# SPSS Workshop (Solutions)

While you do the tasks, save your commands in a syntax and annotate it reasonably. Put your results together in one Word document (only relevant information, not the whole output).

- 1) Add the data from this additional participant:
  - a) Media: Book
  - b) Ind\_Emo: Joy
  - c) Gender: Male
  - d) Age: missing
  - e) Res\_pre: 50
  - f) Res\_post: 60
  - g) Mot\_01:1
  - h) Mot\_02:2
  - i) Mot\_03: missing
  - j) Mot\_04: 1
  - k) Mot\_05: 3
    - → Define missing values for variables d) and i)

## 2) Define values (labels) for the motivation items

•	For example: 1 = str	ongly disagree, 2 = disagree, 3 = neut	ral, 4 = agree, 5 = strongly agree
	talue Labels	×	

Value Labels		Spelling
Add Change Remove	1 = "strongly disagree" 2 = "disagree" 3 = "neutral" 4 = "agree" 5 = "strongly agree"	
	OK Cancel Help	

- 3) Compute a new variable: mean of all motivation items
  - ➔ Transform > Compute Variable

🕼 Compute Variable		×
Larget Variable         Mot_mean         Type & Label         Image: State in the state	Numgric Expression:          =       MEAN(Mol_01, Mol_02, Mol_03, Mol_04, Mol_05)         +       >       7       8         +       >       7       8       9         -       =       2       3       7         +       =       =       1       2       3         /       8       1       0       .       Significance         Statistical       Scoring       String       .       .         *       ()       Delete       *       .       .         MEAN(numexpr,numexpr(]). Numeric. Returns the arithmetic mean of its arguments that have valid, nonmissing values. This function requires two or more arguments, which must be numeric. You can specify a minimum number of valid arguments for this function to be evaluated.       Min         Sd       Sum       Yariance	J Variables:
(optional case selection condition (ff)	tion) OK <u>Paste</u> Reset Cancel Help	

4) Check if the distribution of 'gender' is significantly associated with (or independent of) the 'media' factor and report the key results / numbers in one sentence.

Crosstabs		×	_	
F2_Ind_Emo           Age           Age           Res_pre           Res_post           Mot_01           Mot_02           Mot_02           Mot_04           Mot_05	Row(s): Column(s)	Egact Statistics Cglis Eormat Style Bootstrap Hext		
Crosstabs: Statistics	K Paste Reset Cance	el Help	-	
Crosstabs: Statistics Chi-square Chi-square Contingency coefficient Phi and Cramer's V Lamida	K Paste Reset Cano	el Help Crosstabs: Cell Display Counts ✓ Observed ✓ Expected ✓ Hide small counts Less than 5	z-test Compare column proportions Adjust p-values (Bonferroni method)	
Crosstabs: Statistics Chi-square Contingency coefficient Phi and Cramer's V Lambda Uncertainty coefficient Nominal by Interval Eta	K Paste Reset Canc X Correlations Ordinal Gamma Somers' d Kendall's tau- <u>b</u> Kendall's tau- <u>c</u> Kappa Rijsk	el Help Crosstabs: Cell Display Counts Counts Queserved Expected Hide small counts Less than 5 Percentages Row Column Total	z-test Compare column proportions Adjust p-values (@onferroni method)	

#### F1\_Media \* Gender Crosstabulation

		Gender			
			Male	Female	Total
F1_Media	Tablet	Count	4	4	8
		Expected Count	5,2	2,8	8,0
	Book	Count	7	2	9
		Expected Count	5,8	3,2	9,0
Total		Count	11	6	17
		Expected Count	11,0	6,0	17,0

### Chi-Square Tests

		Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2- sided)	Exact Sig. (1- sided)
ľ	Pearson Chi-Square	1,431ª	1	,232		
1	Continuity Correction <sup>b</sup>	,473	1	,492		
	Likelihood Ratio	1,449	1	,229		
	Fisher's Exact Test				,335	,247
	Linear-by-Linear Association	1,347	1	,246		
	N of Valid Cases	17				

a. 2 cells (50,0%) have expected count less than 5. The minimum expected count is 2,82. b. Computed only for a 2x2 table

→  $\chi^2$  (1) = 1.431, *p* = .232. There was no significant association between Gender and F1\_Media.

But: Warning 'a' (small cell count)  $\rightarrow$  better report Fisher's exact test

- There was no significant association between F1\_Media and Gender: p= .335 (Fisher's Exact Test, two-sided)
- 5) Check if there are age differences between experimental conditions and report the key results / numbers in one sentence.
  - → We need a one-way univariate ANOVA with exp. condition as IV
  - ➔ Analyze > General linear model > Univariate

	🔄 Univariate		×
• Res_post         • Mot_01         • Mot_02         • Mot_03         • Mot_04         • Mot_05         • Mot_05	F1_Media           F2_Ind_Emo           Gender           Res_pre           Res_post           Mot_01           Mot_02           Mot_03           Mot_04           Mot_05	Dependent Variable:       Age       Exed Factor(s):       Exp_Condition       Random Factor(s):	Model Contrasts Plots Post <u>H</u> oc Save Options Bootstrap
Covariate(s):		Covariate(s):	]

#### Levene's Test of Equality of Error Variances

Dependent Variable: Age df1 df2 Sig. 3 12 ,35 F Tests the null hypothesis that the error variance of the dependent with the terror variance of terror va variance of the dependent variable is equal across groups.

a. Design: Intercept + Exp\_Condition

## Tests of Between-Subjects Effects

Dependent Variab	le: Age					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	12,250 <sup>a</sup>	3	4,083	,238	,868,	,056
Intercept	9506,250	1	9506,250	555,109	,000,	,979
Exp_Condition	12,250	3	4,083	,238	,868	,056
Entit	203,300	12	17,125			
Total	9724,000	16				
Corrected Total	217,750	15				

a. R Squared = ,056 (Adjusted R Squared = -,180)

- → F(3, 12) = .238, p = .868,  $\eta^2 = .056$ . There was no significant difference between exp. condition regarding age.
- 6) Check if the post-test results are significantly related to the amount of reported motivation, report the key results / numbers in one sentence, and display the relationship visually in a scatter plot.
  - → We need a Pearson correlation
  - ➔ Analyze > Correlate > Bivariate

la Bivariate Correlations		×
F1_Media F2_Ind_Emo Exp_Condition Gender Age Age Mot_01 Mot_02 Correlation Coefficients Correlation Coefficients	Variables:	Qptions Style Bootstrap
Pearson Kendall's tau-b Spearman		
Test of Significance		]
Elag significant correlations		
	OK Paste Reset Cancel Help	

		Res_post	Mot_mean
Res_post	Pearson Correlation	1	,894**
	Sig. (2-tailed)		,000
	N	17	17
Mot_mean	Pearson Correlation	,894**	1
	Sig. (2-tailed)	,000,	
	N	17	17

 $\rightarrow$  r (15) = .894, p = .000. There was a strong positive and significant Pearson correlation between motivation and post-test results.





7) Report means and standard deviations for post-test results for each experimental group in a table

ta Explore	×
<ul> <li>F1_Media</li> <li>F2_Ind_Emo</li> <li>Gender</li> <li>Age</li> <li>Res_pre</li> <li>Mot_01</li> <li>Mot_02</li> <li>Mot_03</li> <li>Mot_05</li> <li>Mot_mean</li> </ul>	Dependent List
Display Both © Statistics © Plots	Label <u>C</u> ases by:
OK [	Paste Reset Cancel Help

# ➔ Analyze > Descriptive Statistics > Explore

# → Easier way: Via the ANOVA menu → includes nice table:

# Descriptive Statistics

Dependent Variable:	Res_post
---------------------	----------

Exp_Condition	Mean	Std. Deviation	Ν
Tablet+Joy	73,7500	7,36546	4
Tablet+Sadness	40,2500	23,94960	4
Book+Joy	74,4000	17,52997	5
Book+Sadness	46,2500	9,70824	4
Total	59,5882	21,65369	17

- 8) Check if learning gain was affected by factor 1 (media), or factor 2 (induced emotion), and if there was an interaction between the factors. Briefly report the key results / numbers.
  - → We need a two-way repeated measures ANOVA
  - → Analyze > General linear model > Repeated measures

🕼 Repeated Measures Define Factor(s) 🛛 🗙				
Within-Subject Factor Name:				
Add Change Remove				
Measure Name:				
Agd Change Remove Define Reset Cancel Help				
le Repeated Measures				×
		Within-Subjects Variables		Model
Exp_Condition		(Prepost):		Contrasts
Age	<b>* +</b>	Res_post(2)		Plots
✓ Mot_01 ✓ Mot_02				Post <u>H</u> oc
	*			Save
# Mot_05				Options
Wot_mean				
		Between-Subjects Factor(s):		
		F1_Media		
	*	012_mo_cmo		
			•	
		O superior to be set		
		<u>C</u> ovariates:	]	
	•	Covariates:		

	Те	sts of Within-S	Subjects I	Effects			
Measure: MEASURE_1							
Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Prepost	Sphericity Assumed	64,847	1	64,847	,526	,481	,039
	Greenhouse-Geisser	64,847	1,000	64,847	,526	,481	,039
	Huynh-Feldt	64,847	1,000	64,847	,526	,481	,039
	Lower-bound	64.847	1.000	64.847	.526	.481	.039
Prepost * F1_Media	Sphericity Assumed	182,084	1	182,084	1,477	,246	,102
	Greenhouse-Geisser	182,084	1,000	182,084	1,477	,246	,102
	Huynh-Feldt	182,084	1,000	182,084	1,477	,246	,102
	Lower-bound	182.084	1.000	182.084	1,477	.246	.102
Prepost * F2_Ind_Emo	Sphericity Assumed	245,558	1	245,558	1,992	,182	,133
	Greenhouse-Geisser	245,558	1,000	245,558	1,992	,182	,133
	Huynh-Feldt	245,558	1,000	245,558	1,992	,182	,133
	Lower-bound	245,558	1,000	245,558	1,992	,182	.133
Prepost*F1_Media *	Sphericity Assumed	192,005	1	192,005	1,557	,234	,107
12_md_cmo	Greenhouse-Geisser	192,005	1,000	192,005	1,557	,234	,107
	Huynh-Feldt	192,005	1,000	192,005	1,557	,234	,107
	Lower-bound	192,005	1 000	192,005	1,557	,234	,107
Error(Prepost)	Sphericity Assumed	1602,850	13	123,296			
	Greenhouse-Geisser	1602,850	13,000	123,296			
	Huynh-Feldt	1602,850	13,000	123,296			
	Lower-bound	1602,850	13,000	123,296			

- → There was no sign. interaction between point in time × media on learning gain: F(1, 13) = 1.477, p = .246,  $\eta^2 = .102$
- → There was no sign. interaction between point in time × emotion induction on learning gain: F(1, 13) = 1.992, p = .182,  $\eta^2 = .133$
- → There was no sign. interaction between point in time × media × emotion induction on learning gain: F(1, 13) = 1.557, p = .234,  $\eta^2 = .107$
- 9) Check if there was a difference in the pre-test scores between males and females and report the key results / numbers in one sentence.
  - ➔ We need a t-test for independent samples
  - → Analyze > Compare means > Independent samples t-test
  - Effect size: Calculate e.g. here: https://www.psychometrica.de/effect\_size.html
    Independent-Samples T Test

뤚 F1_Media		Test Variable(s):		Options
F2_Ind_Emo     F2_Ind_Emo     F2_Ind_Emo     Ape     Age     Age     Mot_01     Mot_02     Mot_03     Mot_05     Mot_05     Mot_05	*			Bootstrap
OK [	▶ Paste	Grouping Variable: Gender(1 2) Define Groups Reset Cancel H	telp	

Group Statistics							
	Gender	N	Mean	Std. Deviation	Std. Error Mean		
Res_pre	Male	11	47,0000	15,89339	4,79204		
	Female	6	72,3333	20,05659	8,18807		

Independent Samples Test										
		Levene's Test Varia	for Equality of nces	t-test for Equality of Means						
							95% Confident Mean Std Error Diffe		e Interval of the rence	
		F	Sig.	t	df	Sig. (2-tailed)	Difference	Difference	Lower	Upper
Res_pre	Equal variances assumed	,374	,550	-2,870	15	,012	-25,33333	8,82688	-44,14738	-6,51928
	Equal variances not assumed			-2,670	8,512	,027	-25,33333	9,48726	-46,98387	-3,68279

## 2. Comparison of groups with different sample size (*Cohen's d, Hedges' g*)

Analogously, the effect size can be computed for groups with different sample size, by adjusting the calculation of the pooled standard deviation with weights for the sample sizes. This approach is overall identical with  $d_{Cohen}$  with a correction of a positive bias in the pooled standard deviation. In the literature, usually this computation is called *Cohen's d* as well. Please have a look at the remarks below the table.

Additionally, you can compute the confidence interval for the effect size and chose a desired confidence coefficient (calculation according to Hedges & Olkin, 1985, p. 86).

	Group 1	Group 2
Mean	47	72,33
Standard Deviation	15,89	20,06
Sample Size (N)	11	6
Effect Size $d_{Cohenv} g_{Hedges}^*$	1.	456
Confidence Coefficient		- ~
Confidence Interval		

→ There was a significant difference in the pre-test scores between males and females with t (15) = -2.870, p = .012, d = 1.46 and a large effect. Females scored significantly higher.