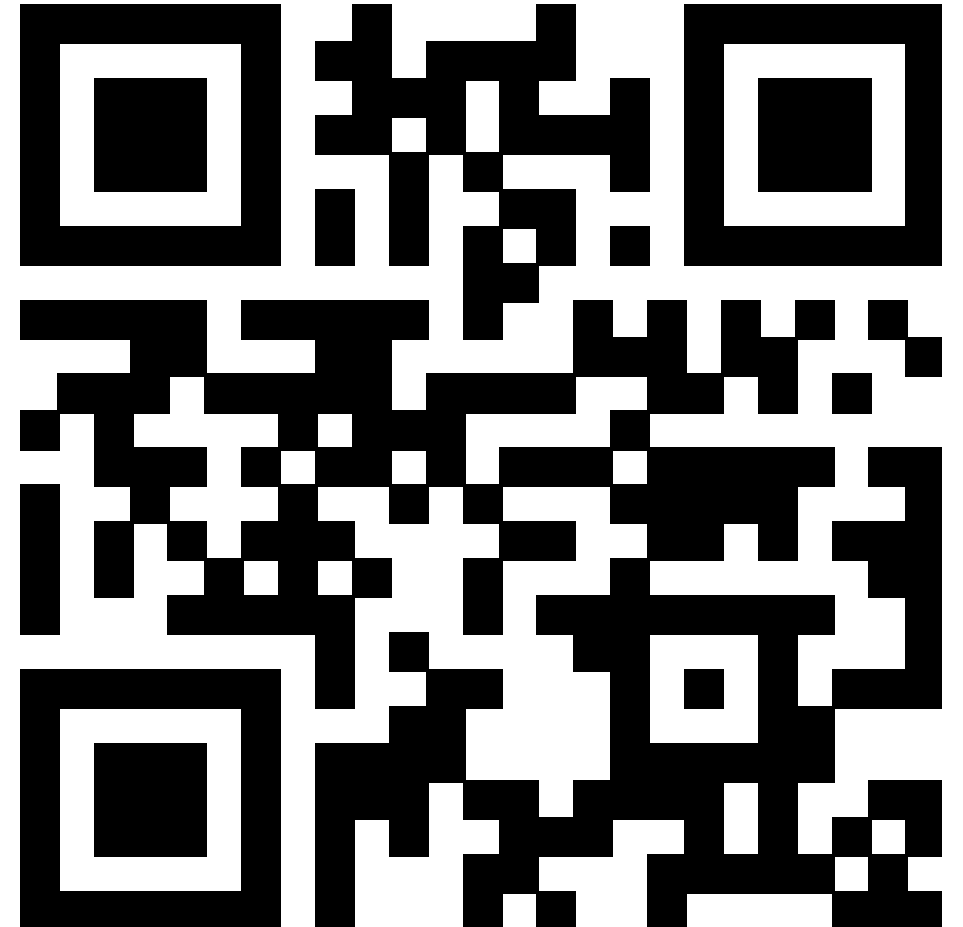


UNIVERSITEIT VAN AMSTERDAM

Outline



- JASP Intro
- Correlation
- Regression
- PROCESS
- T-test
- ANOVA's
- Free-for-all



edu.nl/knhfd

Goals of this Workshop



- Get you familiar with JASP
- Show JASP workflow
- Know how to get in touch
- Have ran your favorite analysis in JASP

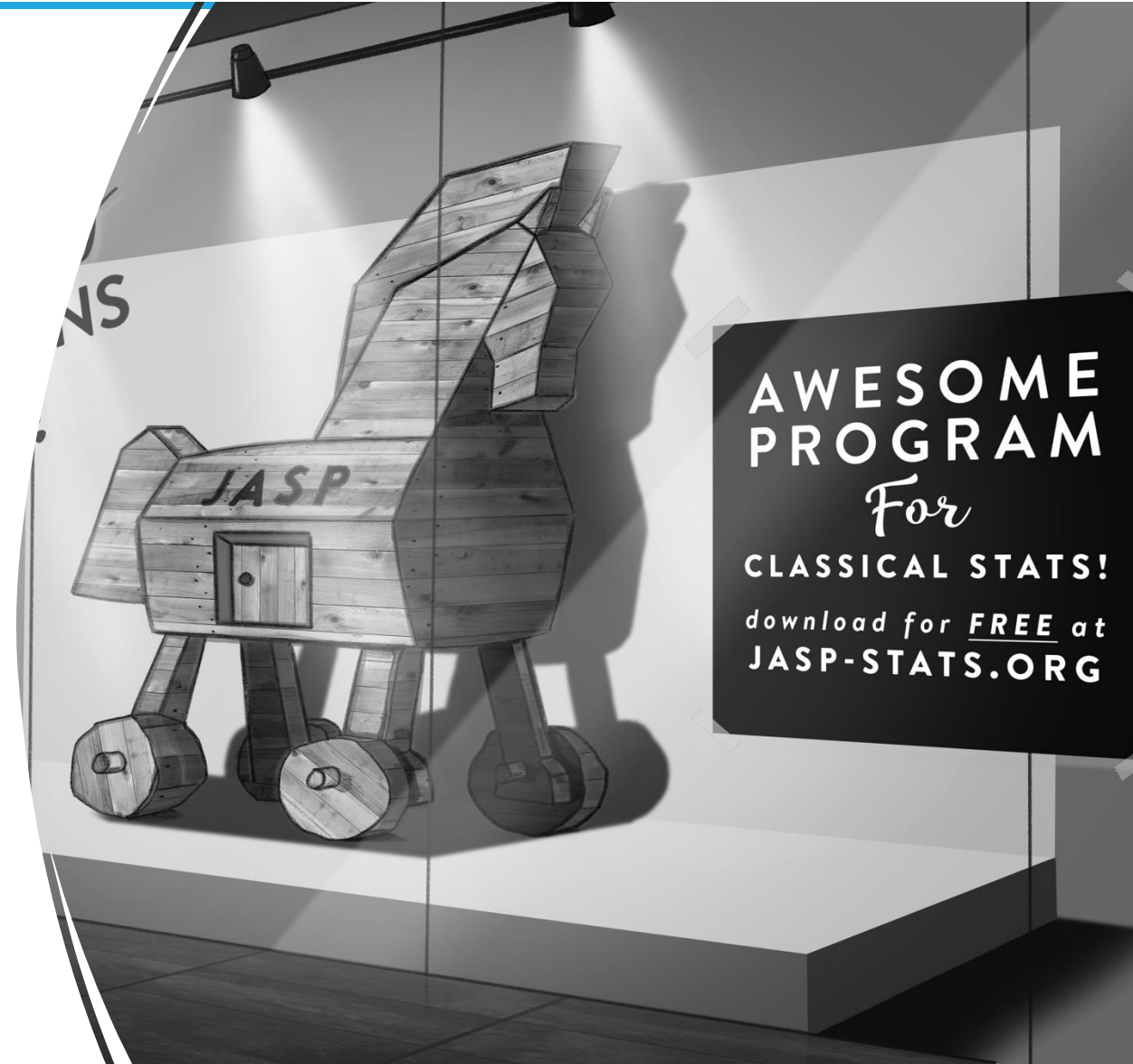
What is JASP?



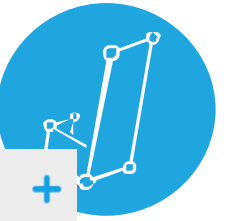
Developed at UvA over the past 10 years, funded by research grants (NWO/EU)

Graphical user interface for conducting frequentist and Bayesian statistics

<https://jasp-stats.org/>



What is JASP?



Descriptives T-Tests ANOVA Mixed Models Regression Frequencies Factor BSTS

► Descriptive Statistics

► Linear Regression

► Correlation

▼ Linear Regression

Dependent Variable: sales

Method: Enter

Covariates: adverts, airplay, attract

Factors:

WLS Weights (optional):

▼ Model

Components: adverts, airplay, attract

Model Terms: adverts, airplay, attract

☒ Include intercept

► Statistics

► Method Specification

► Plots

Linear Regression ▼

```
jaspRegression::RegressionLinear(  
  version = "0.17.1",  
  formula = sales ~ attract + airplay + adverts,  
  isNuisance = ~ adverts,  
  covariates = list("adverts", "airplay", "attract"),  
  coefficientCI = TRUE,  
  collinearityDiagnostic = TRUE,  
  descriptives = TRUE,  
  rSquaredChange = TRUE,  
  residualCasewiseDiagnostic = TRUE,  
  residualCasewiseDiagnosticCooksDistanceThreshold = 0,  
  residualCasewiseDiagnosticZThreshold = 2,  
  residualHistogramPlot = TRUE,  
  residualQqPlot = TRUE,  
  residualVsFittedPlot = TRUE)
```

And now to the multiple linear regression!

Previously, we already computed the regression using only advertisement budget to predict the sales. Now, we will include two more variables: airplay and attract. Because we already know that adverts predict the sales, it is certain that a new model will explain at least the same amount of variance of sales. Because of this, we can test whether including the two new predictors *explains the album sales better* than including just adverts. After we included the three variables as covariates, we can add the adverts to the null model in the 'Model' panel. Now, we will test the new model against the one we fitted moments before (predicting sales by adverts).

Model Summary - sales ▼

Model	R	R ²	Adjusted R ²	RMSE	R ² Change	F Change	df1	df2	p
H ₀	0.578	0.335	0.331	65.991	0.335	99.587	1	198	< .001
H ₁	0.815	0.665	0.660	47.087	0.330	96.447	2	196	< .001

Note. Null model includes adverts

The first line of the model summary shows the 'null model'. See that the statistics correspond to the ones we computed earlier (predicting sales by adverts). The second line is about the new model with three predictors. Based on the R² Change and F-Test of the change, we can see that the new model does significantly better than the previous one. The adjusted R² of the model also drops only a little, showing robust model (probably not very high overfitting).

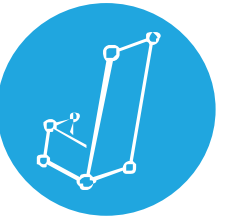
ANOVA

Model		Sum of Squares	df	Mean Square	F	p
H ₀	Regression	433687.833	1	433687.833	99.587	< .001
	Residual	862264.167	198	4354.870		
	Total	1.296×10 ⁺⁶	199			
H ₁	Regression	861377.418	3	287125.806	129.498	< .001
	Residual	434574.582	196	2217.217		
	Total	1.296×10 ⁺⁶	199			

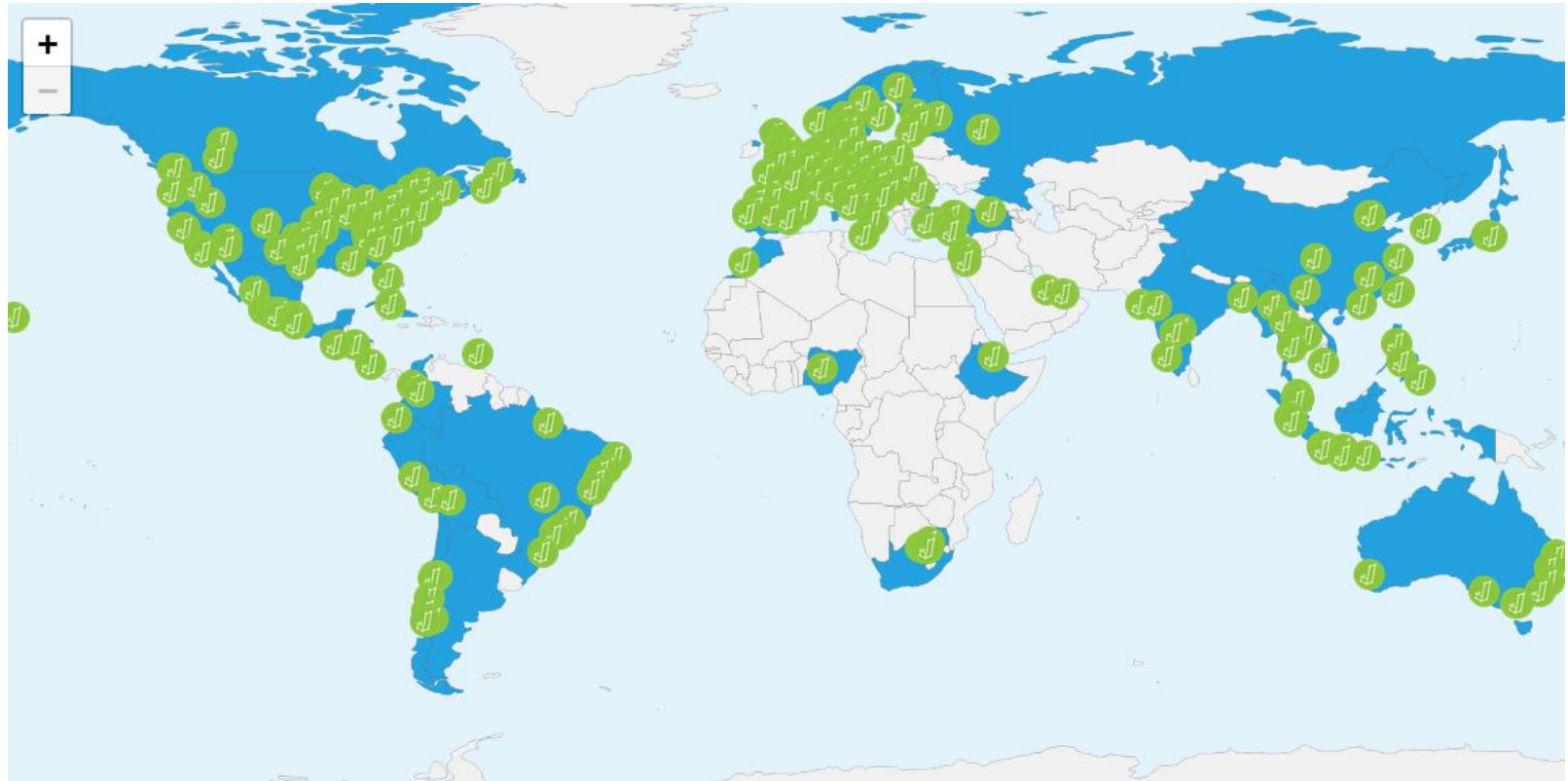
Note. Null model includes adverts

The test of the fit of the model. Both models are highly significant, indicating that either of them significantly improves our estimate of sales to the true 'null model' (which is just the mean of sales).

What is JASP?



Used at 271 universities
across 64 countries
80,000 monthly downloads



<https://jasp-stats.org/teaching-with-jasp/#worldmap>

Features

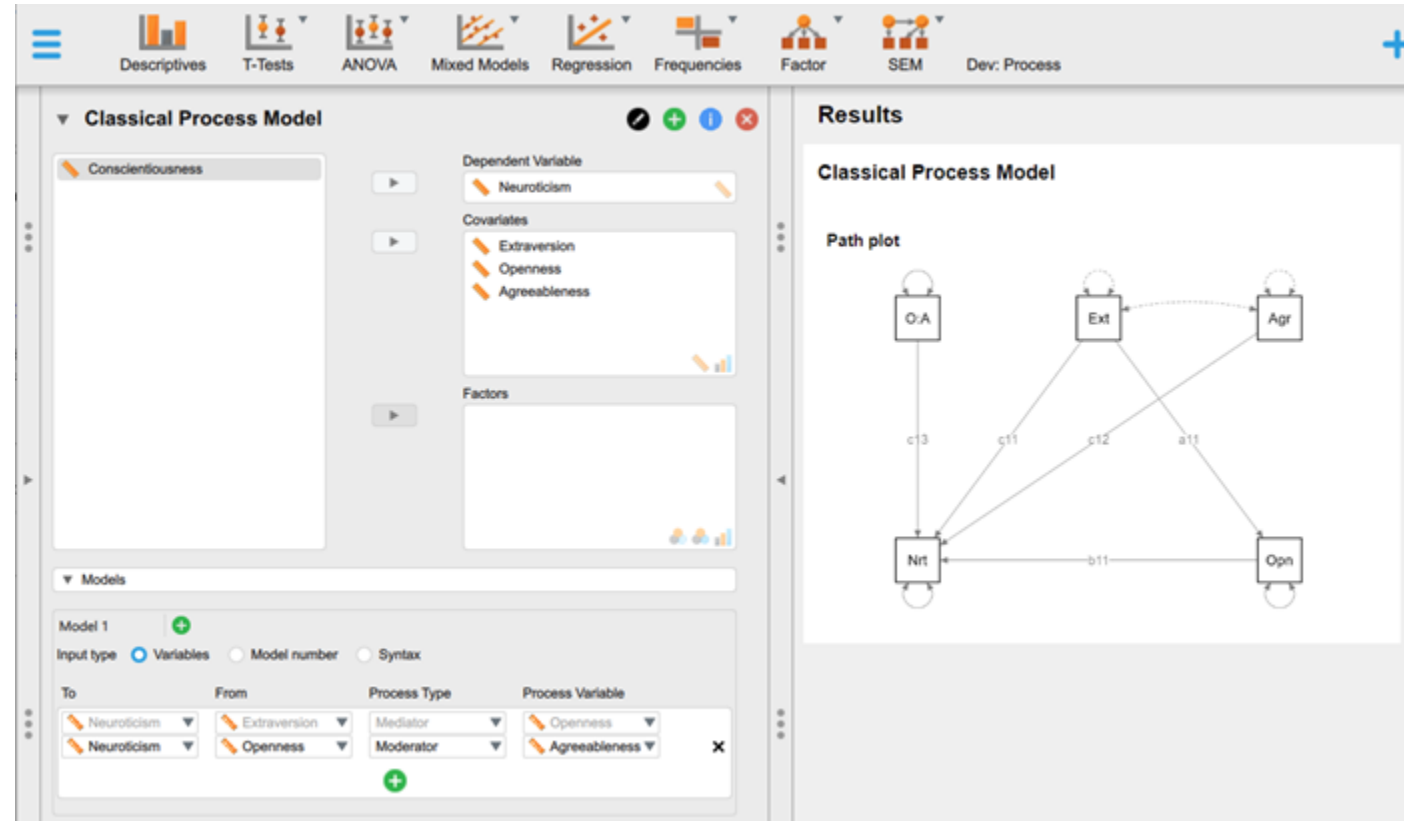


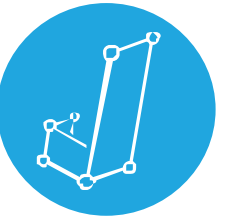
- [Website overview](#)
- [JASP vs. SPSS feature comparison](#)
- Data formats: .sav, .xls, .txt, .csv, .ods, .tsv, .dta, .por, .sas7bdat, .sas7bcat, and the .jasp format
- APA tables
- OSF integration
- R console
- Compute columns
- Filtering

Feature Roadmap



- Full syntax mode ([blog about the first implementation](#))
- More data manipulation
- Select filters





Other Handy Resources

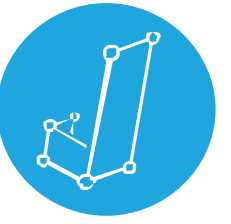
- [How to Use JASP – Inventory of blogs/videos/gifs for frequentist and Bayesian analyses](#)
- [JASP YouTube page](#)
- [The JASP Video Library](#)
- [Step By Step Guide: 1. Bayesian One-Way ANOVA](#) and the [full playlist](#)
- JASP on Bluesky - <https://bsky.app/profile/jaspstats.bsky.social>
- JASP forum - <https://forum.cogsci.nl/index.php?p=/categories/jasp-bayesfactor>
- Found a bug? Please report on Github: <https://github.com/jasp-stats/jasp-issues/issues>
- [JASP Verification Project](#)
- More JASP workshops: <https://jasp-stats.org/workshop/>

JASP Literature



- [The JASP Data Library](#)
- [Discovering Statistics Using JASP](#)
- [Learning Statistics with JASP: A Tutorial for Psychology Students and Other Beginners by Danielle J. Navarro, David R. Foxcroft, and Thomas J. Faulkenberry](#)
- [Statistics of Doom by Erin Buchanan](#)
- [Statistical Analysis in JASP. A Guide for Students by Mark Goss-Sampson](#)
- [Quantitative Analysis with JASP open-source software by Chris Halter](#) (amazon)

Some Examples/Demos



From my own course (Research Methods & Statistics)

- <https://johnnydoorn.github.io/IntroductionBayesianInference/06-exercises.html>

OSF integration

- <https://osf.io/u2e9d/files/osfstorage>

Discover JASP

- <https://discoverjasp.com/>



Data Management



The JASP data editor for the Metallica data

	<div><div></div><div></div><div></div></div> <div>Name</div>	<div><div></div><div></div><div></div></div> <div>Instrument</div>	<div><div></div><div></div><div></div></div> <div>Current member</div>	<div><div></div><div></div><div></div></div> <div>Headbanging intensity</div>	
1	Lars Ulrich	Drums	Yes1	Light	1
2	James Hetfield	Guitar	Yes1	Heavy	3
3	Kirk Hammett	Guitar	Yes1	Light	1
4	Rob Trujillo	Bass	Yes1	Moderate	2
5	Jason Newsted	Bass	No0	Heavy	3

The Variable View

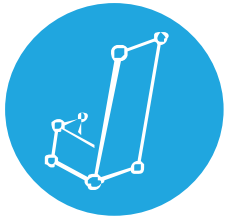








Figure 4.6 The variable settings for 'Name'

Name: Long name:

Column type:  Nominal ▼ Description:

Computed type: Not computed ▼

Label editor Missing values

	Filter	Value	Label
	✓	Lars Ulrich	Lars Ulrich
	✓	James Hetfield	James Hetfield
	✓	Kirk Hammett	Kirk Hammett
	✓	Rob Trujillo	Rob Trujillo
	✓	Jason Newsted	Jason Newsted

Variable Types



Scale

- Numbers (e.g., 7, 0, 120, 8.5)

Nominal

- Categories (e.g., 'Control group', 'Experimental group')

Ordinal

- Ordered values (e.g., 'Dislike', 'Neutral', 'Like')

Variable Settings

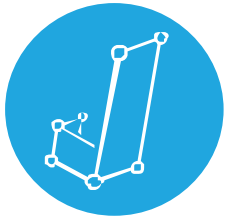



Figure 4.7 Specifying the values for an ordinal variable

Name:

Column type:  Ordinal ▼

Computed type: ▼

Label editor Missing values

1
N
↓

1
N
↺

↑
↓

▲

▼

Filter	Value	Label
✓	1	Light
✓	2	Moderate
✓	3	Heavy

Computing a New Variable



Figure 4.8 The drag and drop interface for computing a new variable

The screenshot shows a software interface for creating a new variable. At the top, there are fields for 'Name' (Net worth per song) and 'Long name' (Net worth per song (\$ million)). Below these are 'Column type' (Scale) and 'Computed type' (Computed with drag-and-drop). A 'Description' field contains the text: 'Computed column, where net worth is divided by the number of song writing credits.' Below the description are three tabs: 'Computed column definition' (selected), 'Label editor', and 'Missing values'. The 'Computed column definition' tab shows a list of variables on the left: Name, Instrument, Current member, and Headbangi... ntensity. In the center, a box contains 'Net worth... million)' and 'Songs'. Below this box is the text 'Computed columns code applied'. On the right, there is a trash can icon and a list of mathematical symbols: $|y|$, σ_y , σ^2_y , and Σy . At the bottom, there is a 'Converting types' button and a 'Compute column' button.



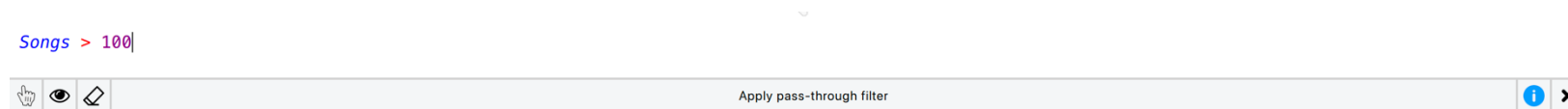
Filtering Data



- Using Variable Settings
- Using the Filter functionality
 - Drag and drop



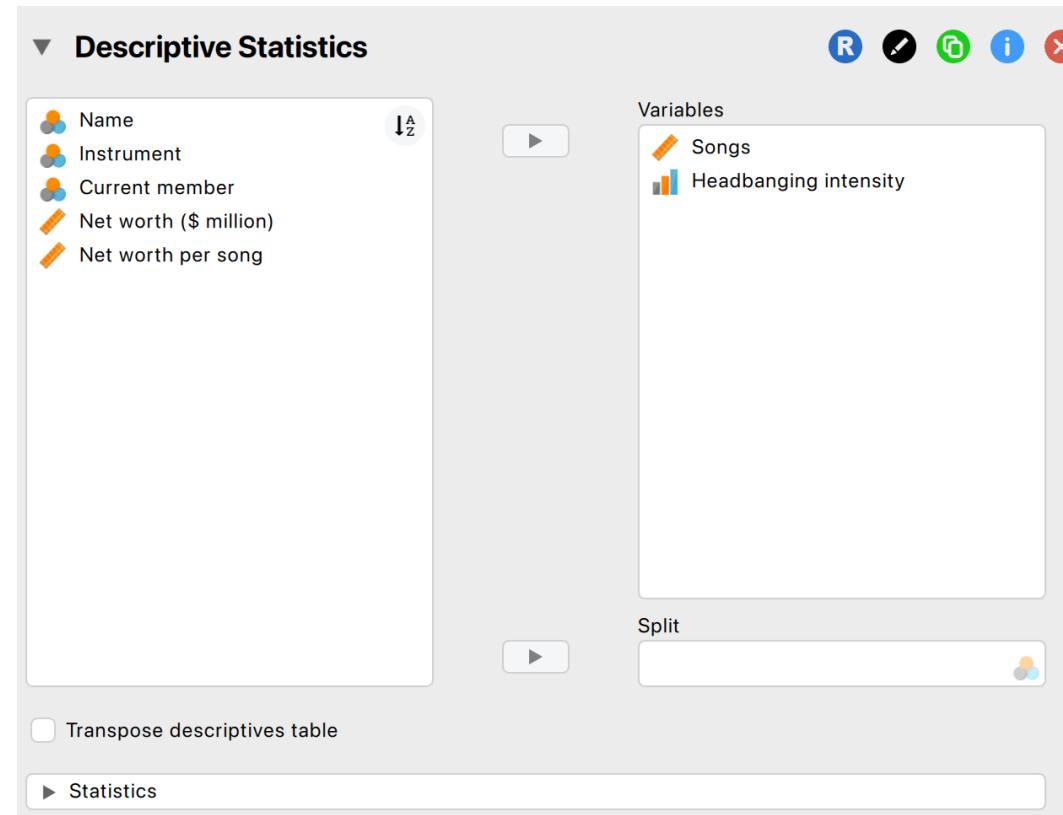
- R-mode



Descriptives



Figure 4.10 Input window for the Descriptives module



Output Window in JASP



Figure 4.11 Example of annotated output

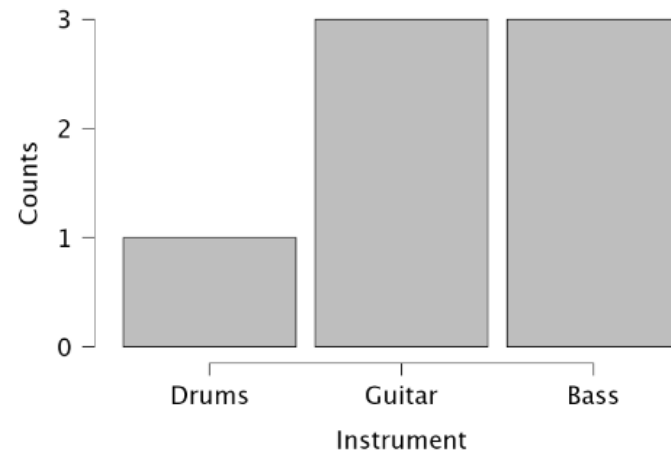
Distribution Plots

B I U f_x $\langle \cdot \rangle$ Normal x_2 x^2 ” “ ≡ ≡ Normal I_x

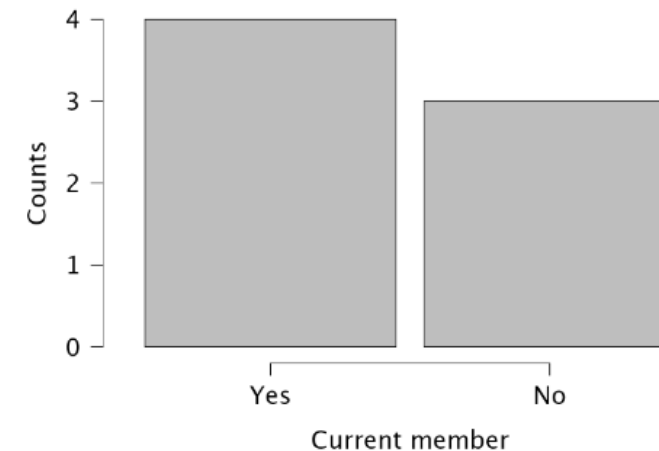
We can have fancy $LaTeX$ formula's in here, [link cute cat video's](#), or insert a drumkit

Below are two distribution plots outlining the members of Metallica. On the left, we see the various instruments being played and their frequencies, and on the right we see how many members are still active, and how many left the band.

Instrument



Current member

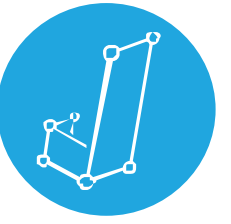


Basic Flow of Data Analysis in JASP



- Describe/visualize data
- Specify the analysis in JASP
- Assess the assumptions (tip: see the help-files)
- Interpret the main analysis table
- Consider follow-up analyses

Regression



Regression with One Predictor



A record company boss was interested in predicting album sales from advertising.

Data

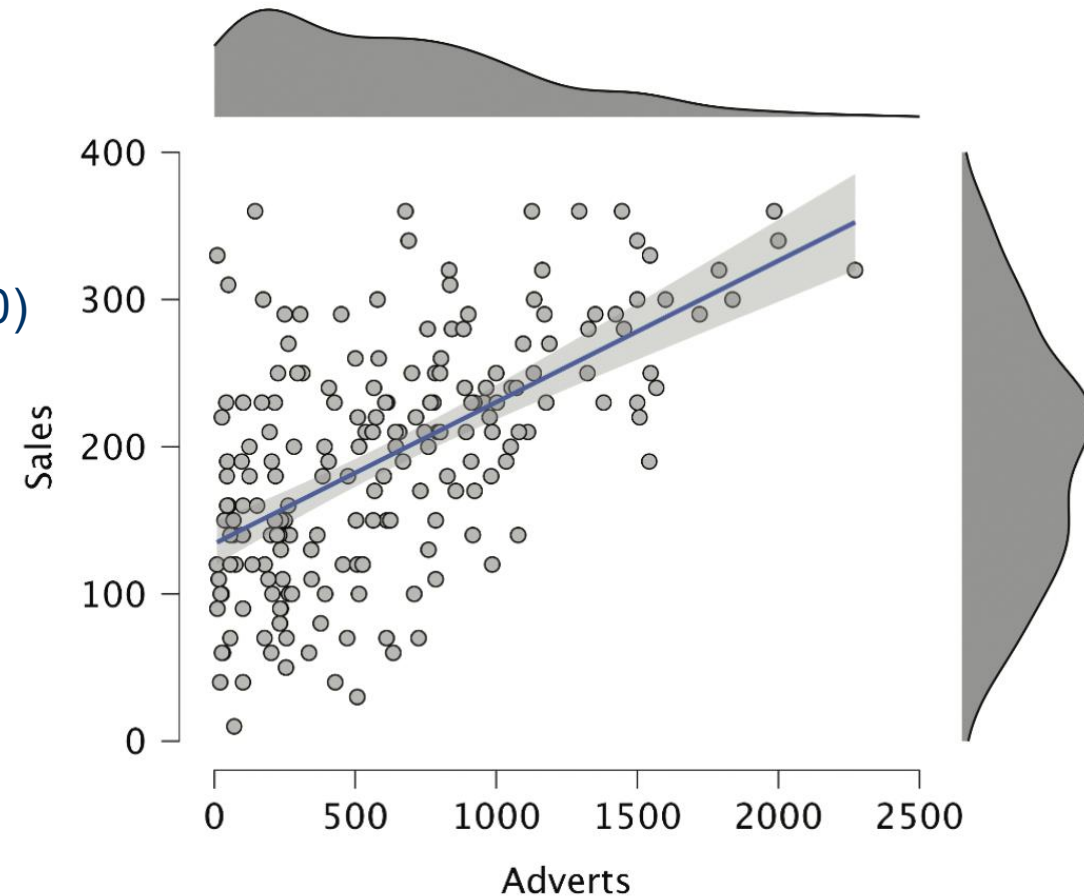
- 200 different album releases

Outcome variable:

- Album sales in the week after release (x1000)

Predictor variables

- Advertisement budget (in £1000)
- Number of plays on the radio
- Image of the band.



The Model as an Equation



- The model contains two regression weights:

$$Y_i = (b_0 + b_1 X_{1i}) + \varepsilon_i$$

- b_0 is the intercept
 - The intercept is the value of the Y variable when all X s = 0
 - E.g., how many albums are sold for 0£ advertisement budget
- b_1 is the coefficient for Adverts.

Regression with One Predictor

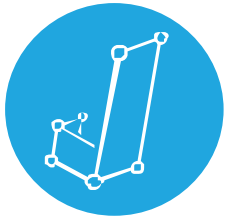


Figure 8.10 Main menu for regression

Linear Regression: Single Predictor

AlbumID
Airplay
Image

Dependent Variable
Sales

Method
Enter

Covariates
Adverts

Factors

WLS Weights (optional)

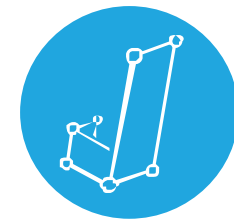
► Model

► Statistics

► Method Specification

► Plots

Model Summary



Output 8.2

Model Summary - Sales

Model	R	R ²	Adjusted R ²	RMSE
M ₀	0.000	0.000	0.000	80.699
M ₁	0.578	0.335	0.331	65.991

Note. M₁ includes Adverts

Multiple Regression



- With several predictors the model now contains multiple regression weights:

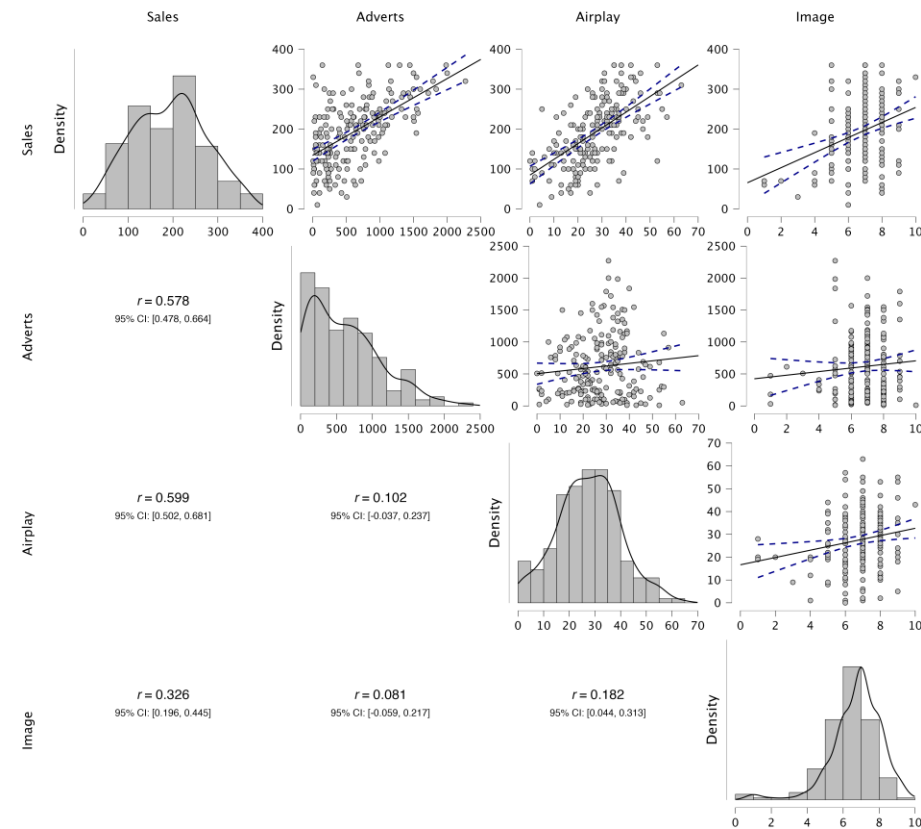
$$Y_i = (b_0 + b_1X_{1i} + b_2X_{2i} + \cdots b_nX_{ni}) + \varepsilon_i$$

- b_0 is the intercept.
 - The intercept is the value of the Y variable when all X s = 0
- b_1 is the coefficient for Adverts
- b_2 is the coefficient for Airplay
- b_n is the coefficient for n^{th} variable.

A model with Several Predictors



Figure 8.11 Matrix scatterplot of the relationships between advertising budget, airplay, image rating and album sales



Multiple Regression



Figure 8.12 Main menu for block 2 of the multiple regression

▼ Model

- Adverts
- Airplay
- Image

Model 0

- Adverts

Model 1

- Adverts
- Image
- Airplay

☒ Include intercept

Normality of Residuals: Histograms and Q-Q Plots

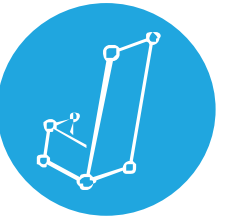
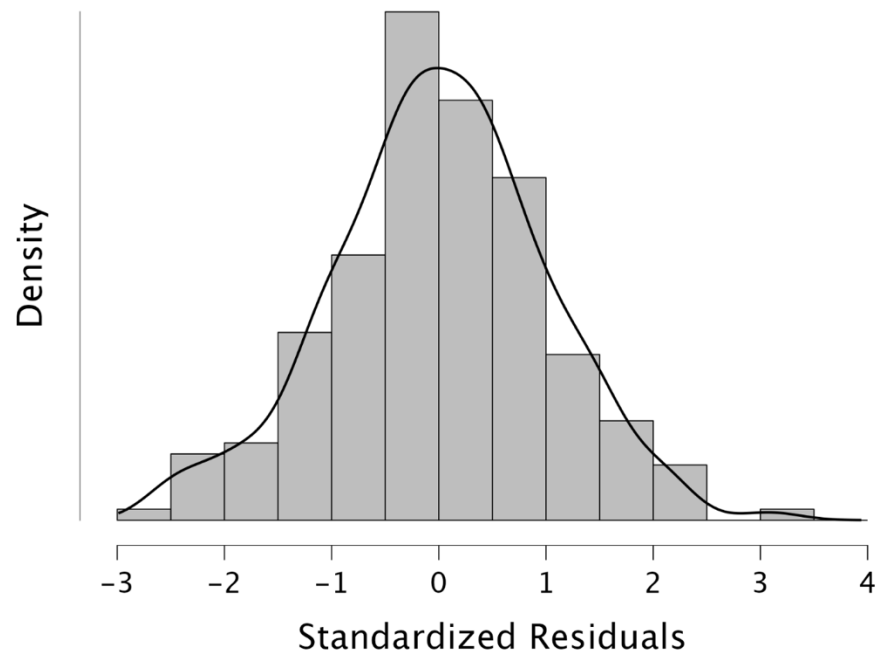
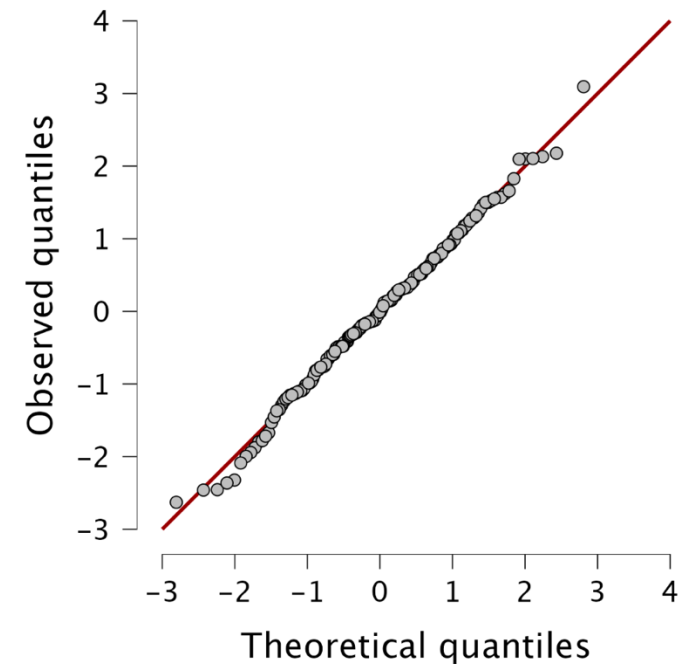


Figure 8.17 Histogram and Q-Q plot for the residuals from our model

Standardized Residuals Histogram



Q-Q Plot Standardized Residuals



Model Parameters



Output 8.7

Coefficients

Model		Unstandardized	Standard Error	Standardized	t	p	95% CI		Collinearity Statistics	
							Lower	Upper	Tolerance	VIF
M ₀	(Intercept)	134.140	7.537		17.799	< .001	119.278	149.002		
	Adverts	0.096	0.010	0.578	9.979	< .001	0.077	0.115	1.000	1.000
M ₁	(Intercept)	-26.613	17.350		-1.534	0.127	-60.830	7.604		
	Adverts	0.085	0.007	0.511	12.261	< .001	0.071	0.099	0.986	1.015
	Image	11.086	2.438	0.192	4.548	< .001	6.279	15.894	0.963	1.038
	Airplay	3.367	0.278	0.512	12.123	< .001	2.820	3.915	0.959	1.043

Interpreting Model Parameters



b-values:

- The change in the outcome associated with a unit change in the predictor.
- E.g., **Advertising budget**: $b = 0.085$
 - As advertising budget increases by one unit, album sales increase by 0.085 units. Both variables were measured in thousands; therefore, for every £1000 more spent on advertising, an extra 0.085 thousand albums (85 albums) are sold. This interpretation is true only if the effects of band image and airplay are held constant.

Regression Exercises



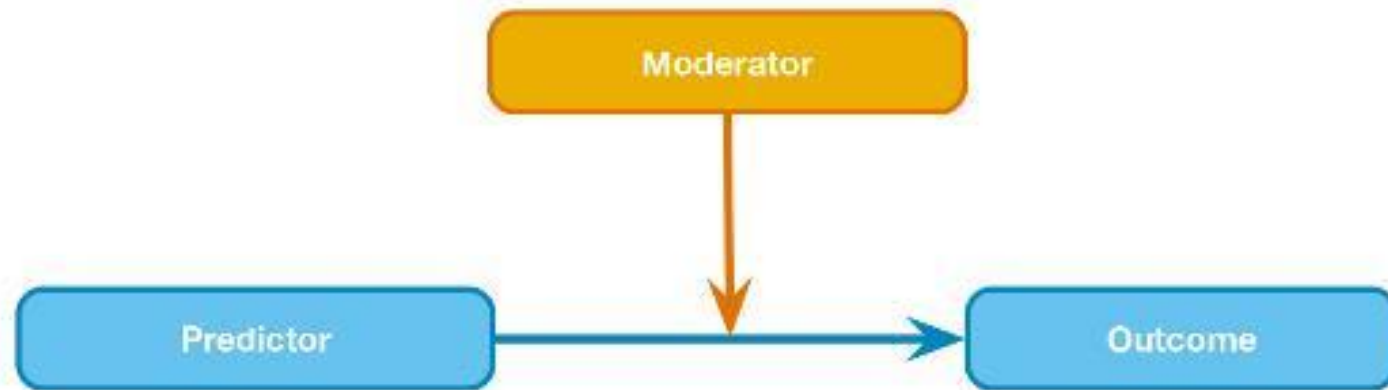
[Alex Examples](#)

[Leni Examples](#)

Moderation



Figure 10.2 Diagram of the *conceptual* moderation model



Example



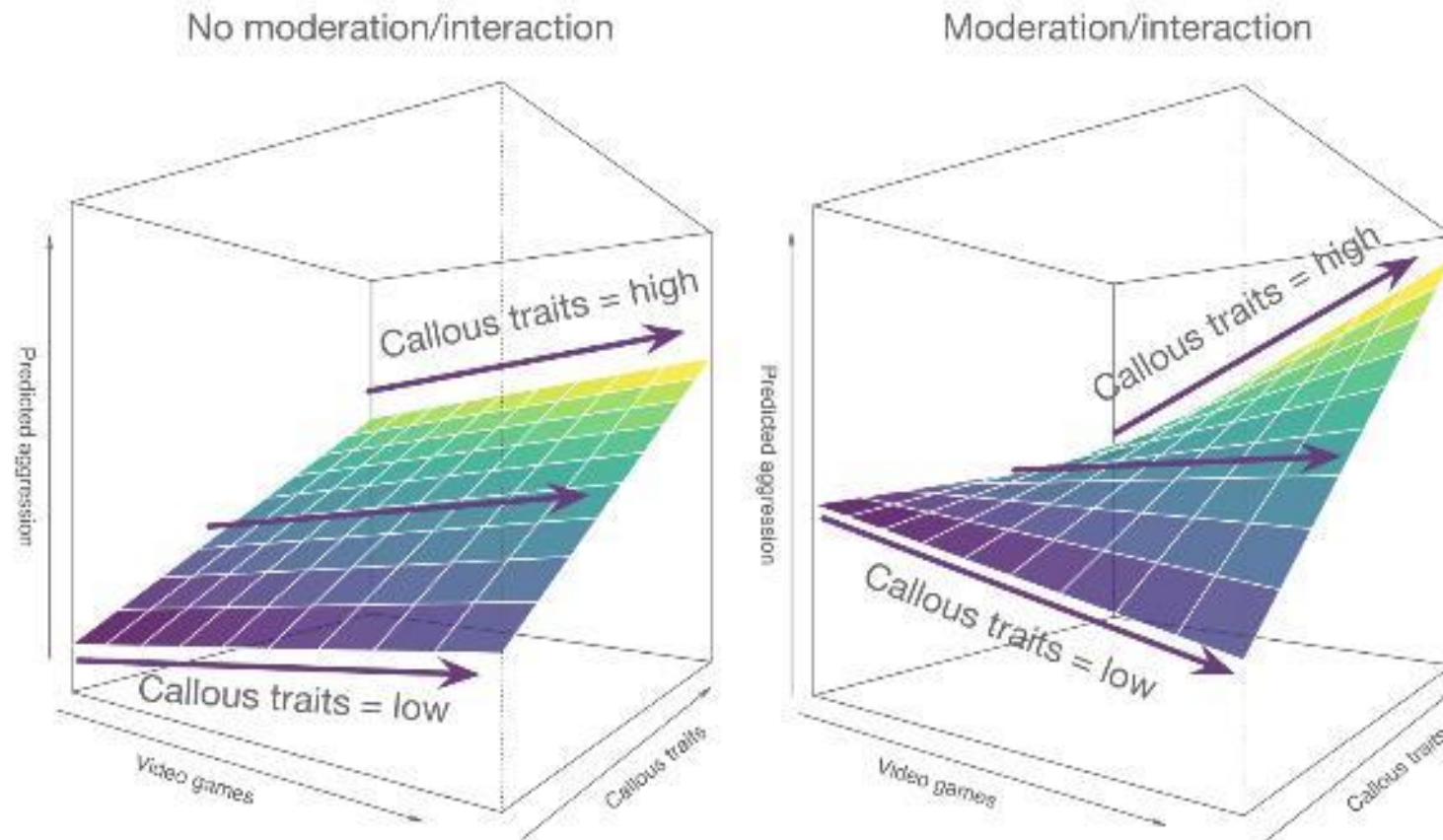
- Do violent video games make people antisocial?
- Participants
 - 442 youths
- Variables
 - Aggression
 - Callous unemotional traits (CaUnTs)
 - Number of hours spent playing video games per week
- Is 'CaUnTs' a moderator?
- Warning
 - That's a Lot to Process! Pitfalls of Popular Path Models



Moderation



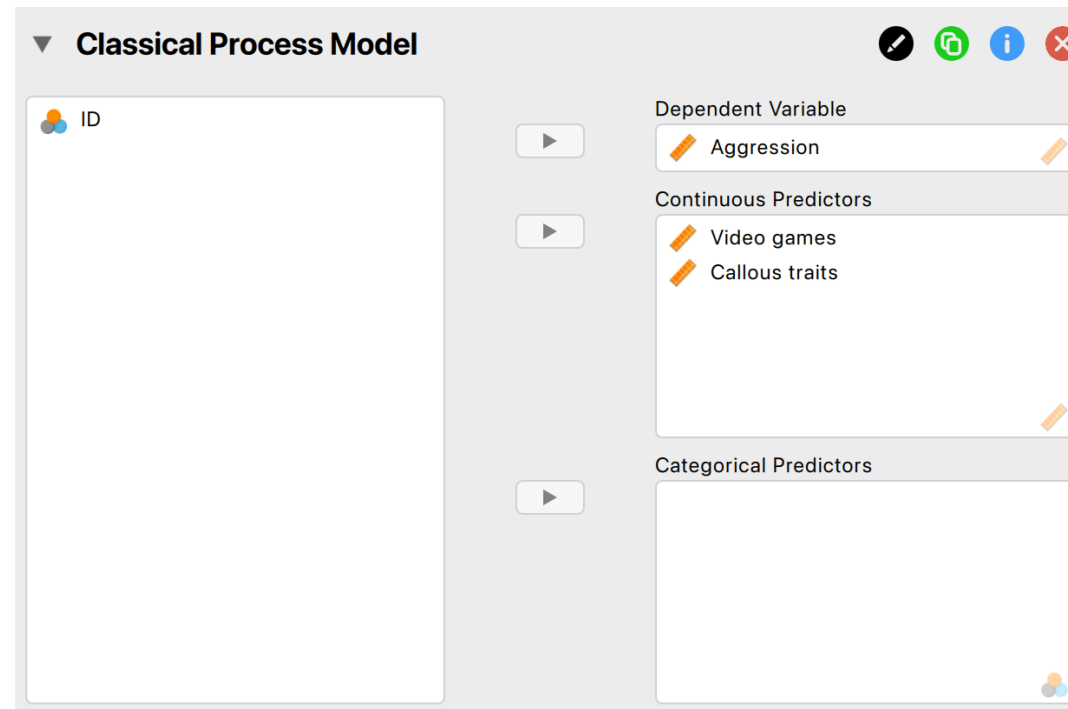
Figure 10.4 Callousness as a moderator



Moderation Analysis in JASP



Figure 10.6 The main menu for running moderation analysis in the Process module



Moderation Analysis in JASP

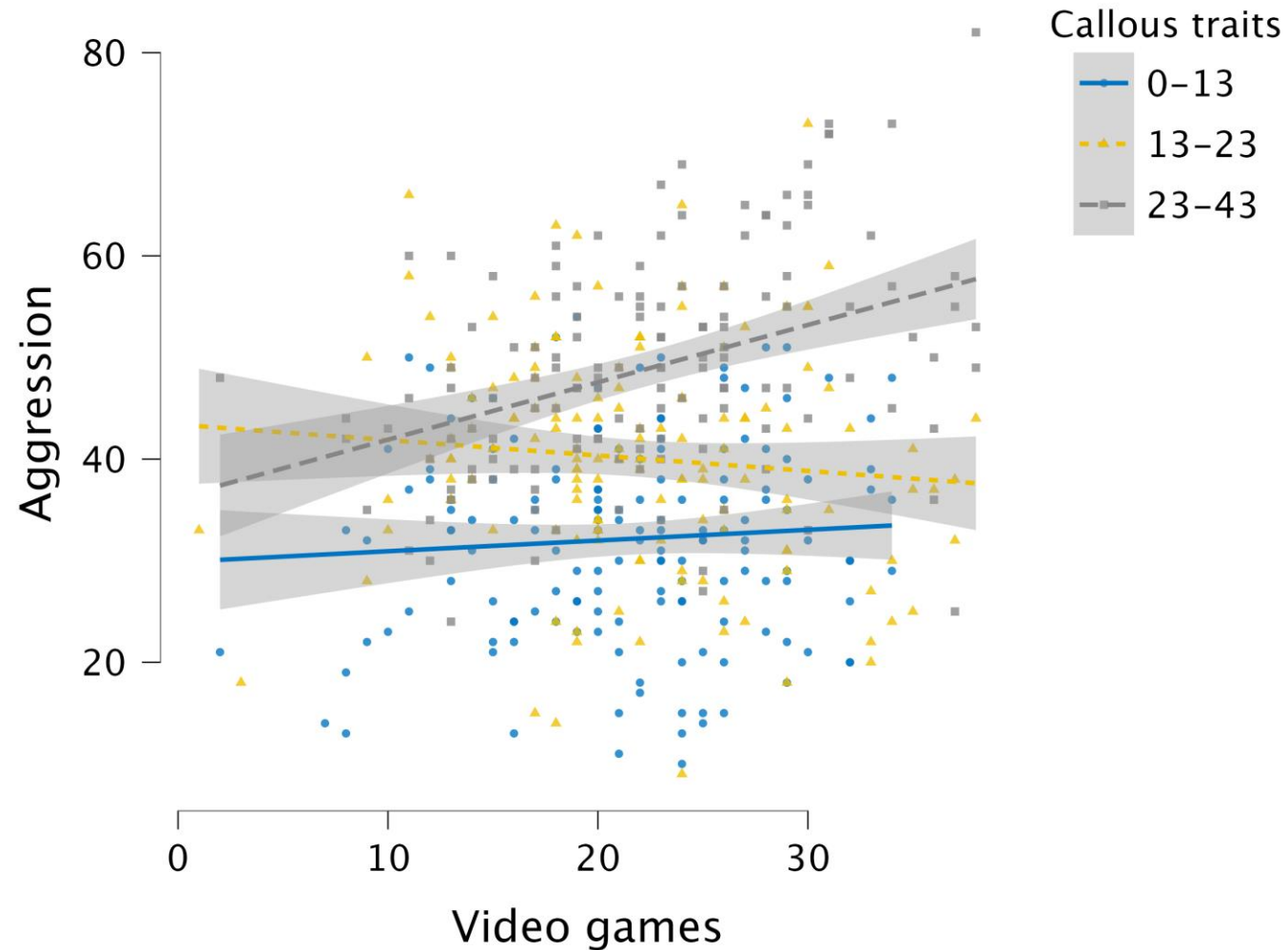


Figure 10.7 Menu for the model builder for a moderation analysis

The screenshot shows the JASP model builder interface. At the top, there is a dropdown menu labeled 'Models'. Below it, a tab labeled 'Model 1' is active, with a green plus icon to its right. Under the 'Input type' section, the 'Paths' radio button is selected, and the 'Hayes configuration' radio button is unselected. Below this, there is a table with four columns: 'From', 'To', 'Process Type', and 'Process Variable'. The 'From' column contains a dropdown menu with 'Video games' selected. The 'To' column contains a dropdown menu with 'Aggression' selected. The 'Process Type' column contains a dropdown menu with 'Moderator' selected. The 'Process Variable' column contains a dropdown menu with 'Callous traits' selected. Below the 'Process Type' dropdown, there is a green plus icon.

From	To	Process Type	Process Variable
Video games ▼	Aggression ▼	Moderator ▼	Callous traits ▼

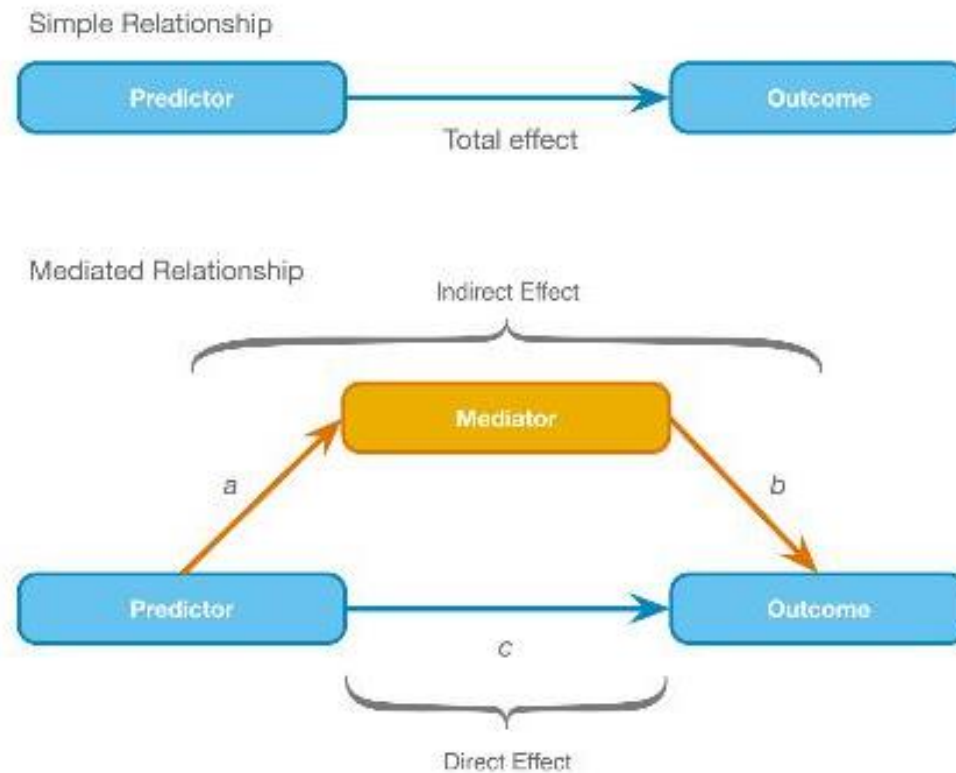
Figure 10.9 Plotting the interaction effect using Flexplot, where Callous traits is binned



Mediation



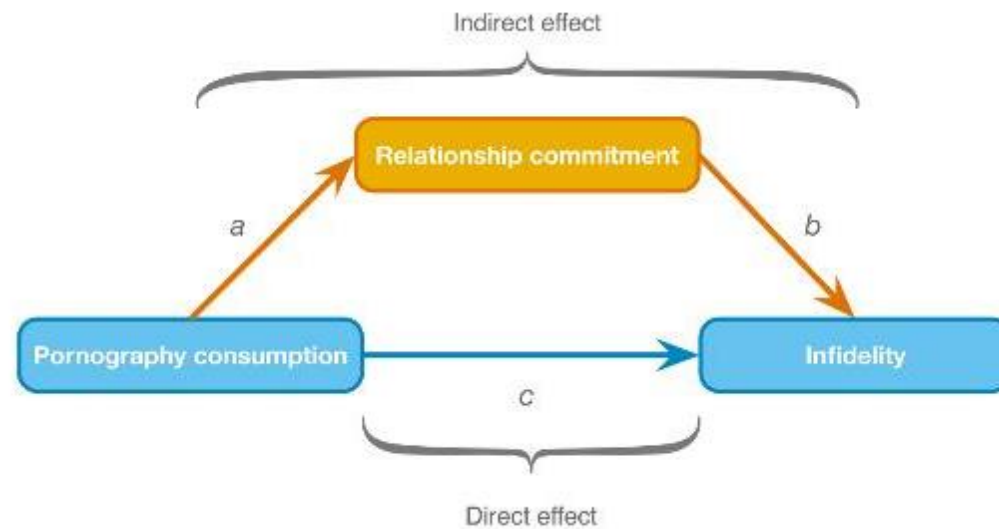
Figure 11.9 Diagram of a mediation model



Mediation Example



Figure 10.12 Diagram of a mediation model from Lambert et al. (2012)



Mediation Analysis in JASP

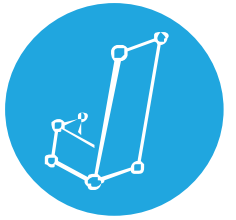


Figure 10.14 The menu for specifying a mediation path

The screenshot shows the JASP interface for specifying a mediation path. At the top, a dropdown menu shows 'Models' with 'Model 1' selected. Below this, the 'Input type' is set to 'Paths' (radio button selected). The 'From' variable is 'ConsumptionLn', the 'To' variable is 'Infidelity', the 'Process Type' is 'Mediator', and the 'Process Variable' is 'Commitment'. A green plus icon is visible below the 'To' variable. The 'Residual Covariances' section has 'Independent variables' checked. The 'Parameter Estimates' section has 'Paths', 'Indirect', and 'Total' checked. The 'Tests' section has 'Local tests' unchecked, 'Test type' set to 'Linear', 'Bootstrap' checked, and 'Replications' set to '1000'. The 'Path Plots' section has 'Conceptual' and 'Statistical' checked.

Models

Model 1 +

Input type ☒ Paths ☐ Hayes configuration

From To Process Type Process Variable

ConsumptionLn Infidelity Mediator Commitment

+

Residual Covariances Parameter Estimates Tests

☒ Independent variables ☒ Paths ☐ Local tests

☐ Mediators ☐ Intercepts Test type

☐ Dependent variables ☒ Indirect Linear

☒ Total ☒ Bootstrap

☐ Residual covariances Replications

1000

Path Plots

☒ Conceptual

☒ Statistical

Mediation Model with Two Mediators



Figure 10.16 A mediation model with two mediators
(Bronstein, 2019)

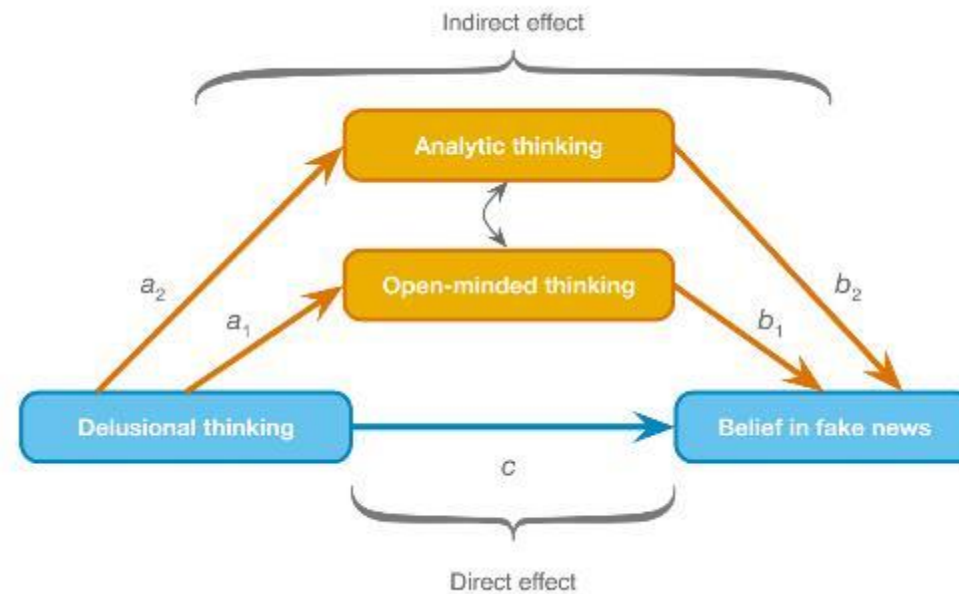


Figure 10.17 The dialogue boxes for running mediation analysis with two mediators



▼ Models

Model 1 +

Input type ☒ Paths ☐ Hayes configuration

From	To	Process Type	Process Variable
Delusion thinking ▼	Fake news belief ▼	Mediator ▼	Open thinking ▼
Delusion thinking ▼	Fake news belief ▼	Mediator ▼	Analytic thinking ▼
Open thinking ▼	Analytic thinking ▼	Direct ▼	<no choice> ▼ x

+

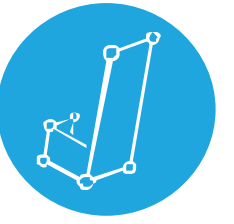
Moderation & Mediation



[Alex Examples](#)

[Leni Examples](#)

Comparing Means

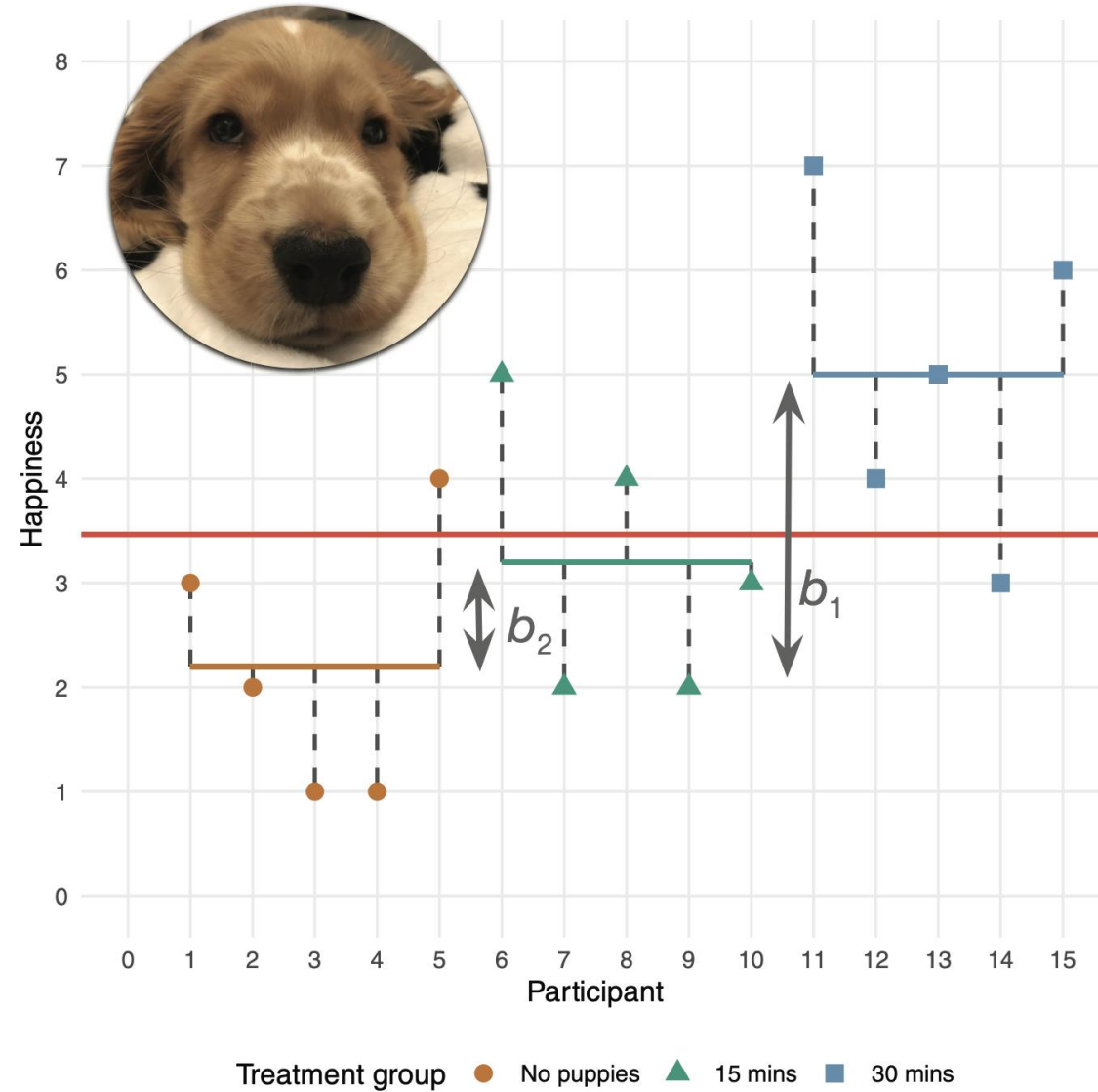


ANOVA: Puppy Example

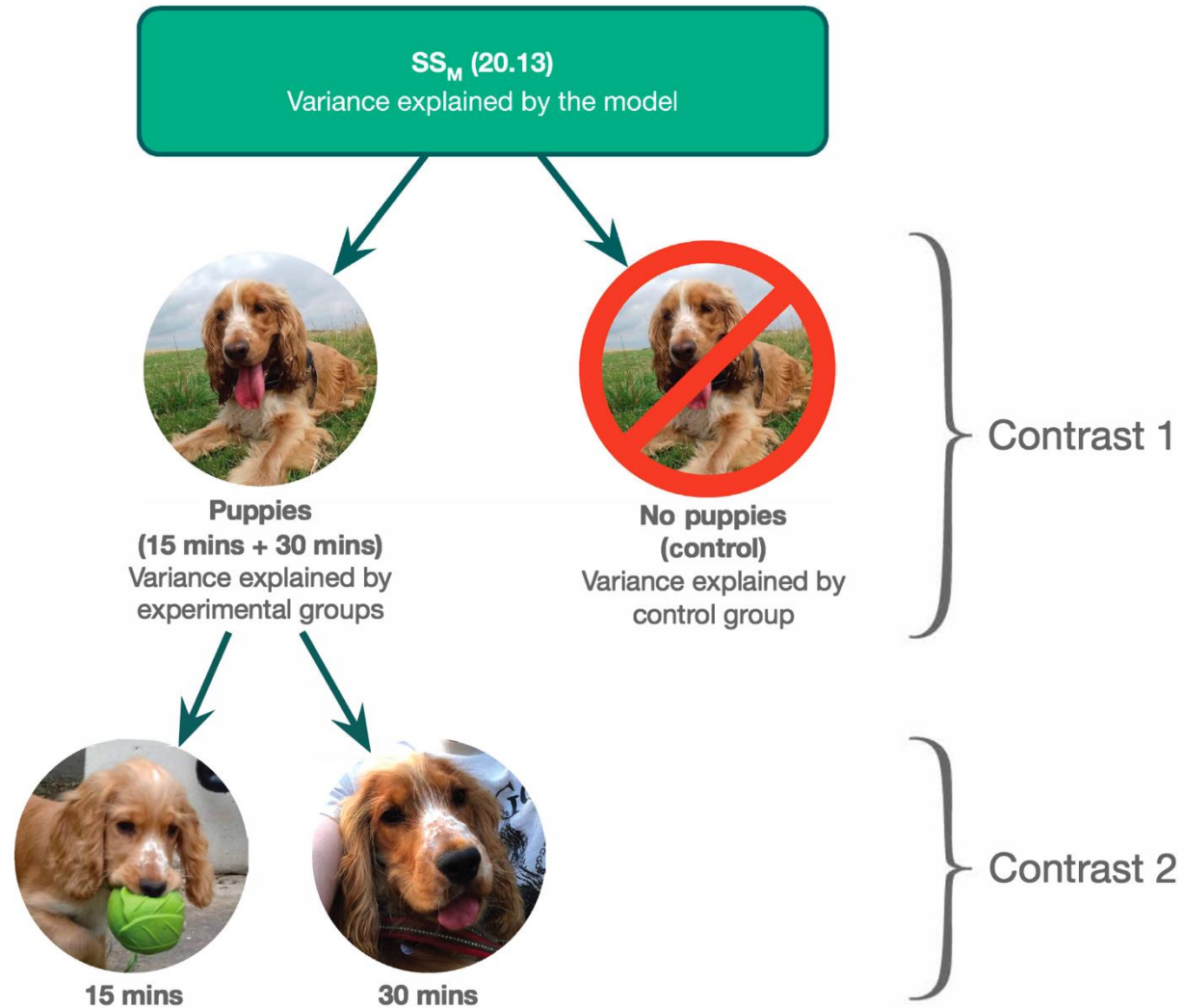


- A puppy therapy RCT in which we randomized people into three groups:
 1. A control group
 2. 15 minutes of puppy therapy
 3. 30 minutes of puppy contact
- The DV is happiness (0 = unhappy) to 10 (happy)
- Predictions:
 1. Any form of puppy therapy should be better than the control (i.e. higher happiness scores).
 2. A dose-response hypothesis that as exposure time increases (from 15 to 30 minutes), happiness will increase too

ANOVA



Contrasts




Contrasts in JASP



▼ Contrasts

Factors

 Dose

custom ▼

Custom for Dose

Add Contrast

Delete Contrast

Reset

	Dose	Contrast 1	Contrast 2
1	No puppies	-2	0
2	15 mins	1	-1
3	30 mins	1	1

☒ Confidence intervals

95.0 %

☒ Effect size

Post Hoc Tests



- Compare each mean against all others.
- In general terms, they use a stricter criterion to accept an effect as significant.
 - Hence, control the family-wise error rate.
 - Simplest example is the Bonferroni method:

$$P_{crit} = \frac{\alpha}{K}$$

Post Hoc Tests



- Assumptions met:
 - Tukey HSD
- Safe Option:
 - Bonferroni
- Unequal variances:
 - Games-Howell

ANCOVA



- Reduces error variance
 - By explaining some of the unexplained variance (SSR) the error variance in the model can be reduced
- Greater insight
 - By including more variables, we gain deeper insight into their interplay (e.g., interactions, shared variance)
- Warning
 - Hidden multiplicity in exploratory multiway ANOVA: Prevalence and remedies



ANCOVA

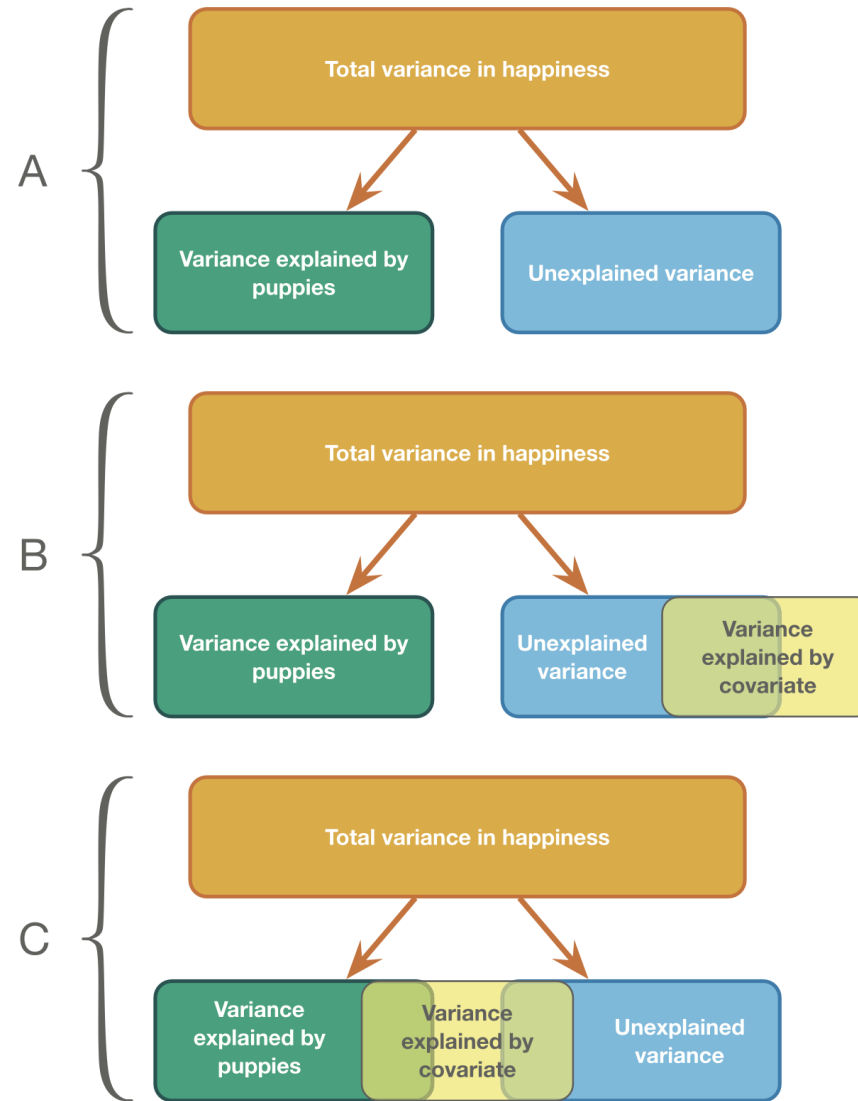
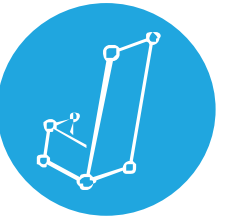
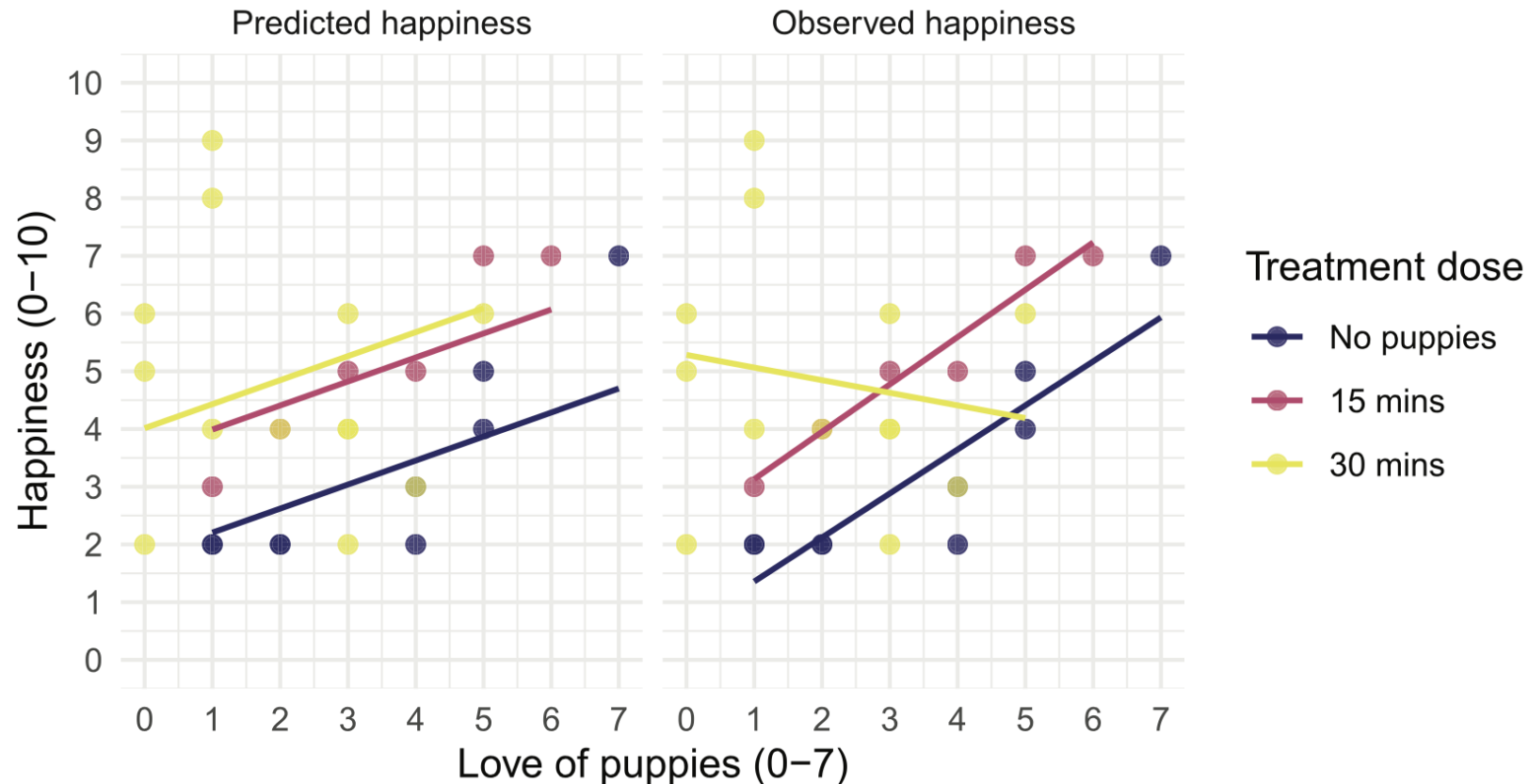


Figure 12.2 The role of the covariate in ANCOVA

Homogeneity of Slopes



Figure 12.3 Scatterplot and linear models of happiness against love of puppies for each therapy condition



Assessing Homogeneity of Slopes



Figure 12.8 *Model* tab for ANCOVA

▼ Model

Components

Dose
Puppy love

↓
A
Z

▶

Model Terms

Dose
Puppy love
Dose * Puppy love

Sum of squares Type III ▼

ANCOVA



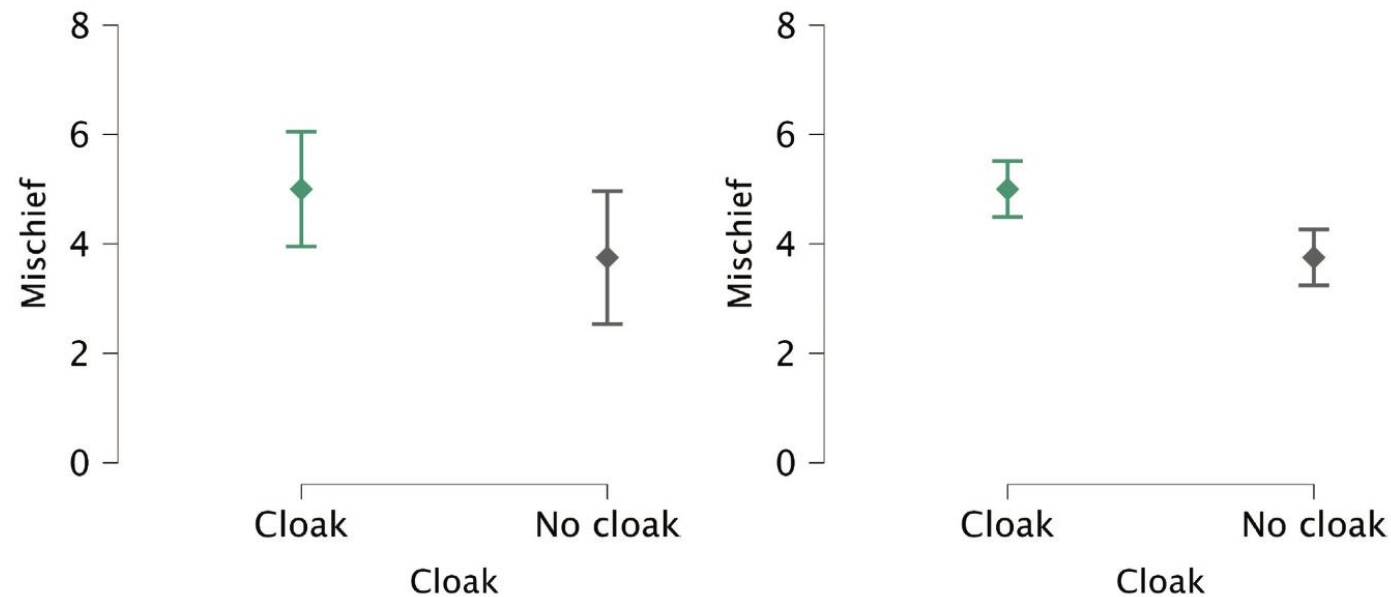
[Alex Examples](#)
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RM ANOVA



- Advantages
 - Unsystematic variance is reduced
 - More sensitive to experimental effects

Figure 9.7 Same data, between-subjects (left) and within-subjects (right)



RM ANOVA Example



- Training sniffer dogs to detect aliens
- After rigorous training, eight dogs sniffed each of four entities for 1 minute:
 - Alien space lizard in its natural form
 - Alien space lizard who had shapeshifted into humanoid form
 - Human
 - Human mannequin
- DV: Number of vocalizations made during each 1-minute sniffing session

Data for Sniffer Dog Example



Table 14.1 Data for the sniffer-dog example

Dog	Alien	Human	Mannequin	Shapeshifter	Mean	s^2
Milton	8	7	1	6	5.50	9.67
Woofy	9	5	2	5	5.25	8.25
Ramsey	6	2	3	8	4.75	7.58
Mr. Snifficus III	5	3	1	9	4.50	11.67
Willock	8	4	5	8	6.25	4.25
The Venerable Dr. Waggy	7	5	6	7	6.25	0.92
Lord Scenticle	10	2	7	2	5.25	15.58
Professor Nose	12	6	8	1	6.75	20.92
Mean	8.13	4.25	4.13	5.75		

The Assumption of Sphericity



- Assumes that the variances of *differences* between conditions are equal
- Estimated and adjusted *df* using:
 - Greenhouse-Geisser estimate
 - Huynh-Feldt estimate
- Tested using Mauchly's test (not recommended)
 - $P < .05$, sphericity is violated
 - $P > .05$, sphericity is met
- Rule of thumb: G-G is conservative and H-F liberal

Defining the Repeated Factors

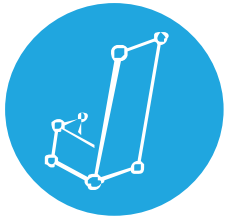


Figure 14.6 The *Repeated Measures Factors menu* for repeated-measures ANOVA

The figure displays two screenshots of the 'Repeated Measures Factors' dialog box, illustrating the setup for a repeated-measures ANOVA.

Left Screenshot (Generic Setup):

- Repeated Measures Factors:** The factor is 'RM Factor 1'. It has two levels: 'Level 1' and 'Level 2'. There is a 'New Level' button and a 'New Factor' button.
- Repeated Measures Cells:** The cells are defined by the levels 'Level 1' and 'Level 2'.

Right Screenshot (Specific Setup):

- Repeated Measures Factors:** The factor is 'Entity'. It has four levels: 'Mannequin', 'Human', 'Shapeshifter', and 'Alien'. There is a 'New Level' button and a 'New Factor' button. The 'Shapeshifter' and 'Alien' levels have an 'x' icon next to them, indicating they are selected or active.
- Repeated Measures Cells:** The cells are defined by the levels 'Mannequin', 'Human', 'Shapeshifter', and 'Alien'.

Factorial: Post hoc comparisons



Output 14.15

*Post Hoc Comparisons – Entity * Scent – Conditional on Entity*

Entity			Mean Difference	95% CI for Mean Difference		SE	t	Cohen's d	95% CI for Cohen's d		Pholm
				Lower	Upper				Lower	Upper	
Human	None	Human	-1.180	-1.669	-0.691	0.197	-5.980	-0.504	-0.837	-0.170	< .001
		Fox	-4.340	-4.939	-3.741	0.242	-17.950	-1.852	-2.577	-1.128	< .001
	Human	Fox	-3.160	-3.877	-2.443	0.289	-10.932	-1.349	-1.972	-0.726	< .001
Shapeshifter	None	Human	1.640	0.690	2.590	0.383	4.281	0.700	0.096	1.304	< .001
		Fox	1.580	0.611	2.549	0.391	4.043	0.674	0.064	1.285	< .001
	Human	Fox	-0.060	-0.937	0.817	0.354	-0.170	-0.026	-0.538	0.486	0.866
Alien	None	Human	2.080	1.143	3.017	0.378	5.506	0.888	0.262	1.513	< .001
		Fox	2.880	1.835	3.925	0.422	6.833	1.229	0.488	1.970	< .001
	Human	Fox	0.800	-0.099	1.699	0.363	2.207	0.341	-0.196	0.879	0.032

RM ANOVA



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