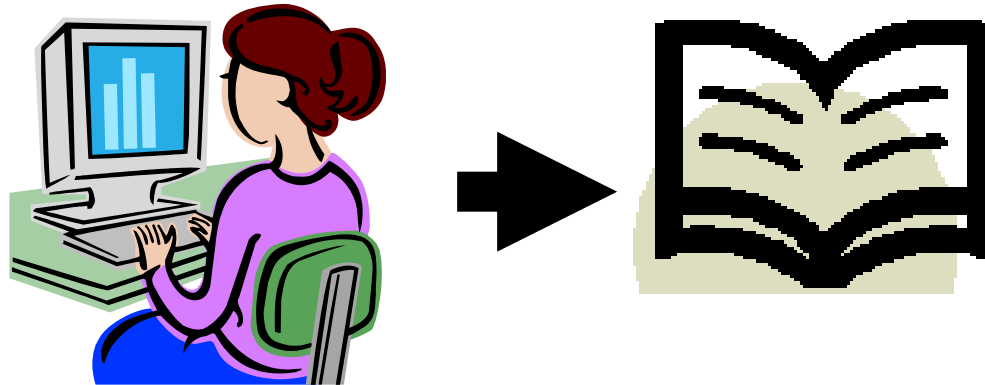


DataToText: For Better or Worse?



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davidakenny.net/places/Uvic/Datatotext23.pdf

Computers Doing Tasks Formerly Done By Humans

Much in the news today about ChatGPT and whether AI will replace humans.

This talk is not about AI, but about “dumb” computer programs that
perform data analyses
generate text to describe the results

This is called *DataToText*.

The State of Data Analysis in the Behavioral Sciences

It is generally agreed that the quality of data analysis is poor.

One of the favorite topics among methodologists is to discuss how poorly done data analyses are conducted.

Concrete evidence of this is the low rates of replications, due in large part to questionable research practices (QRPs).

What can be done to improve data analysis?

Education

Structural changes (e.g., preregistration)

Not usually discussed is a major change in computer software: consumer-focused versus industry-focused.

Consumer versus Industry Perspective

For data analysis, quantitative psychologists are the “industry.”

Currently, there is little effort devoted to making data analysis consumer oriented.

The rewards for quantitative psychologists are to publish papers read by other quantitative psychologists, not by consumers.

DataToText is an attempt to make data analysis more consumer driven.

The Current State of Data Analysis

Many computer packages are complex and those wanting to use the technique need to invest considerable time and effort to be able to use them or they need to hire someone else to do the analysis.

The results from the analysis are very detailed and are not readily apparent how they can be translated into text suitable for publication.

Consumer-Oriented Data Analysis

Data analytic techniques should be easily accessible so that those who need to use a technique, which they may not yet fully understand, have the opportunity to do the analyses that they need to do.

The results from the analysis should be presented in a way that makes it easy to prepare tables and text for publication.

DataToText Option I

report, an R package: easystats.github.io/report/

More “analysis to text” than “data to text.”

Take output from a specific program and re-formats the results as text.

Authors: Makowski, Patil, Lüdecke, Thériault (Université du Québec à Montréal), Ben-Shachar, & Wiernik

Takes R objects from ANOVA, regression, multilevel modeling, Bayesian analysis, and others and converts the output to text.

report Example

```
model <- lm(Sat_M ~ Anxiety_M + Anxiety_W + Abuse_M  
            + Abuse_W, data = riggsdata)  
report(model)
```

We fitted a linear model (estimated using OLS) to predict Sat_M with Anxiety_M, Anxiety_W, Abuse_M and Abuse_W (formula: `Sat_M ~ Anxiety_M + Anxiety_W + Abuse_M + Abuse_W`). The model explains a statistically significant and moderate proportion of variance ($R^2 = 0.16$, $F(4, 150) = 6.95$, $p < .001$, adj. $R^2 = 0.13$). The model's intercept, corresponding to $Anxiety_M = 0$, $Anxiety_W = 0$, $Abuse_M = 0$ and $Abuse_W = 0$, is at 53.46 (95% CI [49.64, 57.28], $t(150) = 27.67$, $p < .001$).

report continued

within this model:

- The effect of Anxiety M is statistically significant and negative (beta = -1.63, 95% CI [-2.50, -0.76], $t(150) = -3.71$, $p < .001$; Std. beta = -0.29, 95% CI [-0.44, -0.13])
- The effect of Anxiety W is statistically significant and negative (beta = -1.17, 95% CI [-2.13, -0.20], $t(150) = -2.39$, $p = 0.018$; Std. beta = -0.20, 95% CI [-0.36, -0.03])
- The effect of Abuse M is statistically non-significant and negative (beta = -0.07, 95% CI [-0.33, 0.19], $t(150) = -0.55$, $p = 0.583$; Std. beta = -0.04, 95% CI [-0.19, 0.11])
- The effect of Abuse W is statistically non-significant and negative (beta = -0.03, 95% CI [-0.27, 0.21], $t(150) = -0.25$, $p = 0.803$; Std. beta = -0.02, 95% CI [-0.18, 0.14])

report continued

Standardized parameters were obtained by fitting the model on a standardized version of the dataset. 95% Confidence Intervals (CIs) and p-values were computed using a Wald t-distribution approximation.

DataToText Option II

Have the researcher tell DataToText what are the variables in the analysis.

DataToText creates code to run the analysis.

DataToText performs the requisite analyses.

DataToText gives the results from those analyses:

- computer code and output

- written text

- tables and figures

DataToText Option III

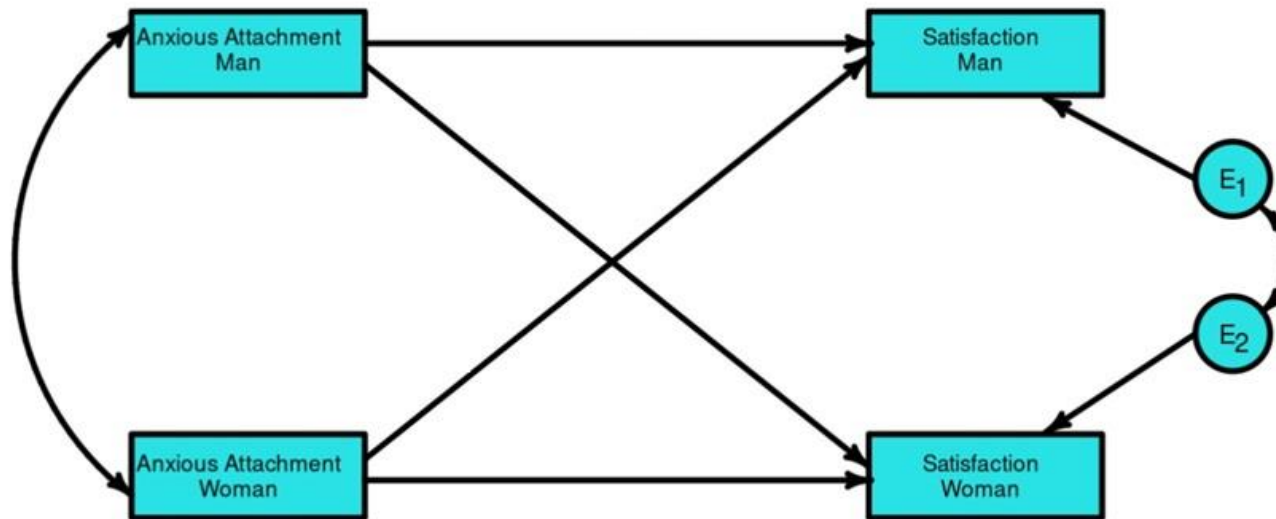
Lakens & DeBruine (2021; *Advances in Methods and Practices in Psychological Sciences*)

The pre-registration plan totally controls all decisions concerning outlier removal, transformations, computation of sum scores according to pre-specified rules. The analysis model and decision rules are also pre-specified. All the information that is required to perform these operations is stored in a structured metadata file.

Illustration of Option II

- Riggs, Cusimano, and Benson (2011) investigated the effects childhood abuse and anxious attachment style on relationship satisfaction in 155 heterosexual couples.
- They used the Actor-Partner Interdependence Model (APIM).

APIIM



Actor Effects: path from own Anxious Attachment to own Satisfaction

Partner Effects: path from partner's Anxious Attachment to own Satisfaction

APIM_MM Shiny App

- app available on the web:
https://davidakenny.shinyapps.io/APIM_MM/
- written in R
- over 7,000 lines of code
- user need not know R or the details of an APIM analysis

Actor-Partner Interdependence Model

Estimated Using Multilevel Modeling

Please [CLICK HERE](#) to make a small donation of \$2.25 to offset some of the costs of maintaining APIM_MM. Thanks to those who have already donated.

[Select Data](#)[Variables](#)[Distinguishable](#)[Miscellaneous](#)[Download Output](#)[Download New Dataset](#)

Input Data File Type

Excel csv

Pairwise Data File

Browse...

riggsp.csv

Upload complete

[Text](#)[Tables](#)[Computer Output](#)[Figures](#)[New Dataset](#)

Variables

☐ Check To View Variable List

Dyad Identification Variable:

Dyad

Outcome Variable Name in Data:

Sat_A

Outcome Variable Name for Text:

Satisfaction

Actor and Partner Variable Input Options

Suffix

Suffix: Provide one stem for both actor and partner, suffix to be added later

Lists: Variables names separated by commas (same order for actor and partner)

Check: Boxes for all variables provided

Predictor Variable Names in the Dataset:

Abuse,Anxiety

☒ Standard Suffix (_A & _P):

☐ Variable Names for the Text the Same

Predictor Variable Names for the Text Output

Abuse,Anxious Attachment

Distinguishable

Indistinguishable: No differences.

Fully Distinguishable: Actor and partner effects, residual variances, and intercepts differ.

Partially Distinguishable: Only residual variances and intercepts differ.

Distinguishable Dyad Members:

- ☐ Indistinguishable
- ☒ Fully Distinguishable
- ☐ Partially Distinguishable

Distinguishing Variable Name in the Dataset:

Gender_A

Distinguishing Variable Name for Text:

Gender

Label for Person with the Smaller Number (plural):

Women

Label for Person with the Larger Number (plural):

Men

Label for Person with the Smaller Number (singular):

Woman|

Label for Person with the Larger Number (singular):

Man

Miscellaneous

☒ Covariates

☒ Covariate Effects Vary by the Distinguishing Variable

Check Covariates:

☐ Partner ☐ Age_A ☐ Abuse_A ☐ Avoid_A
☐ Anxiety_A ☐ Age_P ☐ Gender_P ☐ Abuse_P
☐ Sat_P ☐ Avoid_P ☐ Anxiety_P ☒ Rel_Length
☐ Genderstring

Covariate Names for the Text List:

Relationship Length

☐ Actor-Partner Interaction

☒ Alpha = .05

Identify Normalized Residual Greater Than:

3.0

☐ Remove Outliers from the Analysis

☐ Center Variables

Figure Output Options:

☒ Standardized Values

☐ Standard Errors

Estimate the Actor-Partner Interdependence Model!

Anxious Attachment

The actor effect for Men equals -1.752 and is statistically significant ($p < .001$) and the standardized effect equals -0.296 ($r = -.312$ and a medium effect size). The actor effect for Women equals -1.821 and is statistically significant ($p < .001$) and the standardized effect equals -0.308 ($r = -.294$ and a small effect size). The test that the two actor effects are statistically significantly different is not significant, $Z = -0.103$ ($p = .918$). The partner effect from Women to Men equals -1.374 and is statistically significant ($p = .005$) and the standardized effect equals -0.232 ($r = -.225$ and a small effect size). The partner effect for Men to Women equals -1.379 and is statistically significant ($p = .002$) and the standardized partner equals -0.233 ($r = -.253$ and a small effect size). The test that the two partner effects are statistically significantly different is not significant, $Z = -0.007$ ($p = .995$).

Table 2: Separate Effect Estimates for the Actor-Partner Interdependence Model for Men and Women (Partner effects refer to the member whose outcome is being measured.)

Variable	Role	Effect	Estimate	Lower	95% CI	Upper	p value
Satisf.	Men	Intercept	56.281	51.910	to	<.001	<.001
	Women		59.970	55.638	to	64.303	<.001
Abuse	Men	Actor	-0.049	-0.302	to	0.204	.705
		Partner	-0.029	-0.260	to	0.203	.807
		k	0.589	-10.722	to	10.962	
	Women	Actor	-0.248	-0.477	to	-0.018	.035
		Partner	-0.103	-0.354	to	0.148	.422
		k	0.415	-1.130	to	3.399	
AnxAttac	Men	Actor	-1.752	-2.607	to	-0.896	<.001
		Partner	-1.374	-2.332	to	-0.417	.005
		k	0.785	0.212	to	1.939	
	Women	Actor	-1.821	-2.771	to	-0.872	<.001
		Partner	-1.379	-2.226	to	-0.531	.002
		k	0.757	0.261	to	1.908	
RelLength	Women		-1.213	-2.195	to	-0.231	.016
	Men		-1.747	-2.721	to	-0.774	<.001

3. GLS Computer Output

Two Intercept Model

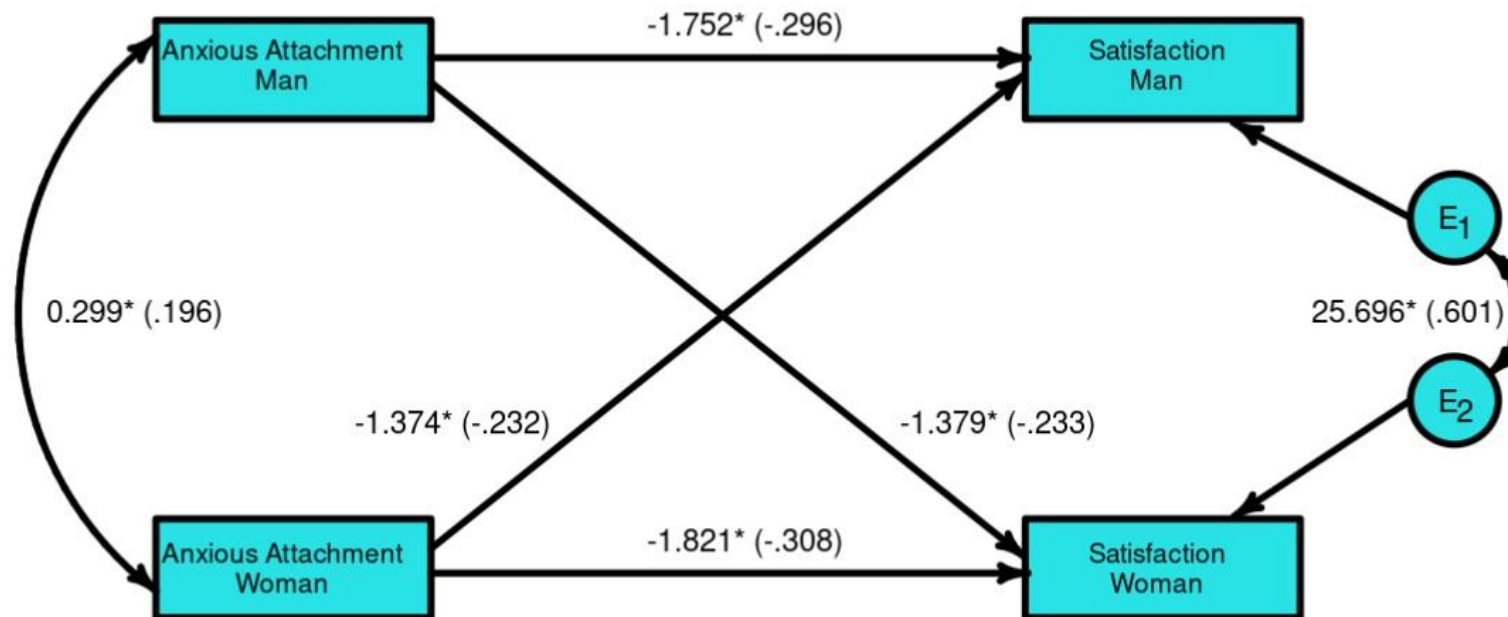
The gls statement to the "Two Intercept Model" for distinguishable dyads is:

```
gls(outvar ~ act11 + part11 + act21 + part21 + act12 + part12 + act22 +  
part22 + d1 + d2 - 1 + cci11 + cci21, na.action=na.omit, method="REML",  
verbose=TRUE, correlation = corCompSymm(form=~1|Dyad_ID),  
weights=varIdent(form=~1|distvar), data=MaDa
```

The "DyadID" variable in the R syntax is Dyad in the original dataset, the variable "outvar" is the outcome variable that was originally called Sat_A, and MaDa is the new dataset created by R. The variables d1 and d2 are dummy variables for the Women and Men, respectively. For Abuse, the variable act11 is the dummy variable d1 times the actor variable for Women and act21 is the dummy variable d2 times the actor variable for Men. The variables part11 and part21 are similarly defined. The dummy product terms for the other mixed variables are defined accordingly. The effect of Relationship Length for Women is "cci11," and for Men is "cci21."

Output follows...

Anxious Attachment: APIM (Standardized Estimates)



For Better or Worse?



DataToText is Mindless!

Thought and intelligence is
needed for:

What analysis to do

The execution of the analysis

The interpretation of the analysis

DataToText is Mindless!

Thought and intelligence is
needed for:

What analysis to do

High school student Jenna Smith entering variables into a DataToText program.



Researcher Brad Anderson not knowing anything about estimating the APIM.



Definitely bad, maybe even terrible.

However, it might be better than what would have otherwise been done!

For Better?

More Comprehensible Results with DataToText

Because DataToText provides a verbal summary of the results, researchers might better understand their results.

Perhaps in some cases the Results section might be the best written part of the paper.

Output produced by DataToText may be more intelligible to the reader than the analyst, and so although the analyst may not fully understand the results, readers, editors, and reviewers may be able to!

DataToText is Mindless!

Thought and intelligence is
needed for:

What analysis to do

The execution of the analysis

Data Analysis Requires Thought

Not all problems have a flow-chart
structure

Confirmatory Factor Analysis

Time-series Modeling

However...

Some problems have a flow-chart structure (although we might disagree some about that flow-chart).

For many analyses, we do have explicit or implicit standards for reporting of results.

For these problems, DataToText would be a useful tool.

DataToText is Mindless!

Thought and intelligence is
needed for:

What analysis to do

The execution of the analysis

The interpretation of the analysis

The Researcher Needs to Understand the Results

Good data analysis is more than doing the right analysis; the researcher must still understand the meaning of the results.

No computer program today can understand the results.

For Worse? Is not DataToText Plagiarism?

Yes, if the text is copied without credit.

No if

- DataToText cited

- copied material placed in quotes

Computer-generated reports are routinely used in psychiatric screening, personality assessment, neuropsychology, and personnel psychology.

For Better?

More Accurate Results

Keeps everything straight. Avoids some errors.

Does more advanced, “state-of-the-art” analyses.

Provides verbal and graphical interpretation of the results.

Could use DataToText as a check.

For Better?

Test Assumptions

Makes assumptions explicit.

Can provide statistical tests of certain assumptions.

Assumption Testing Is Like Flossing

Something we know that we should do but
do not do as often we should.

DataToText can test certain assumptions

- level of measurement
- outliers
- distributional



Suggest Better Analyses

DataToText can provide explicit guidance about the analysis and might lead to the “right” or at least a “better” analysis being done.

Riggs et al: “The question is whether Gender makes a statistically meaningful difference: Is there a statistical benefit to treat dyad members as distinguishable? The test of overall distinguishability yields a chi square statistic with seven degrees of freedom, which equals 5.466 ($p = .486$). Because the test of distinguishability is not statistically significant, we conclude that there is not statistical evidence of distinguishability. It may make sense and increase power to treat dyad members as indistinguishable.”

Warnings

DataToText can issue warnings.
APIM_MM app currently has nine
different warnings:

List of APIM_MM Warnings

1. level of measurement of the outcome
2. multicollinearity of the actor and partner variables
3. **centering predictors:** WARNINGS: Because zero is not a possible value for Abuse, grand-mean centering that variable should be considered, and because zero is not a possible value for Relationship Length, grand-mean centering that variable should be considered.
4. large differences in variance between predictors and outcome
5. weak covariates
6. outliers
7. too few observations to conduct an analysis
8. strong correlation between errors
9. strong skew in the outcome measure

Summary: Mindless Data Analysis

Surprisingly, mindless data analysis can produce informative, detailed reports of results that is nearly publishable.

Perhaps data analysis is not as intelligent as we might think it is or perhaps we can program that intelligence?

For **Better**? Help For Those Who Have Difficulty With English

English is not first language of many researchers. These researchers often struggle with writing papers in English.

No doubt many native English speakers struggle with writing.

At least the Results Section, perhaps the most important section of a paper will be comprehensible.

DataToText can help with the writing.

Final Words

Certainly, DataToText is a potentially dangerous tool and is certainly open to abuse.

However, it has potential benefits:

- Often better than amateur data analysts doing bad data analysis

- Often does more extensive analysis than typically done

Thank You

david.kenny@uconn.edu

davidakenny.net/places/Uvic/Datatotext23.pdf

<https://quantitdepod.org/s3e13-the-actor-partner-interdependence-model/>

Is APIM_MM Being Used?

My most used DataToText app.

About 30 people have donated \$2.25 (US).

About 20 papers have cited the app.

- several dissertations

- many from non-English speaking countries

- not top-tier journals, but some 2nd tier