

Discovering Statistics Using JASP



JASP

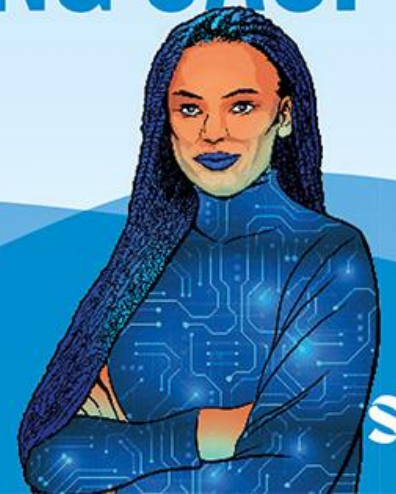
2025 Workshop



UNIVERSITEIT VAN AMSTERDAM

ANDY FIELD, JOHNNY VAN DOORN
& ERIC-JAN WAGENMAKERS

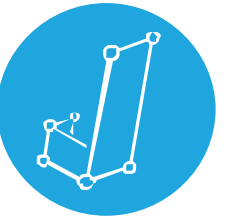
**DISCOVERING
STATISTICS
USING JASP**



 **JASP**

S

Outline



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

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



Data Management



The JASP data editor for the Metallica data

The Variable View

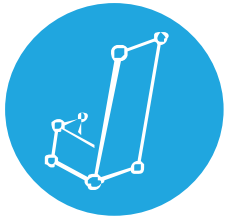








Figure 4.6 The variable settings for 'Name'

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

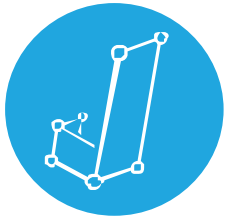



Figure 4.7 Specifying the values for an ordinal variable

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

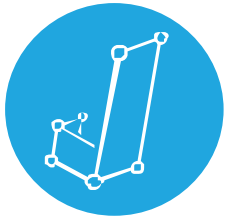


Figure 4.8 The drag and drop interface for computing a new variable

The interface is a window titled 'Computing a New Variable'. It contains the following elements:

- Name:** A text field containing 'Net worth per song'.
- Long name:** A text field containing 'Net worth per song (\$ million)'.
- Column type:** A dropdown menu set to 'Scale'.
- Description:** A text area containing 'Computed column, where net worth is divided by the number of song writing credits.'
- Computed type:** A dropdown menu set to 'Computed with drag-and-drop'.
- Computed column definition:** A section with three tabs: 'Computed column definition' (selected), 'Label editor', and 'Missing values'.
 - On the left, a list of variables: 'Name', 'Instrument', 'Current member', and 'Headbangi... ntensity'.
 - In the center, a drag-and-drop area showing 'Net worth... million)' and 'Songs' being added to a formula bar.
 - At the top of the formula bar, a set of operators: '+ - * ÷ / ^ √ % = ≠ < ≤ > ≥ ^ √ | ~'.
 - At the bottom of the formula bar, the text 'Computed columns code applied'.
 - On the right, a trash can icon.
- Bottom bar:** Contains a 'Converting types' button, a 'Compute column' button, and an information icon.



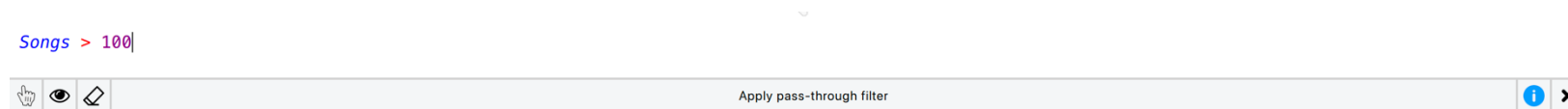
Filtering Data



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



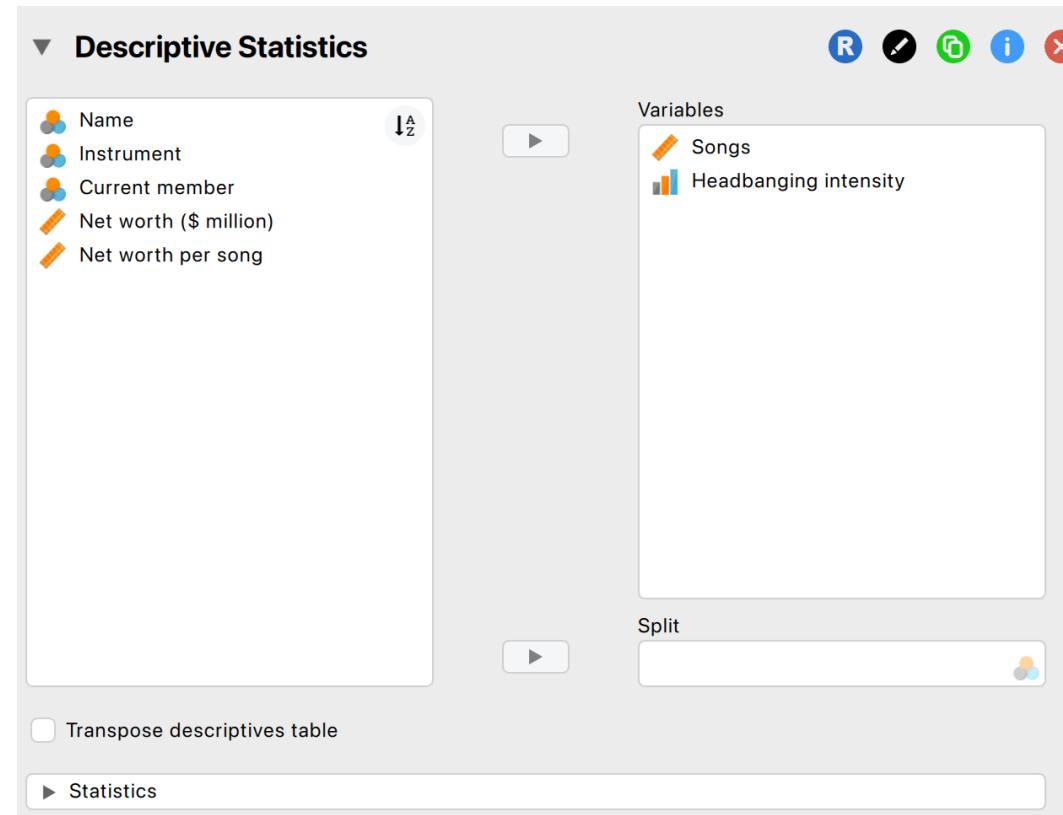
- R-mode



Descriptives



Figure 4.10 Input window for the Descriptives module



Output Window in JASP



Figure 4.11 Example of annotated output

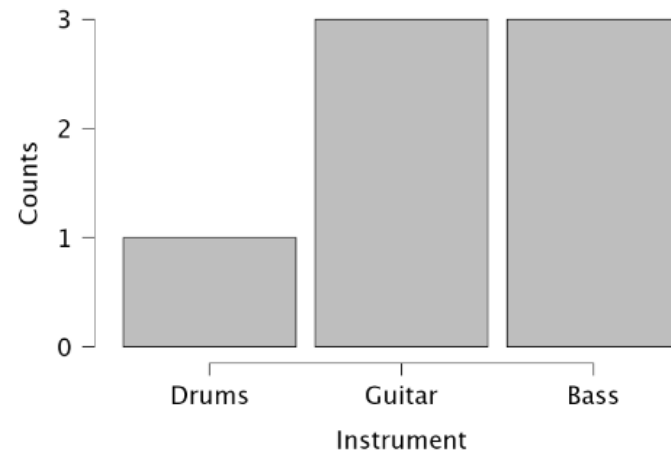
Distribution Plots

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

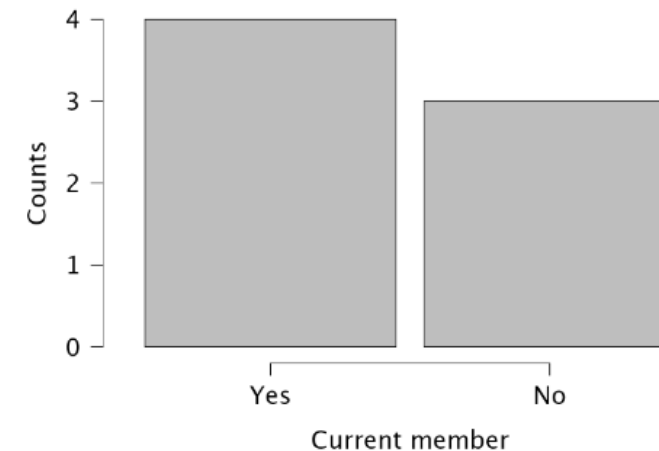
We can have fancy $LaTeX$ formula's in here, [link cute cat video's](#), or insert a drumkit

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

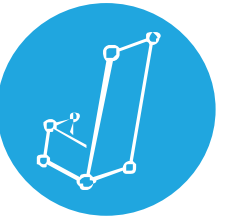


Basic Flow of Data Analysis in JASP



- 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 with One Predictor



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

Data

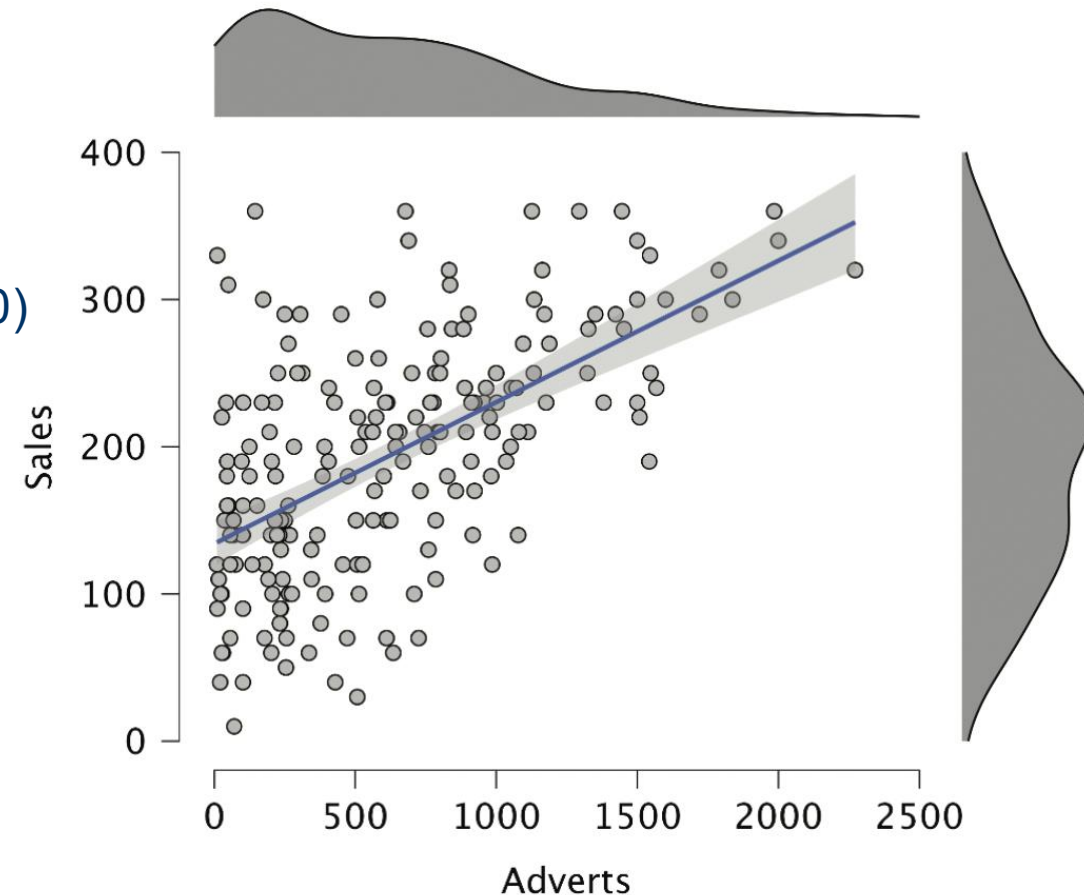
- 200 different album releases

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)

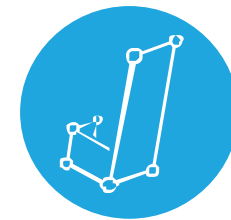
► Model

► 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

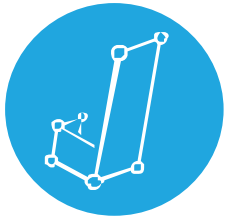
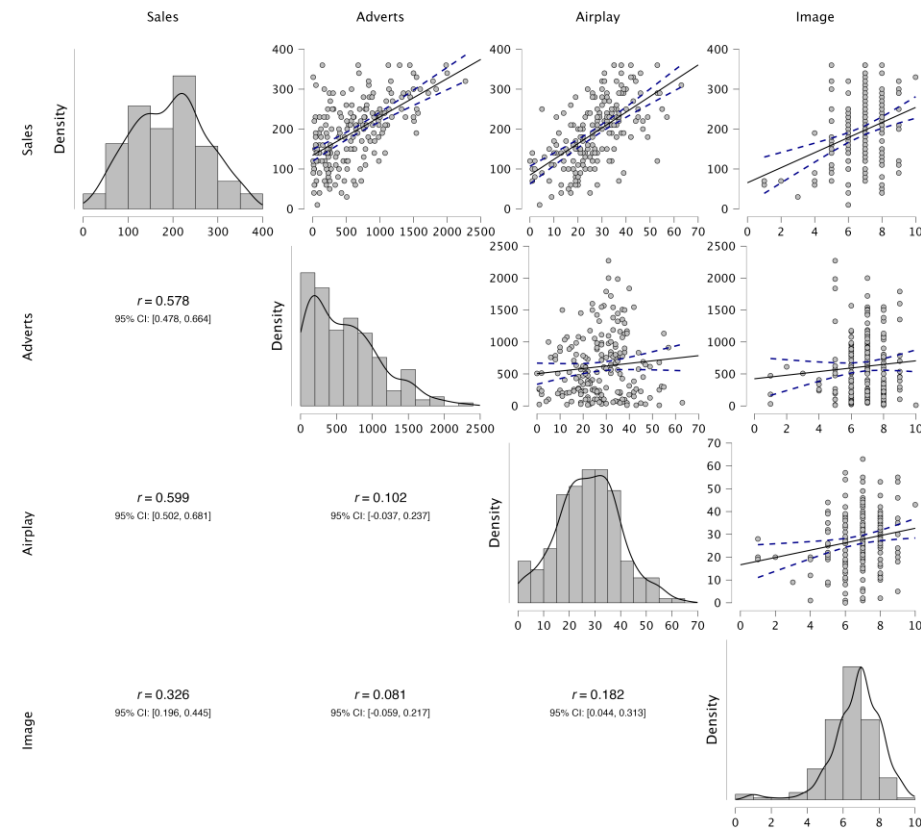


Figure 8.11 Matrix scatterplot of the relationships between advertising budget, airplay, image rating and album sales



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

+

×

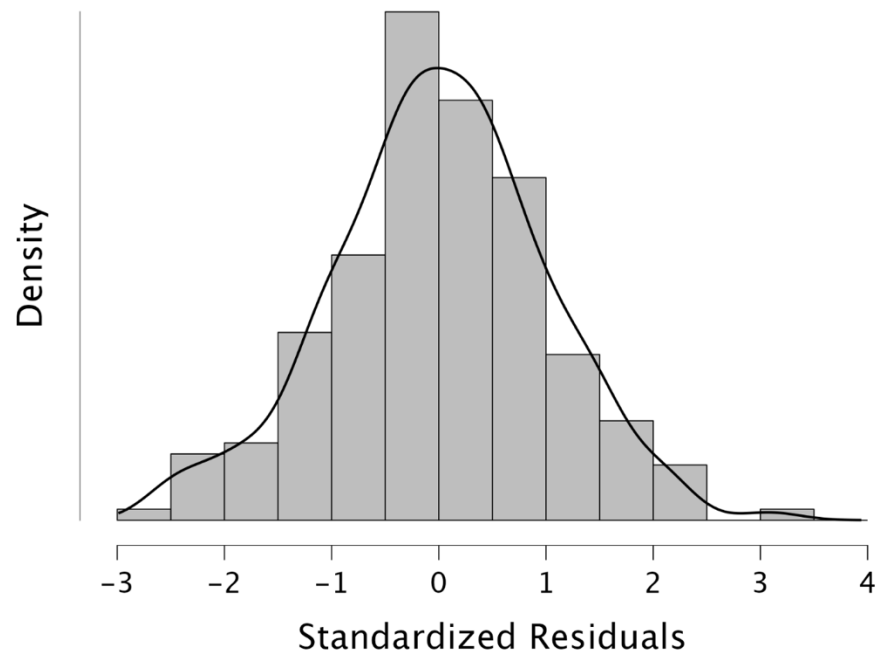
☒ Include intercept

Normality of Residuals: Histograms and Q-Q Plots

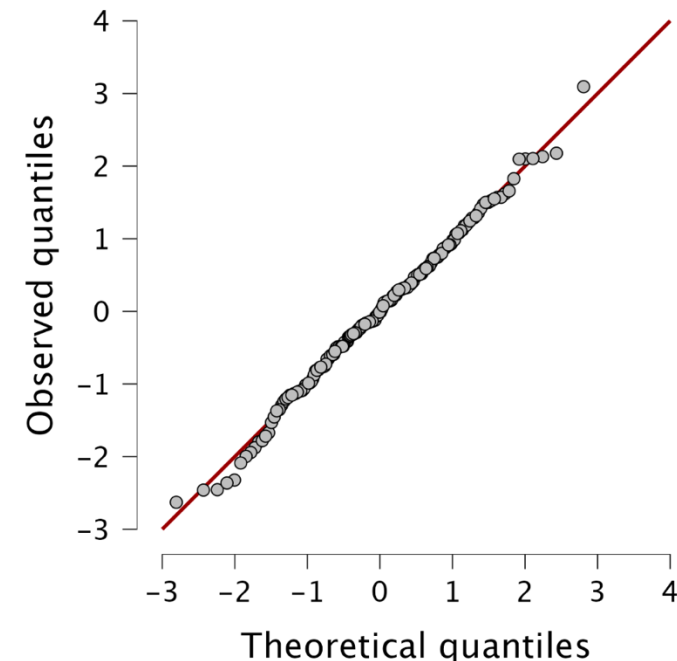


Figure 8.17 Histogram and Q-Q plot for the residuals from our model

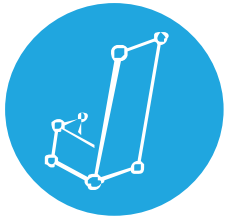
Standardized Residuals Histogram



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.

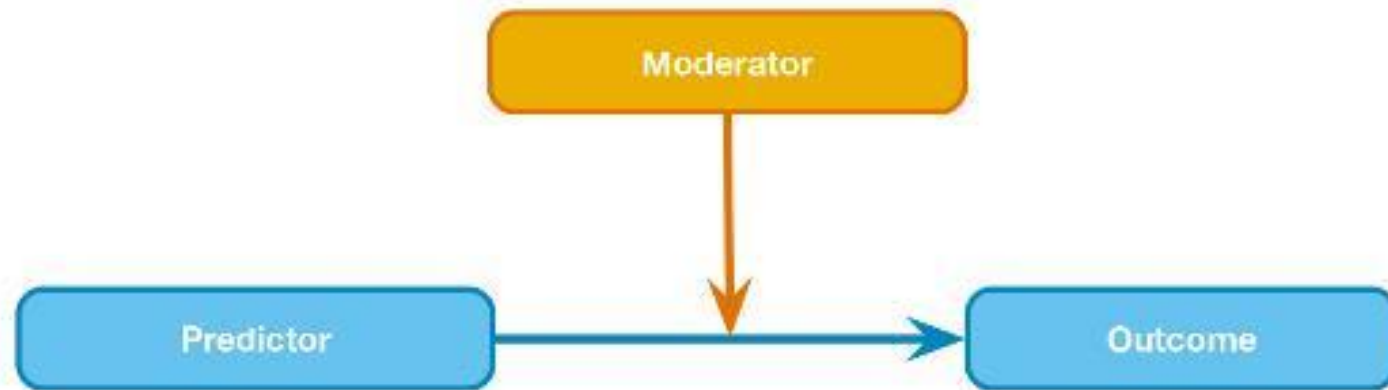
Regression



Moderation



Figure 10.2 Diagram of the *conceptual* moderation model



Example



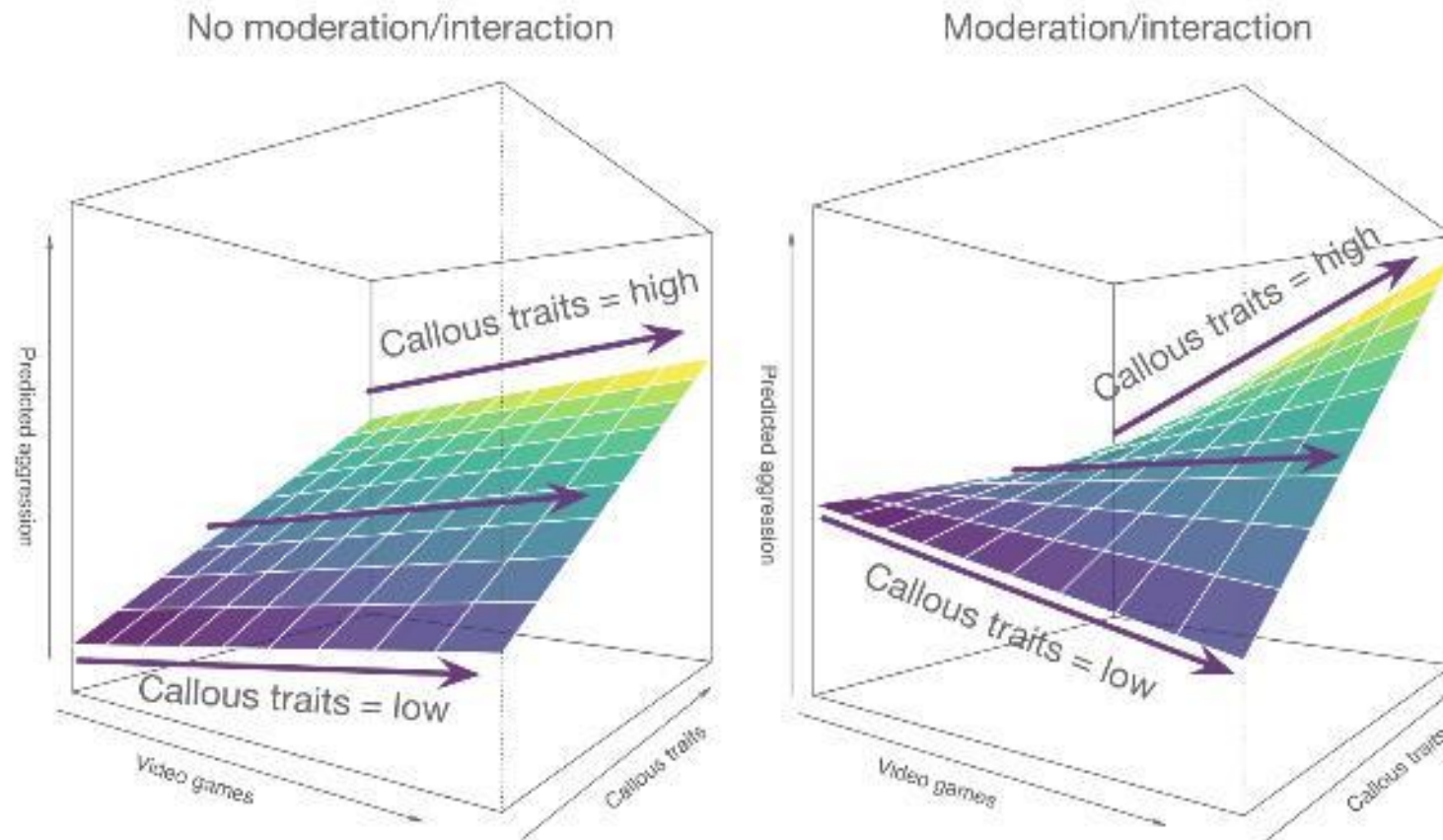
- Do violent video games make people antisocial?
- Participants
 - 442 youths
- Variables
 - Aggression
 - Callous unemotional traits (CaUnTs)
 - Number of hours spent playing video games per week
- Is 'CaUnTs' a moderator?
- Warning
 - That's a Lot to Process! Pitfalls of Popular Path Models



Moderation



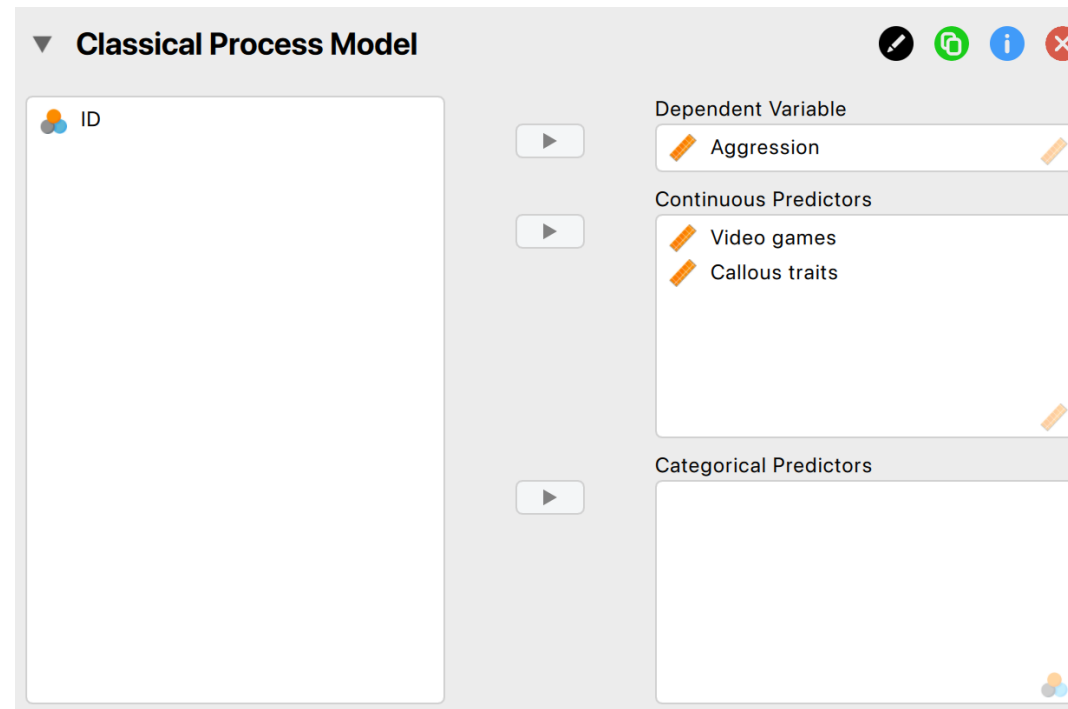
Figure 10.4 Callousness as a moderator



Moderation Analysis in JASP



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



Moderation Analysis in JASP

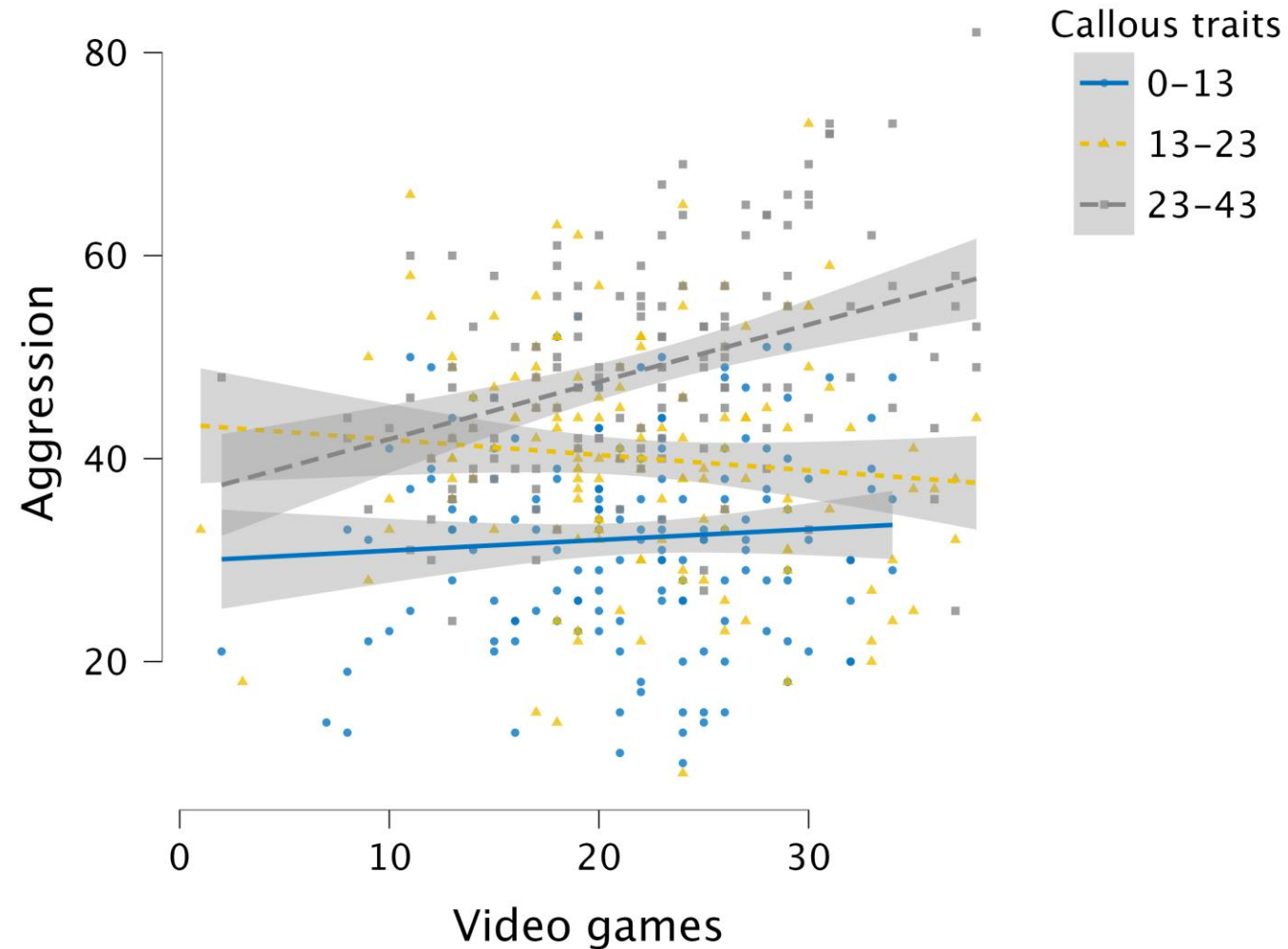
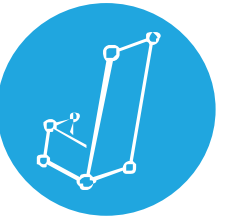


Figure 10.7 Menu for the model builder for a moderation analysis

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 |

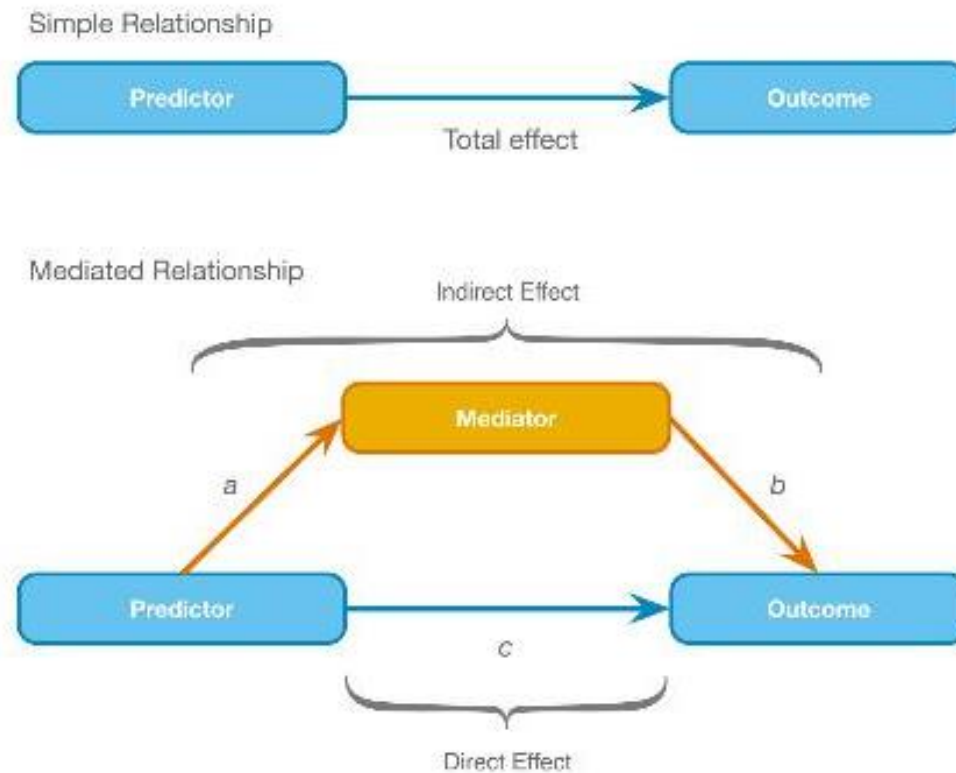
Figure 10.9 Plotting the interaction effect using Flexplot, where Callous traits is binned



Mediation



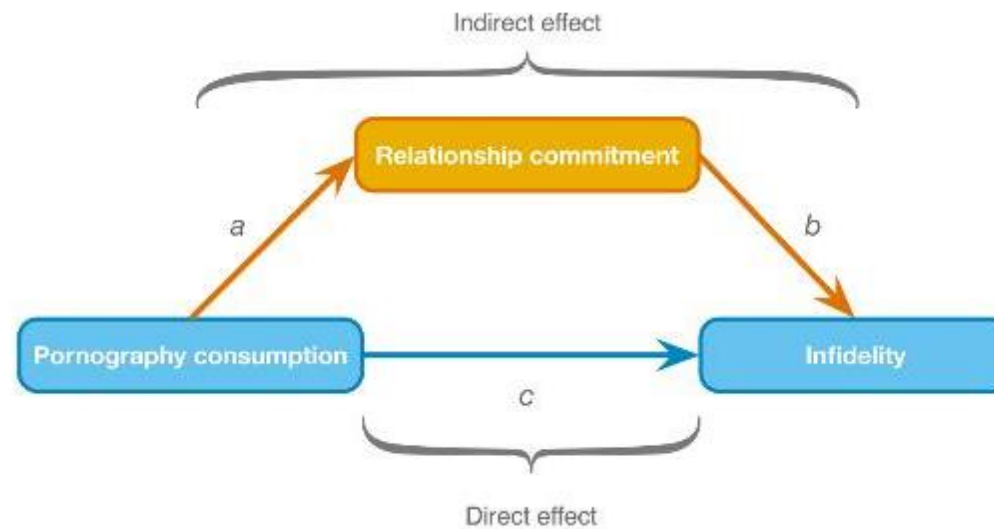
Figure 11.9 Diagram of a mediation model



Mediation Example



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



Mediation Analysis in JASP

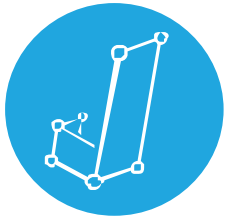


Figure 10.14 The menu for specifying a mediation path

The screenshot shows the JASP interface for specifying a mediation path. At the top, a dropdown menu shows 'Models' with a plus icon to add a new model. Below this, 'Model 1' is selected. The 'Input type' is set to 'Paths' (radio button selected). The path specification is shown in a table-like structure:

| From | To | Process Type | Process Variable |
|---------------|------------|--------------|------------------|
| ConsumptionLn | Infidelity | Mediator | Commitment |

Below the path specification, there are three main sections: 'Residual Covariances', 'Parameter Estimates', and 'Tests'. 'Residual Covariances' has checkboxes for 'Independent variables' (checked), 'Mediators', and 'Dependent variables'. 'Parameter Estimates' has checkboxes for 'Paths' (checked), 'Intercepts', 'Indirect' (checked), 'Total' (checked), and 'Residual covariances'. 'Tests' has a checkbox for 'Local tests' (unchecked), a 'Test type' dropdown set to 'Linear', a checkbox for 'Bootstrap' (checked), and a 'Replications' input field set to '1000'. At the bottom, 'Path Plots' has checkboxes for 'Conceptual' (checked) and 'Statistical' (checked).

Mediation Model with Two Mediators



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

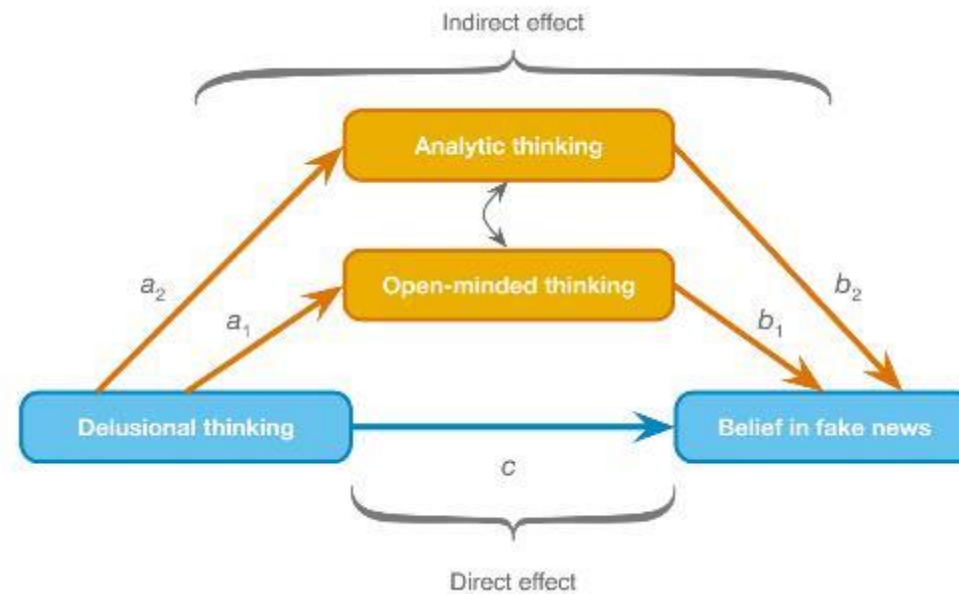
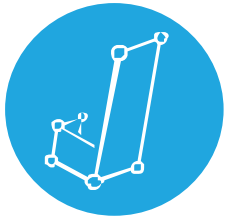


Figure 10.17 The dialogue boxes for running mediation analysis with two mediators



▼ 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

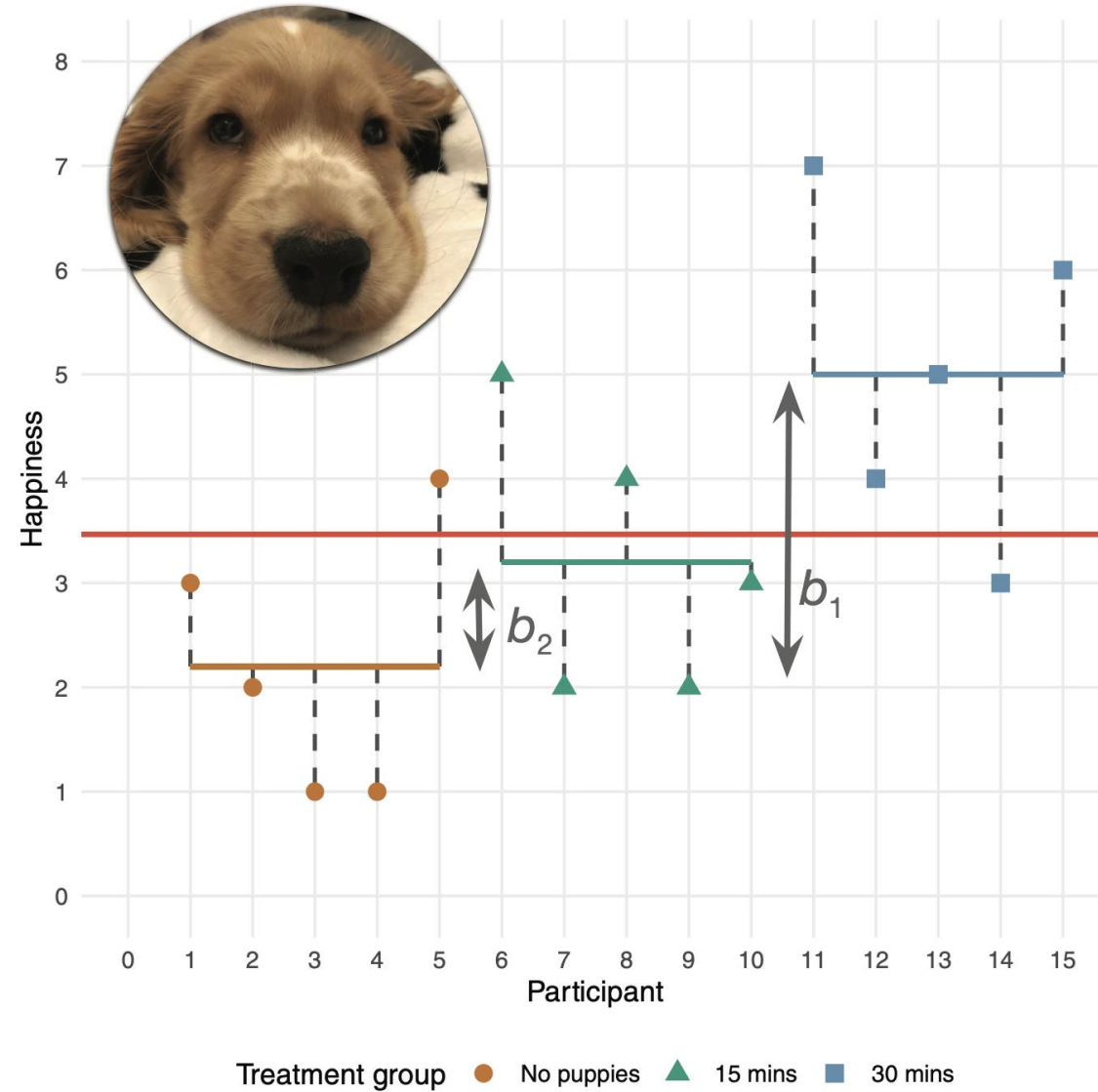
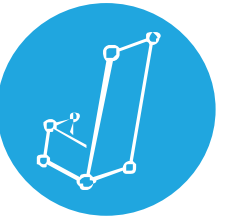


ANOVA: Puppy Example

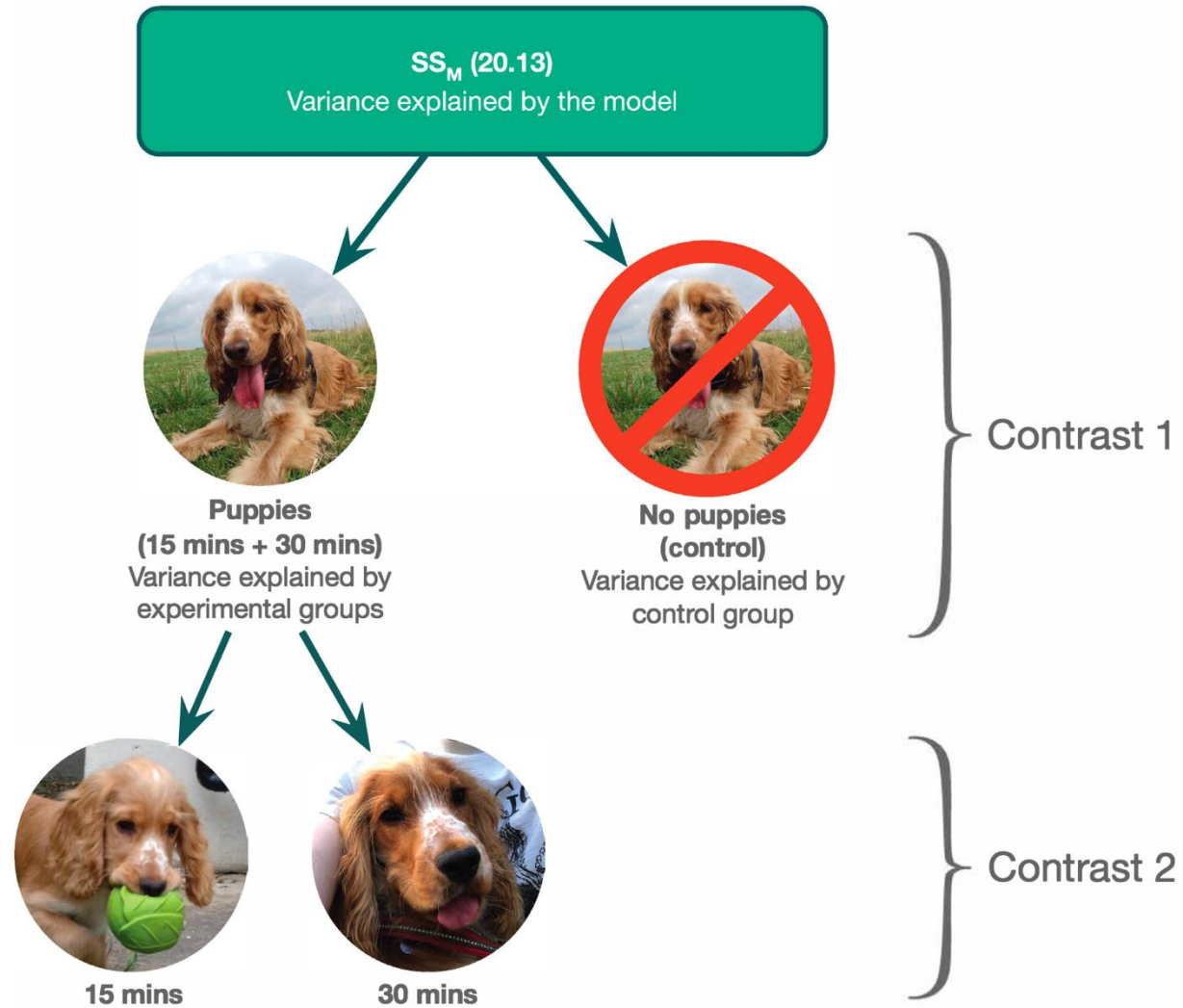


- A puppy therapy RCT in which we randomized people into three groups:
 1. A control group
 2. 15 minutes of puppy therapy
 3. 30 minutes of puppy contact
- The DV is happiness (0 = unhappy) to 10 (happy)
- Predictions:
 1. Any form of puppy therapy should be better than the control (i.e. higher happiness 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

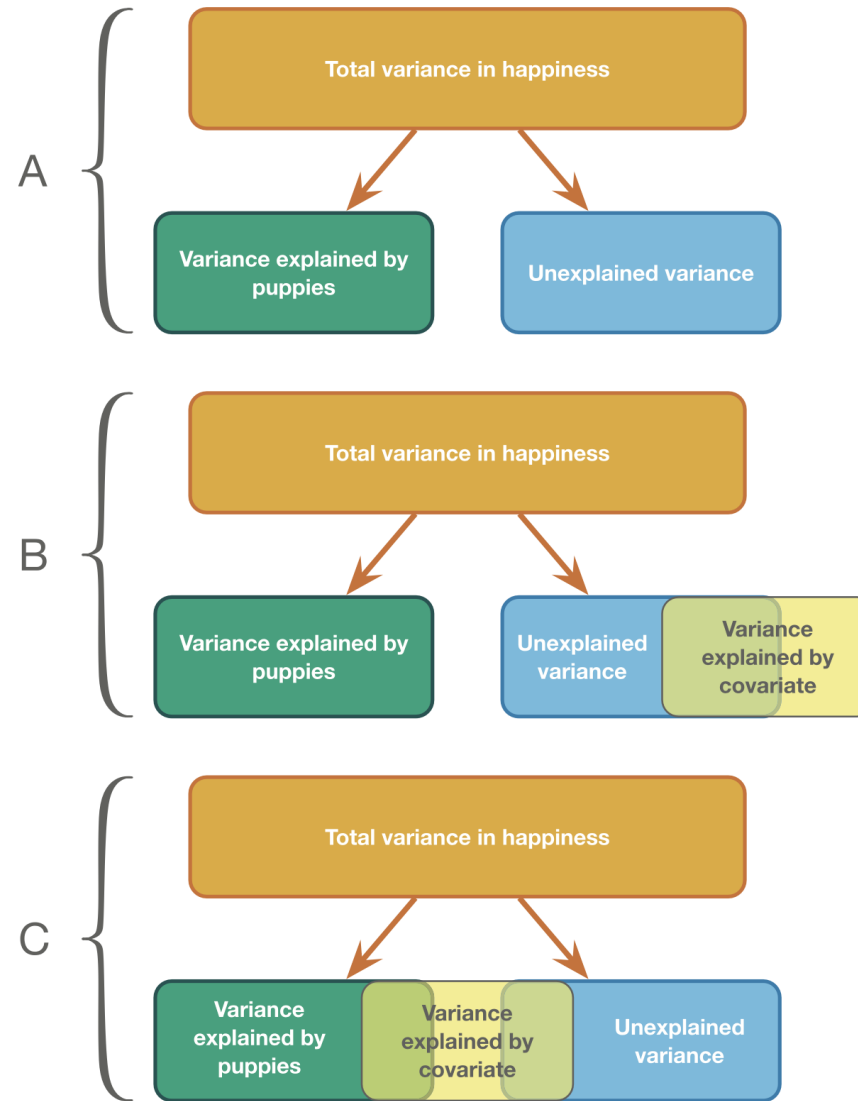
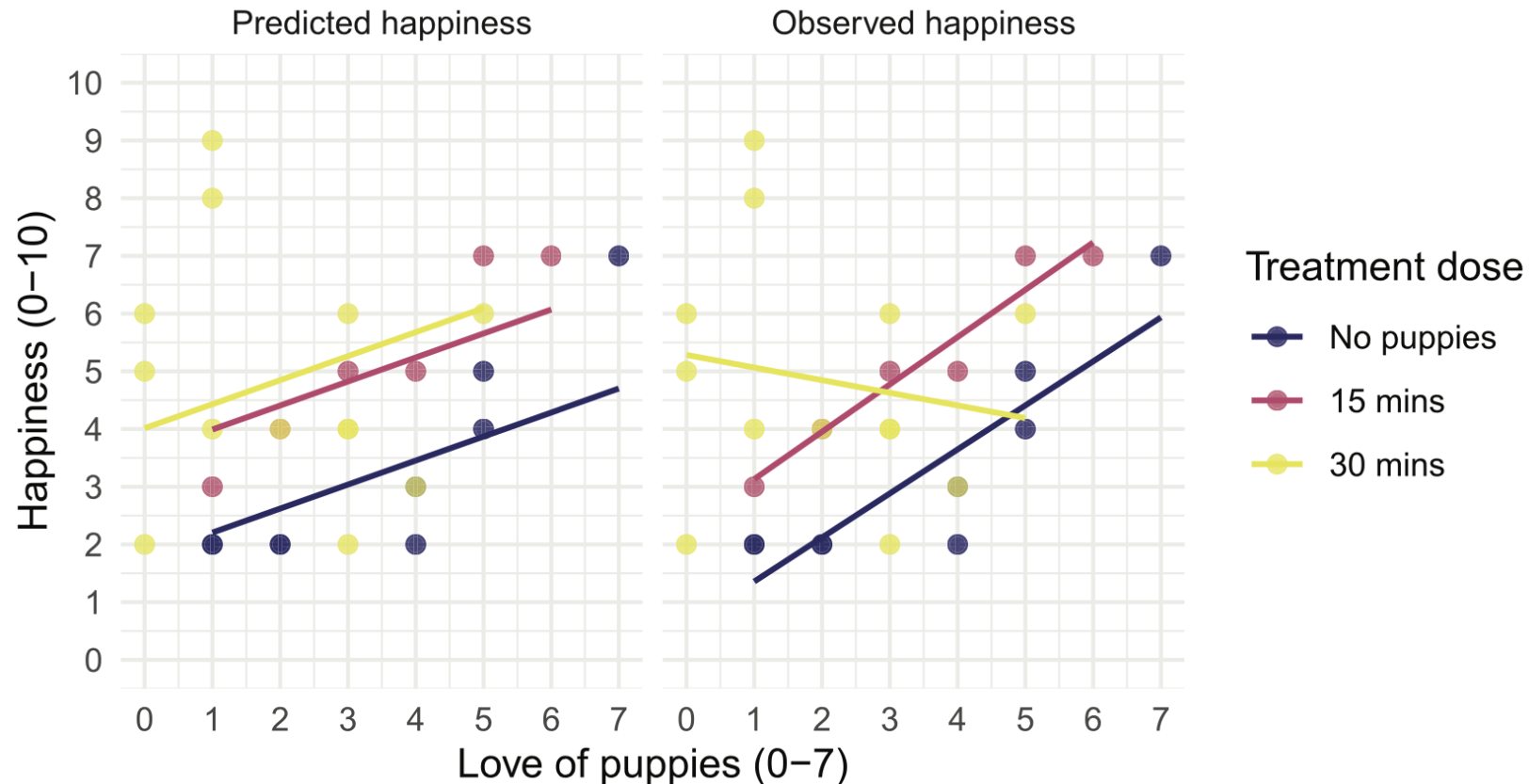


Figure 12.2 The role of the covariate in ANCOVA

Homogeneity of Slopes



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



Assessing Homogeneity of Slopes

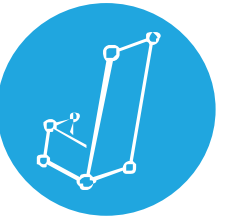


Figure 12.8 *Model* tab for ANCOVA

▼ Model

Components

Dose
Puppy love

↓
A
Z

▶

Model Terms

Dose
Puppy love
Dose * Puppy love

Sum of squares Type III ▼

ANCOVA

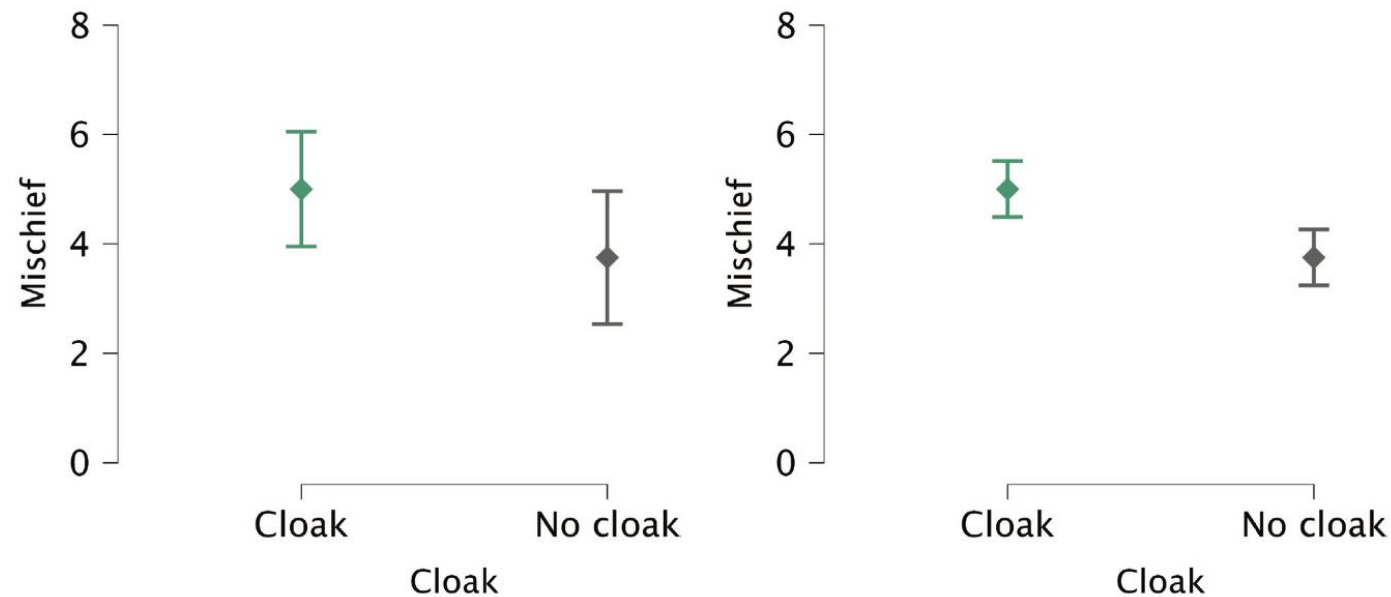


RM ANOVA



- 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 in SPSS, illustrating the process of defining repeated factors for a repeated-measures ANOVA.

Left Screenshot (Generic Setup):

- Repeated Measures Factors:** The dialog box shows a single factor named 'RM Factor 1'. Below the factor name, there are three options: 'Level 1', 'Level 2', and 'New Level'. At the bottom, there is a 'New Factor' button.
- Repeated Measures Cells:** The dialog box shows a table with two columns. The first column is empty, and the second column contains 'Level 1' and 'Level 2'. There is an empty row below 'Level 2'.

Right Screenshot (Specific Setup):

- Repeated Measures Factors:** The dialog box shows a single factor named 'Entity'. Below the factor name, there are four options: 'Mannequin', 'Human', 'Shapeshifter', and 'Alien'. The 'Shapeshifter' and 'Alien' options have an 'X' next to them, indicating they are selected. At the bottom, there is a 'New Factor' button.
- Repeated Measures Cells:** The dialog box shows a table with two columns. The first column is empty, and the second column contains 'Mannequin', 'Human', 'Shapeshifter', and 'Alien'. There is an empty row below '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

