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APIM_MM: A Web-Based Package for Estimating the Actor-Partner Interdependence Model by Multilevel Modeling

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Note: There might be differences between screen shots or output shown in this document those generated by the current version program due to changes in the program made after this document was produced. In particular, there have been changes to shiny package, and the presention of information on the left-side of the screen is presented in a different format.

The program APIM_MM is based on an R program using RStudio's shiny. I thank Thomas Lederman, Lara Stas, Axel Mayer, and Rob Ackerman who have given me helpful advice on this program. William Cook and Stefano Livi have given me feedback on the content of the program.

To access APIM_MM from the web, the following web address is entered in the browser:

https://davidakenny.shinyapps.io/APIM_MM/

This program conducts an Actor-Partner Interdependence analysis of dyadic data. Data must be in a pairwise structure (one record for each person with the data from the person and the person's partner on the record). There must be a numeric dyad identification variable on each record and no more than two records can have the same score on the dyad identification variable. The program requires at least one predictor mixed variable and one outcome mixed variable. Dyad members can be indistinguishable, fully distinguishable, and partially indistinguishable. Covariates can be included and an analysis of actor-partner interactions for each mixed variable can be estimated using either a product score or a discrepancy score. With distinguishability, pooled actor and partner effects across members are presented, as well as tests of distinguishability. Outliers can be automatically removed from the dataset, and the program provides a detailed analysis

of nonindependence. Variables can be grand mean centered or standardized (see below on how the standardization is done) by the program. The program provides a decomposition of nonindependence using a method unique to the program.

Difficulties have been encountered running the program with a large number of dyads, i.e., over 2,000.

The program issues warnings about potential problems in the analysis. Among the warnings issues are:

1. Failure to center actor and partner variables
2. Failure to center covariates
3. Residual outliers
4. Skew in residuals with sometimes a warning about a ceiling or floor effect
5. High collinearity between actor and partner variables
6. High collinearity between errors
7. Covariates that explain little or no variance
8. Extreme differences in variance of a predictor and the outcome variable
9. A dichotomous outcome
10. Small sample size
11. Suggestion to lower alpha with large sample sizes

The program issues the following important disclaimer:

> Although great effort has been undertaken to ensure the accuracy of results, no complete guarantee can be about their accuracy. It is your responsibility to check the results and text for accuracy. Should the user notice any problems with the program, he or she should notify David. A. Kenny.

If you do use the program, if only to check your analyses, I do ask you to cite the program:

> Kenny, D. A. (2015, February). An interactive tool for the estimation and testing the Actor-Partner Interdependence Model using multilevel modeling [Computer software]. Available from https://davidakenny.shinyapps.io/APIM_MM/.

There are several key features of the program that deserve special mention:

GLS: The program uses multilevel modeling, but no random effects are estimated. Rather the program estimates the correlation of the errors of the two members. The estimation method is generalized least squares (GLS) which is similar to ordinary regression analysis with a correlation of the errors and heterogeneous variances (when

dyad members are distinguishable). The estimates and standard errors are identical or very similar to those from conventional multilevel modeling programs. The program outputs the GLS syntax for major analyses.

Degrees of Freedom: The tests of actor, partner, and covariate effects use a *Z* test. That is, the degrees of freedom for error are assumed to be infinite. For this reason, *p* values for this program are slightly smaller than those given by most other multilevel modeling programs. For studies with 50 or more dyads, the difference would be trivial. Perhaps an interested user could figure out the code to implement the Satterthwaite degrees of freedom.

Covariates: The program allows for covariates. They can be between, within, or mixed variables. With distinguishable dyads, the covariates can be allowed to interact with the distinguishable variable. If this option is chosen, the covariate needs to vary within both levels of distinguishing variable.

Computer Code: The program outputs the R gls output for the major runs. It also gives the R code for the run. Thus, the user can with the downloaded data and R code, redo the major analyses in R.

k Ratio: This is the ratio of partner effect to the actor effect. To compute a confidence interval, the Monte Carlo method, sometimes called a parametric bootstrap, is used. That is, based on the standard errors of the two estimated effects and their covariance, the program can sample values of *k*. The program creates a sampling distribution of 40,000 cases to obtain the confidence interval.

Standardization: When dyad members are distinguishable, the overall standard deviation is used. It is the pooled within groups standard deviation, meaning that the effect of the distinguishing variable is removed. The program also provides the standardized coefficients for each of the two members within a distinguishing variable. The overall standardized coefficient is denoted as "Beta (o)" and the one within levels of the distinguishing variable as "Beta (s)."

Partition of Nonindependence: This material has not been published and is unique to APIM_MM. The overall degree of nonindependence is partitioned into potentially seven different sources:

1. Spurious due to actor and partner effects.
2. Covariation between the actor and partner variables and actor or partner effects.
3. Covariation between two mixed variables and actor partner effects.
4. Effects due to individual covariates.

5. Covariation between covariates.
6. Covariation between covariates and mixed variables.
7. Unexplained covariation not explained by any of the above.

Typically, only sources 1 and 4 are conceptually meaningful. If one wanted to claim that the model has successfully explained the nonindependence in the outcome, then the unexplained covariation should be small (i.e., less than 20 percent of the total covariance) and the residual intraclass correlation would not be statistically significant.

Test of Actor-Partner Interaction: Two different options are given. One is the product and the other is the discrepancy score. Note that the program just gives these interaction effects and its interpretation and does not give the results from the full model. Should the user want to get the full model results, the interaction must be created in the dataset and treated as a covariate by APIM_MM.

Centering: Three different types of centering can be chosen. First is grand-mean centering. Second is grand-mean centering of variables where "zero is not a possible value." What is meant by that is the maximum and minimum score of the variable is examined and if they are both greater than or less than zero, grand mean centering is conducted. So for instance if the variable is dichotomy that is effects coded (+1 and −1), technically zero is not possible, but this variable would not be grand mean centered if this centering option were chosen. Lastly, the variables, including the outcome, are all standardized. With distinguishable dyads, the pooled within-groups standard deviation is used.

Outlier Detection and Removal: Currently, the program measures outliers using the standardized residual, which is the score minus the predicted value divided by the standard deviation of errors. This is sometimes called a *standardized residual*, but the true standardized residual requires leverage values, which I am trying to determine how to compute. Any help here would be most appreciated.

Tests of Distinguishability: When dyad members are distinguishable, a rather detailed examination of distinguishability is conducted. Tests of the following are made:

a. Intercepts are equal.
b. Actor effects are equal for all mixed predictors.
c. Partner effects are equal for all mixed predictors.
d. Actor and partner effects are equal for all mixed predictors (partial distinguishability).
e. Effects of the covariate are equal.
f. Error variances are equal.

g. Only the intercepts are unequal.
h. All are equal (complete indistinguishability).

Based on these results, the user might wish to rerun the analysis. The program may even make a suggestion.

Error Checks: If the program is unable to conduct an analysis, it does give a warning in some cases. Some of the current error checks are as follows:

a. More than two members in a "dyad."
b. Only one member of each "dyad."
c. No actor and partner variables in the analysis.
d. If the same variable is used more than once, e.g., as both a covariate and a distinguishing variable.

If the user notices that there is not an error check, please inform me and I shall try to add it.

Reactivity: Even after a run is complete, the user can make changes in the run without entering in all the information. To rerun the analysis, begin by first clicking the top blue button "Estimate the Actor-Partner Interdependence Model." This can be helpful when the user makes an error or if based on the prior run the user wants to do something different. So for instance, if the researcher does a run with distinguishable dyads with covariates, and the analysis indicates that dyads can be treated as indistinguishable, that there is an outlier, and that the covariate explains little or no variance, a second run can be done which removes outliers, treats dyads as indistinguishable, and removes the covariates. For each of the two runs, the results (text, tables, figures, and computer output) can be saved to a file.

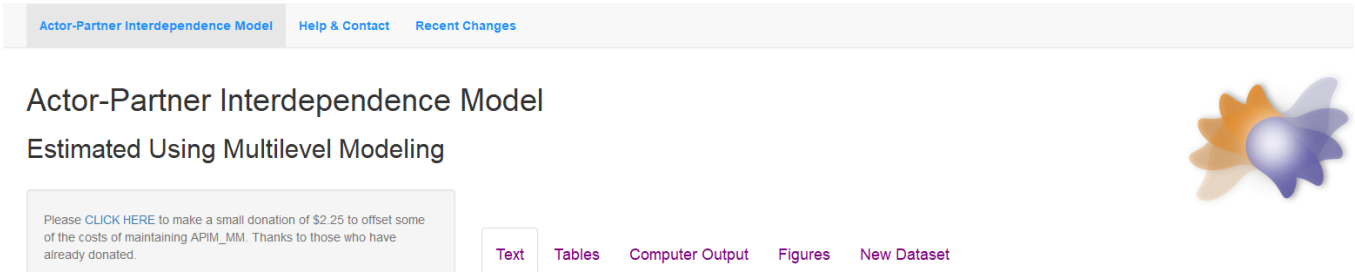
Download the Dataset: One can download the final dataset that APIM_MM creates for the analyses. This is especially useful if dyads are distinguishable, actor-partner interactions created, there are outliers in the dataset, and covariates vary by the distinguishing variable.

Examples of Program Runs

Three different examples are presented. The first is a simple example with indistinguishable dyad members and the second a more complex example with multiple predictor variables, covariates, and a test of the actor-partner interaction. The third repeats the first analysis with a between-dyads covariate and tests the interaction of the covariate with the actor and partner variables.

Simple Example

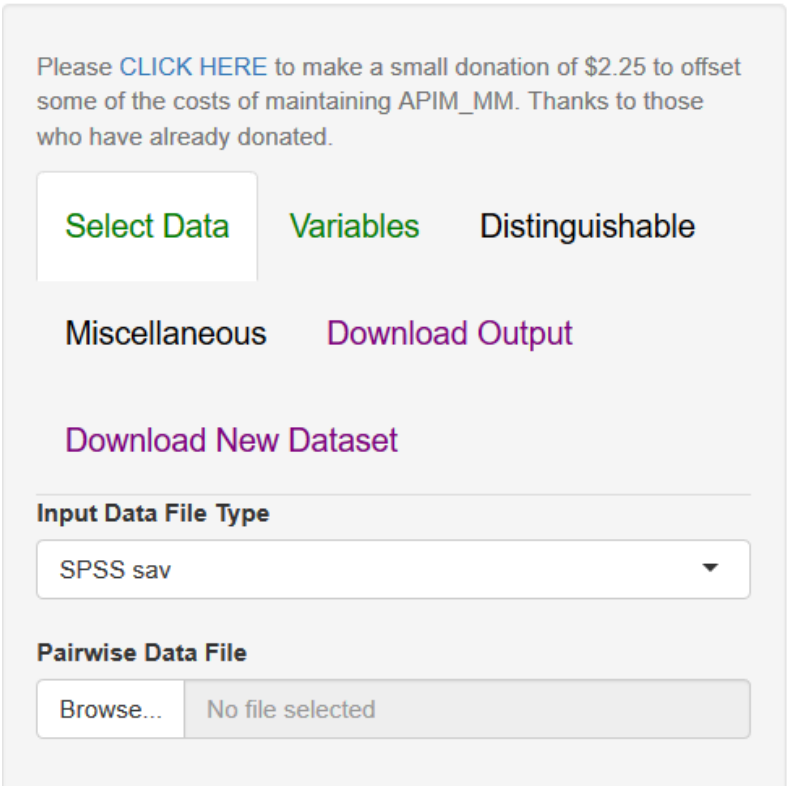
When the program is opened, one obtains the following screen:



First, note the blue tabs at the top left of the screen. The first tab, the "Actor-Partner Interdependence Model" is clicked, which gives the above screen and is the one that needs to be open to set up and examine the analysis.

The tab next to it, "Help & Contact" has some documentation of the program, as well as a link to this document and a way to contact me.

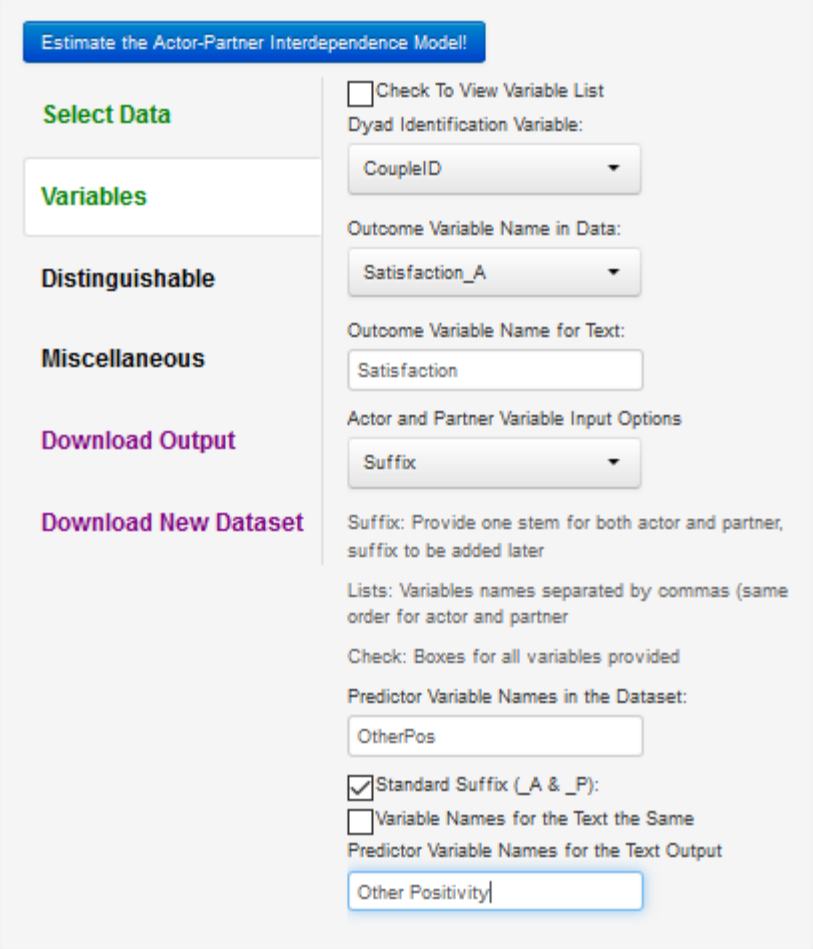
The last blue tab, "Recent Changes," describes changes and corrections to the program that have been made, as well as changes that are planned. To begin, make sure the "Actor-Partner Interdependence Model" tab is open to begin. The following screen appears:



Next, note the left-vertical tabs -- two green, two black, and two purple). The two green tabs must be completed for a run to begin. The two black tabs involve specialized APIM options. And the two purple tabs involve output options.

The user ordinarily clicks each tab, beginning with Select Data. The default is an SPSS "sav" file, but a csv file can be chosen. The user can browse directory to locate the file. Again, note the structure of the data file must be a pairwise. (There are apps for converting an individual file to a pairwise data structure -- https://davidakenny.shinyapps.io/ItoP/ -- or a dyad file to pairwise -- https://davidakenny.shinyapps.io/DtoP /.)

Once a file is chosen, the user needs to select variables from that file for an APIM analysis. The Variables tab is chosen:



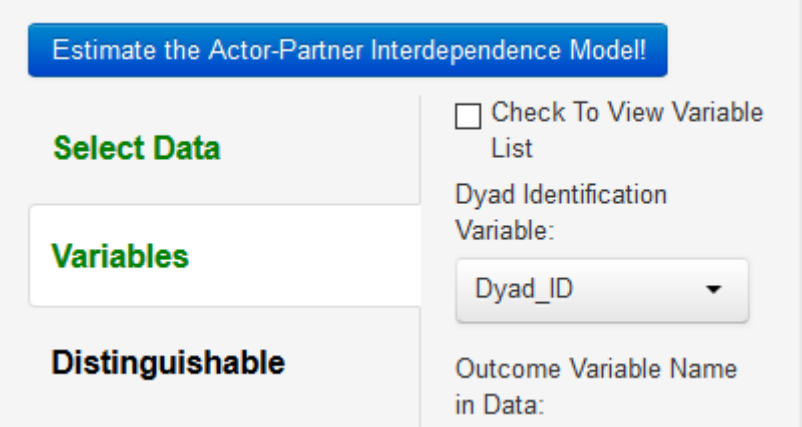
First, the outcome variable must be chosen from the dataset and named. In this case, that variable is Satisfaction_A and it is given the name Satisfaction for the text.

For the predictor variables, APIM_MM expects parallel lists of actor and partner variables in the variables. Entering these variables is confusing, but is a critical step in the analysis. Three different options are offered to enter these parallel lists:

> Check: This is perhaps the most familiar option. If chosen, the user is given the entire list of variables in the dataset, and the user then checks those that are appropriate for the set. The variables need not be checked in the same order for the actor and partner variables, but they must be in the same order in the dataset itself. For instance, if the variables were ASat, PSat, AAge, and PAge (A being actor and P being partner), the user might check (in any order) ASat and AAge for actors and then PSat and PAge for partner (again in any order). However, in the dataset, if ASat comes before AAge, then PSat must also come before PAge. If this is not the case, this option cannot be used unless one reorders the variables in the dataset.
>
> Lists: For this method, the user needs to type the complete names of both set of variables. So for Actor the list would be "ASat,AAge" and for Partner the list would be "PSat,PAge". Order within a list does not matter, but the order needs to be the same across lists, in this case with Sat ahead of Age for both actor and partner lists. Variables on the list are separated by commas.
>
> Suffix: This is least obvious but often the simplest strategy (especially if ItoP created the pairwise dataset) and because it the simplest, it the default option. Presume that the variables are Sat_A, Age_A, Sat_P, and Age_P. Actor and partner are designated by a suffix, A or P. With this method, the user gives a single list without the suffix of "Sat,Age" and then tells the program what suffix and separator are. For APIM_MM the suffix defaults to "A" and "P" but that can be over-ridden. For this option you can change the names given to the variables for the text output. As can be seen above for the example, for “OtherPos” the name “Other Positivity” is used.

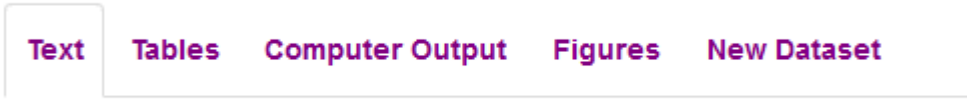
The user is free to decide which option is best. It is always advisable to verify in the output that the correct set of variables was chosen.

Considered first in an indistinguishable run and there is no need to use any of the options under **Distinguishable** or **Miscellaneous** tabs, but they are discussed later. To run this indistinguishable run, the user just clicks on the blue button “Estimate the Actor-Partner Interdependence Model!” on the top left.



The program does some screening for obvious errors: For instance, if the variables are not in the dataset or the same variable is a predictor and an outcome, the user is notified of the error.

When the analysis is successfully completed, which might take a few seconds, five purple horizontal tabs on the right side of the screen appear which produce five different types of results. They are Text, Tables, Computer Output, Figures, and New Dataset:



Below is what can be accessed for this run in each of the five purple horizontal tabs on the right:

Text

CAUTION: If you do decide to use information contained here in a paper, please make sure that you acknowledge that you have used this program. Also should you decide to copy the exact text below, you would need to put quotes around that material to avoid plagiarism. Although great effort has been undertaken to ensure the accuracy of results, no complete guarantee can be about their accuracy. It is your responsibility to check the results and text for accuracy. If you do find an error, please report it to David A. Kenny.

WARNINGS: 1. Because zero is not a possible value for Other Positivity, grand-mean centering that variable should be considered. 2. There are 2 outliers (standardized residual greater than 4 or less than -4) for Satisfaction. Examine the data to see what observations might be considered to be outliers. 3. There is evidence of negative skew in the residuals of Satisfaction.

Summary of APIM Results

The focus of this study is the investigation of the effect of Other Positivity on Satisfaction. Both the effect of own

Other Positivity (actor) and the effect of partner's Other Positivity (partner) on Satisfaction are studied. There are a total of 148 dyads and 296 individuals with no missing data. The means and standard deviations are presented in Table 1. The actor variable in the dataset is OtherPos_A, the partner variable in the dataset is OtherPos_P, and its name in the text is Other Positivity. To learn more about the Actor-Partner Interdependence Model (APIM), it might help to read Kenny, Kashy, Cook (2006) or Kashy and Kenny (2000). For more information about patterns of actor and partner effects, both Kenny and Cook (1999) and Kenny and Ledermann (2010) may be of help. There are webinars (at http://davidakenny.net/webinars/listw.htm#Dyad -- and there is a small charge) that can also be consulted.

The standard deviation of the errors is 0.417. The R squared for the full model is .295. The partial intraclass correlation for Satisfaction controlling for actor and partner variables equals .469 and is statistically significant ($p < .001$). Thus, the two members of the dyad are similar to one another. The intercept, the predicted score for Satisfaction when all predictors equal zero, is 0.670 and is statistically significant ($p = .039$).

The analyses use generalized least squares analysis with correlated errors and restricted maximum likelihood estimation. The tests of coefficients are Z tests and the tests of correlations are based on one-way analysis of variance tests. A summary of results of the analyses is contained in Table 2. Below are presented results for Other Positivity.

The actor effect for Other Positivity equals 0.400 and is statistically significant ($p < .001$). The standardized actor effect is 0.402 ($r = .423$ and a medium effect size). The partner effect equals 0.288 and is statistically significant ($p < .001$). The standardized partner effect is 0.289 ($r = .318$ and a medium effect size). The value of k or the ratio of the partner effect to the actor effect equals 0.719. The 95% confidence interval for k using the Monte Carlo Method (i.e., the parametric bootstrap) is from 0.491 to 1.002. It can be concluded that the contrast ($k = -1$) and the actor-only ($k = 0$) models are implausible and that the couple model ($k = 1$) is plausible.

Partition of Nonindependence

The correlation between the two members' scores on Satisfaction ignoring all the predictors is .618. We can determine how much of this correlation is explained by the Actor Interdependence Model. Overall the model explains a correlation of .290 or 46.90 percent of the total nonindependence. This overall explained correlation due to the model is made of two different pieces. (The percentages of explained correlation are only meaningful when the overall correlation is relatively substantial; moreover, it is very possible that some percentages are negative.) The first piece is spuriousness due to the combination of an actor and a partner effect for each mixed variable, which explains a correlation of .232 (37.59 percent of the total). The second piece is due the correlation of the actor and partner variables with actor or partner effects, which explains a correlation of .058 (9.31 percent of the total). The unexplained correlation equals .328 or 53.10 percent of the total nonindependence. A summary of these results is contained in Table 3.

References

Kashy, D. A., & Kenny, D. A. (2000). The analysis of data from dyads and groups. Reis, H. T., & Judd C. M. (Eds.), Handbook of research methods in social and personality psychology, pp. 451-477. New York: Cambridge University Press.

Kenny, D. A., & Cook, W. L. (1999). Partner effects in relationship research: Conceptual issues, analytic difficulties, and illustrations. Personal Relationships, 6, 433-448.

Kenny, D. A., Kashy, D. A., & Cook, W. L. (2006). Dyadic data analysis. New York: Guilford Press.

Kenny, D. A., & Ledermann, T. (2010). Detecting, measuring, and testing dyadic patterns in the actor-partner interdependence model. Journal of Family Psychology, 24, 359-366.

Tables

Table 1: Descriptive Statistics

	Mean	SD	Minimum	Maximum
Satisfaction	3.605	0.496	1.167	4.000
Other Positivity	4.264	0.498	2.600	5.000

Table 2: Effect Estimates for the Actor-Partner Interdependence Model

Variable	Effect	Estimate	Lower	CI_95	Upper	p_value	Beta	r
Satisfaction	Intercept	0.670	0.038	to	1.302	.039		
Other Positivity	Actor	0.400	0.308	to	0.493	<.001	0.402	.423
	Partner	0.288	0.195	to	0.381	<.001	0.289	.318
	k	0.719	0.491	to	0.999			

Table 3: Partition of Nonindependence

Source of Correlation	Amount	% Total	Amount	% of Total
Overall Correlation	.618	100.00		
Total Due the APIM	.290	46.90		
Spurious Due to Actor and Partner Effects			.232	37.59
Correlation of the Actor and Partner Variables			.058	9.31
Unexplained Correlation	.328	53.10		

Computer Output

Model with Indistinguishable Dyads

The gls statement to run the indistinguishable model is:

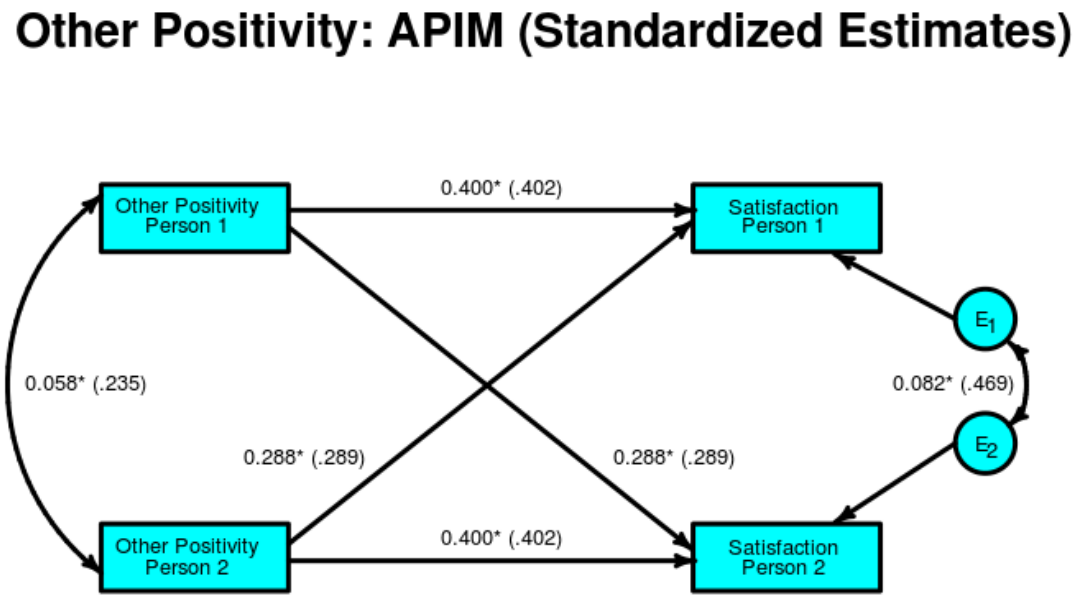
gls(outvar ~ OtherPos_A + OtherPos_P, na.action=na.omit, method="REML", verbose=TRUE, correlation=corCompSymm(form=~1|Dyad_ID), data=MaDa

The "DyadID" variable in the R syntax is CoupleID in the original dataset, the variable "outvar" is the outcome variable that was originally called Satisfaction_A, and MaDa is the new dataset created by R.

```
Generalized least squares fit by REML
  Model: pix
  Data: MaDa
```

```
       AIC      BIC    logLik
  306.7183 325.1191 -148.3591

Correlation Structure: Compound symmetry
 Formula: ~1 | Dyad_ID
 Parameter estimate(s):
      Rho
0.4693414

Coefficients:
                Value Std.Error  t-value p-value
(Intercept) 0.6697541 0.3224381 2.077155  0.0387
OtherPos_A  0.4004231 0.0473141 8.463075  0.0000
OtherPos_P  0.2879705 0.0473141 6.086351  0.0000

 Correlation:
           (Intr) OthP_A
OtherPos_A -0.793
OtherPos_P -0.793  0.267

Standardized residuals:
       Min         Q1        Med         Q3        Max
-4.7764701 -0.4655155  0.1302733  0.6414975  1.7720088

Residual standard error: 0.4173659
Degrees of freedom: 296 total; 293 residual
```

Figures

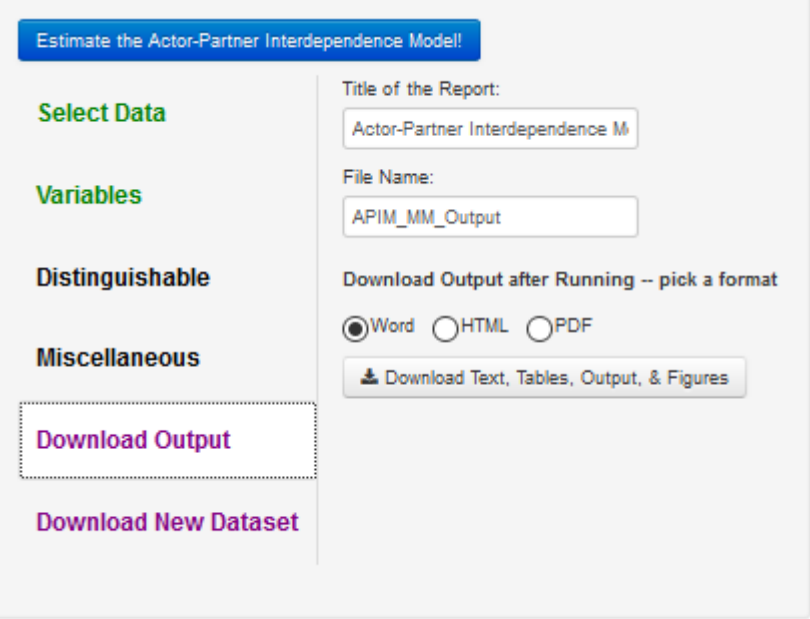


New Dataset

The first few cases of the dataset used in the analyses are presented below. The "DyadID" variable is CoupleID in the original dataset, and the variable "outvar" is the outcome variable that was originally called Satisfaction_A. Also the variable "sres" is the standardized residual error and "outl" denotes whether the observation is considered an outlier or not.

Dyad_ID	outvar	OtherPos_A	OtherPos_P	sres	outl
3	4.000000	4.6	4.0	0.806049059	0
10	3.166667	3.8	4.0	-0.423075761	0
11	3.833333	4.4	4.8	0.046623296	0
17	3.166667	3.6	4.4	-0.507183176	0
21	4.000000	3.8	4.8	1.021596415	0
22	3.666667	5.0	4.6	-0.790355569	0

The text, tables, computer output with setup, figure, and description of the new dataset can be accessed by clicking on the bottommost tab on the left: Download Output.

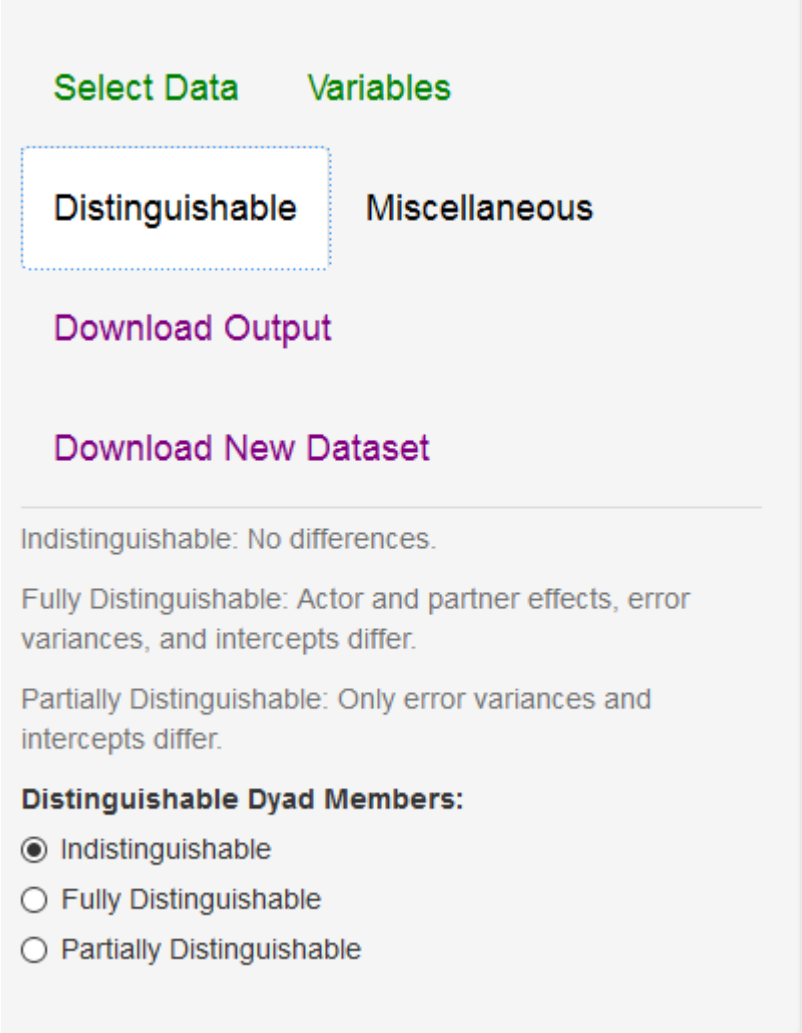


The user can change the name of the Title of the Report and the File Name. The format of the file is an option, allowing for docx, html, and pdf formats. The Output file also contains a few lines of the data file that is used for analysis. The docx (davidakenny.net/doc/APIM_MM_Output_Run1.docx), html (davidakenny.net/doc/APIM_MM_Output_Run1.html), and pdf (davidakenny.net/doc/APIM_MM_Output_Run1.pdf) versions can be downloaded.

More Complex Example

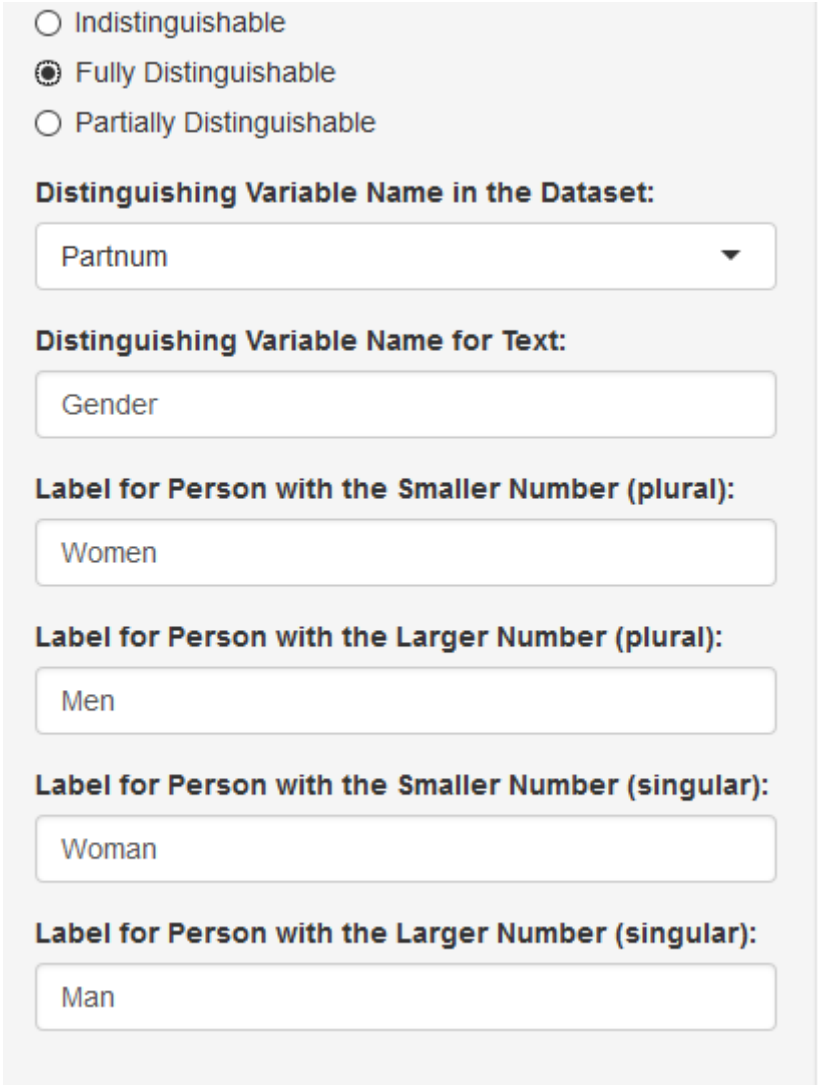
We next consider a much more complex example with distinguishable dyads, tests of interaction, covariates with interactions, and grand mean centering of the predictor variables.

If the user wanted to conduct an analysis with distinguishable dyads, the pairwise dataset would be loaded. There are two predictor variables for Satisfaction, being Other Positivity and Self Positivity. After the user enters variables, the user would click on the left tab “Distinguishable” to obtain the following screen:



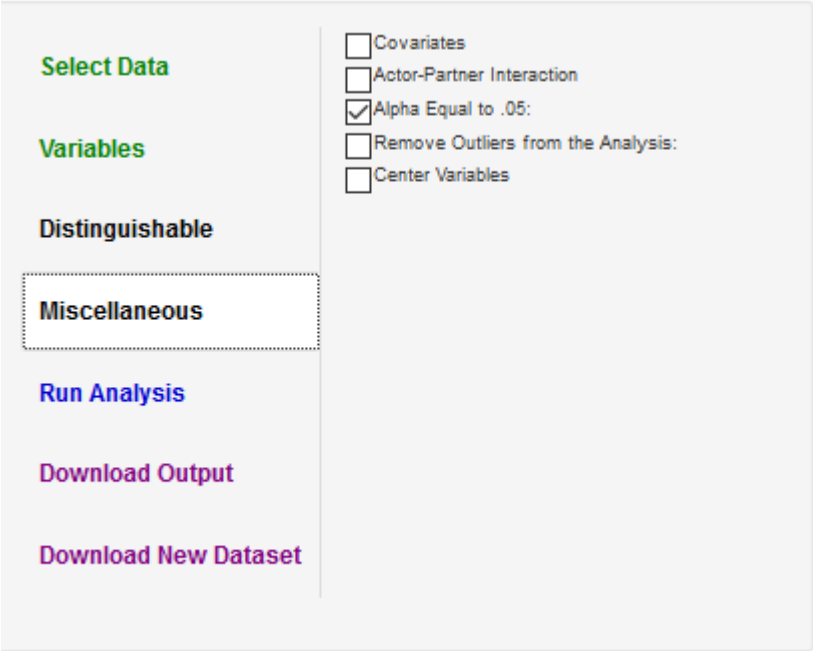
The program defaults to "Indistinguishable." The two options are "Fully Distinguishable," which would normally be chosen of "Partially Distinguishable," which has equal actor and partner effects for the two members on all mixed variables, but the intercepts and variances may differ.

If one checks on the screen shown above either "Fully or Partially Distinguishable," the following screen appears:



For this run, "Fully Distinguishable" was selected. One needs to select from the list a **numeric** variable in the dataset that is to be used to distinguish the two members. This must be a dichotomous within-dyads variable. For the text output, one needs to give names to the two members, both plural and singular. You must know which member has the lower and higher number in the dataset.

The one remaining tab is Miscellaneous. It allows the user to pick covariates by checking them from a list, test actor-partner interactions, change alpha, remove outliers, and center variables. Here all of these options are used, except changing alpha. Below is the screen that appears:

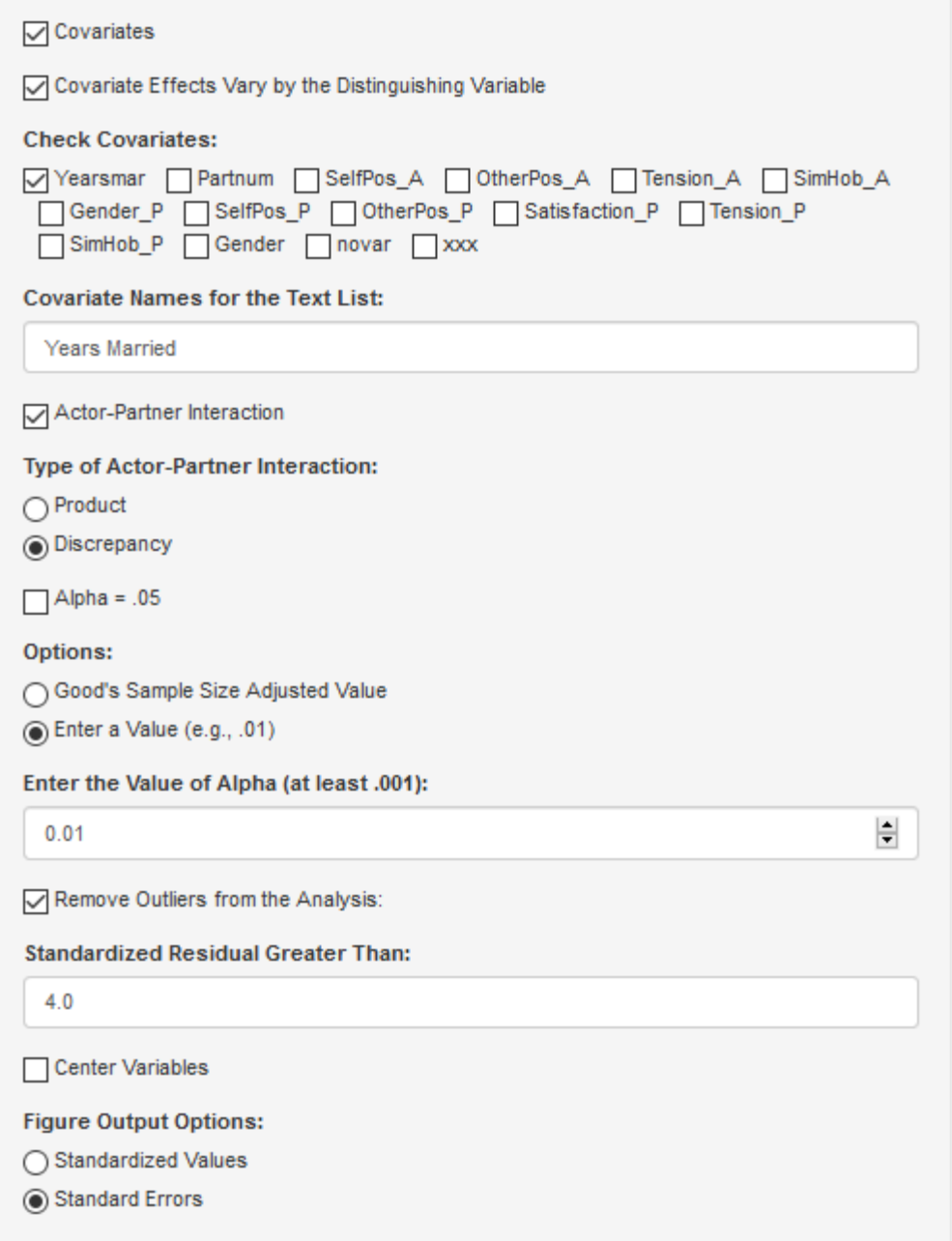


Covariates

The user first clicks the "Covariates" button and then selects the variables in the dataset that are covariates. If there is a distinguishing variable, the user may click on the button "Covariate Effects Vary by Distinguishing Variable" which allows for separate effects for Women and Men. Below just one covariate is chosen "Gender_num" and it is not given a name in the text, and so the default name of "Covariate 1" is used. Note that the name can have a space and special characters. If there are multiple covariates, each can be given a name, separated by commas, and in the same order as in the variable list.

Actor-Partner Interaction

Two different options are given. One is the product and the other is the discrepancy score. Note that the program just gives these interaction effects and its interpretation and does not give the results from the full model. Should the user want to get the full model results, the interaction must be created in the dataset and treated as a covariate by APIM_MM. If product terms are created it is advisable to first grand-mean center the variable first.



Alpha

The default is .05. However, users may pick their own value, but it must be at least .001. APIM_MM also offers the option to compute an alpha adjusted by sample size. Its formula is

$$\frac{.05}{\sqrt{n/100}}$$

where *n* is the number of dyads.

Outliers

The program will delete a person (not the dyad) if the outlier exceeds the value given. This option should be used carefully and the user should still carefully examine the values eliminated and understand why they are outliers. Moreover, currently APIM_MM uses a suboptimal definition of an outlier.

Centering

Three different types of centering can be chosen. First is grand-mean centering. Second is grand-mean centering of variables where "zero is not a possible value." What is meant by that is the maximum and minimum score of the variable is examined and if they are both greater than or less than zero, grand mean centering is conducted. So for instance if the variable is dichotomy that is effects coded (+1 and −1), technically zero is not possible, but this variable would not be grand mean centered if this centering option were chosen. Lastly, the variables, including the outcome, are all standardized. With distinguishable dyads, the pooled within-groups standard deviation is used.

After the above options are selected, the user goes to upper blue "Estimate the Actor-Partner Interdependence Model" tab to run the analysis. Again, there will be five parts of the output, all of which can be downloaded to a file.

Display on Figures

Either the standardized values (the default) or standard errors in parentheses are displayed in the figures.

Text

CAUTION: If you do decide to use information contained here in a paper, please make sure that you acknowledge that you have used this program. Also, should you decide to copy the exact text below, you would need to put quotes around that material to avoid plagiarism. Although great effort has been undertaken to ensure the accuracy of results, no complete guarantee can be about their accuracy. It is your responsibility to check the results and text for accuracy. If you do find an error, please report it to David A. Kenny.

WARNING: 1. Because the covariate explains less than one-half a percent for both Women and Men of the total variance, it might be dropped from the model.

Summary of APIM Results with Distinguishable Dyads

The focus of this study is the investigation of the effect of Other Positivity and Self Positivity on Satisfaction. Both

the effect of own Other Positivity and Self Positivity (actor) and the effect of partner's Other Positivity and Self Positivity (partner) on Satisfaction are studied. Separate actor and partner effects are estimated for Women and Men, the dyad members being distinguishable on the basis of their Gender. The user has chosen to remove outliers from the analysis. Standardized residuals that are greater than 4 in absolute value are treated as outliers. Such a strategy still requires a careful examination as to why the observations were dropped. There are 2 outliers in the dataset which have been removed from the analysis, and they are: Observation 183 from Dyad 357 whose score on Satisfaction is 1.500 with a standardized residual of -4.032, and lastly Observation 272 in Dyad 457 whose score is 1.167 with a standardized residual of -4.368. For the APIM analysis, there are a total of 148 dyads and 294 individuals with no missing data with a total of 147 Women and 147 Men. There are 2 dyads where there are complete data on only one of the two members with one being a Woman and other being a Man. Women are coded with a 1 and Men with a 2. For these analyses, Women are recoded with a -1 and Men with a 1. There is one covariate in the analysis: It is Years Married. The means and standard deviations before centering are presented in Table 1. For all subsequent analyses, all predictor variables are grand-mean centered. Because for some dyads only one member is measured, the descriptive statistics are based on both of the actor and partner variables. The actor variables in the dataset are OtherPos_A and SelfPos_A, the partner variables in the dataset are OtherPos_P and SelfPos_P, and their names in the text are Other Positivity and Self Positivity. The covariate in the dataset is Yearsmar and its name in the text is Years Married. To learn more about the Actor-Partner Interdependence Model (APIM), it might help to read Kenny, Kashy, Cook (2006) or Kashy and Kenny (2000). For more information about patterns, both Kenny and Cook (1999) and Kenny and Ledermann (2010) may be of help. There are webinars (at http://davidakenny.net/webinars/listw.htm#Dyad -- and there is a small charge) that can also be consulted.

For Women the standard deviation of the errors for Women is 0.420 and for Men is 0.349. The R squared of the full model for Women is .310 and for Men is .303. The proportion of total variance explained by the covariate after controlling for actor and partner variables for Women is .000 and for Men is .002. The proportion of total variance explained by the actor and partner variables after controlling for the covariate for Women is .310 and for Men is .303. The partial correlation for Satisfaction controlling for actor and partner variables and the covariate equals .466 and is statistically significant ($p < .001$). Thus, the errors of Women and Men are similar to one another. All predictor variables are grand-mean centered. The intercept for Women is 3.568 and is statistically significantly different from zero ($p < .001$) and the intercept for Men is 3.628 and is statistically significant ($p < .001$). The difference between the two, which is a test of the main effect of Gender, is not statistically significant ($p = .592$). The overall intercept is 3.598 and is statistically significantly different from zero ($p < .001$).

The analyses use generalized least squares analysis with correlated errors and restricted maximum likelihood estimation. The tests of coefficients are Z tests and the tests of correlations are based on t-tests of correlation coefficients. Effect sizes for actor and partner effects are partial correlations and d when the predictor is dichotomous. Betas are given twice, one using the overall standard deviation across all persons (o) and a second using the standard deviation for Women and Men separately (s). If betas are to be compared across members, the beta (o) value should be examined. A summary of results of the APIM analyses and the overall effects are in Tables 2 and 3. Below are presented results for each variable.

Other Positivity

The actor effect for Women equals 0.362 and is statistically significant ($p < .001$) and the standardized effect equals 0.389 ($r = .379$ and a medium effect size). The actor effect for Men equals 0.400 and is statistically significant ($p < .001$) and the standardized effect equals 0.430 ($r = .451$ and a medium effect size). The test that the two actor effects are statistically significantly different is not significant, $Z = 0.381$ ($p = .703$). The partner effect from Men to Women equals 0.365 and is statistically significant ($p < .001$) and the standardized effect equals 0.393 ($r = .377$ and a medium effect size). The partner effect for Women to Men equals 0.258 and is statistically significant ($p < .001$) and the standardized partner equals 0.277 ($r = .335$ and a medium effect size). The test that the two partner effects are statistically significantly different is not significant, $Z = -1.056$ ($p = .292$).

The combined actor effect across both Women and Men equals 0.381 and is statistically significant ($p < .001$) and the standardized effect equals 0.409 ($r = .411$ and a medium effect size). The combined partner effect across both Women and Men equals 0.311 and is statistically significant ($p < .001$) and the standardized effect equals 0.336 ($r = .358$ and a medium effect size). For Other Positivity overall, there is evidence for a couple model (Kenny & Cook, 1999) in that the actor and partner effects are not significantly different. (The sum of the actor and partner variables is a significant predictor but the difference is not.) It may make sense to sum or average the two Other Positivity scores. The overall k, the ratio of the partner effect to the actor effect, equals 0.817. The 95% confidence interval for k using the Monte Carlo Method (i.e., the parametric bootstrap) is from 0.579 to 1.118. It can be concluded that the contrast ($k = -1$) and the actor-only ($k = 0$) models are implausible and that the couple model ($k = 1$) is plausible.

Next considered are the relative sizes of actor and partner effects. For Other Positivity and Women, there is evidence for a couple model (Kenny & Cook, 1999) in that the actor and partner effects are not significantly different. (The sum of the actor and partner variables is a significant predictor but the difference is not.) It may make sense to sum or average the two Other Positivity scores. For Other Positivity and Men, there is evidence for a couple model (Kenny & Cook, 1999) in that the actor and partner effects are not significantly different. (The sum of the actor and partner variables is a significant predictor but the difference is not.) It may make sense to sum or average the two Other Positivity scores. The value of k for Women equals 1.010 and its 95% confidence interval using the Monte Carlo Method (i.e., the parametric bootstrap) is from 0.514 to 1.933. It can be concluded that the contrast ($k = -1$) and the actor-only ($k = 0$) models are implausible and that the couple model ($k = 1$) is plausible. The value of k for Men equals 0.644 and its 95% confidence interval using the Monte Carlo Method (i.e., the parametric bootstrap) from 0.317 to 1.132. It can be concluded that the contrast ($k = -1$) and the actor-only ($k = 0$) models are implausible and that the couple model ($k = 1$) is plausible. The 95% confidence interval using the Monte Carlo Method (i.e., the parametric bootstrap) for the difference between the k for Men minus the k for Women is from -0.490 to 1.477. Because zero is in the confidence interval, it can be concluded that the k for Women is not different from the k for Men.

The actor-partner interaction is measured using the product of the actor and partner variables for Other Positivity. First considered are the results for Women. The interaction equals -0.25876 and is not statistically significant ($p = .075$). The partner effect for actors who are one standard deviation above the overall mean on Other Positivity for Women is 0.237 ($p = .021$) and for actors who are one standard deviation below the mean is 0.493 ($p < .001$). (The value of Other Positivity for those scoring one standard deviation above the mean is 0.495 and for those scoring one standard deviation below the mean is -0.495). There is no evidence of an actor-partner interaction for Other Positivity for Women. Next considered are the results for Men. The interaction equals -0.18887 and is not statistically significant ($p = .205$). The partner effect for actors who are one standard deviation above the mean on Other Positivity for Men is 0.169 ($p = .076$) and for actors who are one standard deviation below the mean is 0.356 ($p < .001$). There is no evidence of an actor-partner interaction for Other Positivity for Men. The test that the actor-partner interaction is equal for Women and Men is not statistically significant ($p = .659$). There is no evidence that the actor-partner interaction differs for Women and Men. Next considered are the overall results across both Women and Men. The interaction equals -0.22382 and is not statistically significant ($p = .071$). The partner effect for actors who are one standard deviation above the mean on Other Positivity overall is 0.203 ($p = .008$) and for actors who are one standard deviation below the mean is 0.425 ($p < .001$). There is no evidence of an overall actor-partner interaction for Other Positivity.

Self Positivity

The actor effect for Women equals 0.119 and is not statistically significant ($p = .200$) and the standardized effect equals 0.103 ($r = .093$ less than small). The actor effect for Men equals -0.062 and is not statistically significant ($p = .421$) and the standardized effect equals -0.054 ($r = -.067$ less than small). The test that the two actor effects are statistically significantly different is not significant, $Z = -1.479$ ($p = .140$). The partner effect from Men to Women

equals -0.235 and is statistically significant (p = .013) and the standardized effect equals -0.203 (r = -.200 and a small effect size). The partner effect for Women to Men equals -0.033 and is not statistically significant (p = .662) and the standardized partner equals -0.029 (r = -.034 less than small). The test that the two partner effects are statistically significantly different is not significant, Z = 1.639 (p = .102).

The combined actor effect across both Women and Men equals 0.028 and is not statistically significant (p = .634) and the standardized effect equals 0.025 (r = .020 less than small). The combined partner effect across both Women and Men equals -0.134 and is statistically significant (p = .025) and the standardized effect equals -0.120 (r = -.126 and a small effect size). For Self Positivity overall, there is evidence for a contrast model (Kenny & Cook, 1999) in that the actor and partner effects are equal and opposite signs. (The difference between the actor and partner variables is a significant predictor but the sum is not.) It may make sense to difference the two scores of Self Positivity. The overall k, the ratio of the partner effect to the actor effect, equals -4.740. The 95% confidence interval for k using the Monte Carlo Method (i.e., the parametric bootstrap) is from -36.224 to 34.611. The confidence interval for k is very wide and it cannot be determined what model is the most likely.

Next considered are the relative sizes of actor and partner effects. For Self Positivity and Men, there is evidence for a contrast model (Kenny & Cook, 1999) in that the actor and partner effects are equal and opposite signs. (The difference between the actor and partner variables is a significant predictor but the sum is not.) It may make sense to difference the two scores of Self Positivity. The value of k for Women equals -1.974 and its 95% confidence interval using the Monte Carlo Method (i.e., the parametric bootstrap) is from -18.751 to 14.138. The confidence interval for k is very wide and it cannot be determined what model is the most likely. The value of k for Men equals 0.537 and its 95% confidence interval using the Monte Carlo Method (i.e., the parametric bootstrap) from -9.979 to 10.811. The confidence interval for k is very wide and it cannot be determined what model is the most likely. The 95% confidence interval using the Monte Carlo Method (i.e., the parametric bootstrap) for the difference between the k for Men minus the k for Women is from -28.931 to 25.209. Because zero is in the confidence interval, it can be concluded that the k for Women is not different from the k for Men.

The actor-partner interaction is measured using the product of the actor and partner variables for Self Positivity. First considered are the results for Women. The interaction equals -0.01632 and is not statistically significant (p = .927). The partner effect for actors who are one standard deviation above the overall mean on Self Positivity for Women is -0.244 (p = .045) and for actors who are one standard deviation below the mean is -0.231 (p = .027). (The value of Self Positivity for those scoring one standard deviation above the mean is 0.412 and for those scoring one standard deviation below the mean is -0.412). There is no evidence of an actor-partner interaction for Self Positivity for Women. Next considered are the results for Men. The interaction equals 0.00077 and is not statistically significant (p = .997). The partner effect for actors who are one standard deviation above the mean on Self Positivity for Men is -0.036 (p = .762) and for actors who are one standard deviation below the mean is -0.036 (p = .734). There is no evidence of an actor-partner interaction for Self Positivity for Men. The test that the actor-partner interaction is equal for Women and Men is not statistically significant (p = .928). There is no evidence that the actor-partner interaction differs for Women and Men. Next considered are the overall results across both Women and Men. The interaction equals -0.00777 and is not statistically significant (p = .959). The partner effect for actors who are one standard deviation above the mean on Self Positivity overall is -0.140 (p = .132) and for actors who are one standard deviation below the mean is -0.134 (p = .092). There is no evidence of an overall actor-partner interaction for Self Positivity.

Covariate

The percentage of variance uniquely explained by the covariate for Women is .000 and for Men is .002. The covariate Years Married is a between-dyads variable. Its overall effect across both Women and Men equals -0.004 and is not statistically significant (p = .299), and its standardized effect equals -0.047 (r = -.069 less than small). The effect of Years Married for Women equals -0.003 and is not statistically significant (p = .543), and its standardized effect equals -0.047 (r = -.043 less than small). The effect for Men equals -0.005 and is not

statistically significant (p = .220), and its standardized effect equals -.100. The test that these two effects are statistically significantly different is not significant, Z = -0.432 (p = .666). Because this test is not statistically significant, it cannot be concluded that there is a difference if the effect of Years Married on Satisfaction for Women and Men.

Test of Distinguishability

The question is whether Gender makes a statistically meaning difference: Is there a statistical benefit to treat dyad members as distinguishable? The test of overall distinguishability yields a chi square statistic with 7 degrees of freedom which equals 13.669 (p = .034). Because the test of distinguishability is statistically significant, we conclude that members can be statistically distinguished as Women and Men. A more focused examination of distinguishability can be undertaken. The test of the effect of Gender (the difference between intercepts) is not statistically significant, chi square(1) = 0.300 (p = .584). The test of the interactions of Gender with the actor effect is not statistically significant, chi square(2) = 2.322 (p = .313), and the test of the interactions of Gender with the partner effect is not statistically significant, chi square(2) = 3.653 (p = .161). The combined test of the interactions of Gender with both the actor and partner effect is not statistically significant, chi square(4) = 4.568 (p = .335). The test of covariate interactions is not statistically significant, chi square(1) = 0.194 (p = .660). The test that error variances are different is statistically significant, chi square(1) = 6.105 (p = .013). Finally, the test that a model that treats dyads as indistinguishable but allows for an effect due to Gender is not statistically significant, chi square(6) = 10.849 (p = .093). Table 4 summarizes these results.

Partition of Nonindependence

The correlation between the two members' scores on Satisfaction ignoring all the predictors is .621. We can determine how much of this correlation is explained by the Actor Interdependence Model. Overall the model a correlation of explains .323 or 51.97 percent of the total nonindependence. This overall explained correlation due to the model is made of three different pieces. (The percentages of explained correlation are only meaningful when the overall correlation is relatively substantial; moreover, it is very possible that some percentages are negative.) The first piece is spuriousness due to the combination of an actor and a partner effect for each mixed variable, which explains a correlation of .283 (45.58 percent of the total). The second piece is due the correlation of the actor and partner variables with actor or partner effects, which explains a correlation of .064 (10.26 percent of the total). The third piece is due the correlation between different mixed variables and their actor and partner effects, which explains a correlation of -.024 (-3.86 percent of the total). Overall the covariate explains a correlation of -.010 or -1.65 percent of the total nonindependence. This overall explained correlation due to the covariate is made of two different pieces. The first piece is due to the effects of the individual covariate on the two members, which explains a correlation of .004 (0.61 percent of the total). The second piece is due to the correlation between the covariate with the mixed variables and their effects, which explains a correlation of -.014 (-2.26 percent of the total). The unexplained correlation equals .308 or 49.68 percent of the total nonindependence. A summary of these results is contained in Table 5.

References

Kashy, D. A., & Kenny, D. A. (2000). The analysis of data from dyads and groups. Reis, H. T., & Judd C. M. (Eds.), Handbook of research methods in social and personality psychology, pp. 451-477. New York: Cambridge University Press.

Kenny, D. A., & Cook, W. L. (1999). Partner effects in relationship research: Conceptual issues, analytic difficulties, and illustrations. Personal Relationships, 6, 433-448.

Kenny, D. A., Kashy, D. A., & Cook, W. L. (2006). Dyadic data analysis. New York: Guilford Press.

Kenny, D. A., & Ledermann, T. (2010). Detecting, measuring, and testing dyadic patterns in the actor-partner interdependence model. Journal of Family Psychology, 24, 359-366.

Tables

Table 1: Descriptive Statistics before Centering

Variable	Role	Mean	SD	Minimum	Maximum
Satisfaction	Women	3.605	0.503	1.833	4.000
	Men	3.635	0.416	2.500	4.000
Other Positivity	Women	4.251	0.521	2.600	5.000
	Men	4.283	0.470	3.000	5.000
Self Positivity	Women	4.293	0.408	3.200	5.000
	Men	4.082	0.391	2.600	5.000
Yearsmar	Women	-0.062	7.710	-11.214	15.036
	Men	-0.055	7.717	-11.214	15.036

Table 2: Separate Effect Estimates for the Actor-Partner Interdependence Model for Women and Men

Variable	Role	Effect	Estimate	Lower	CI_95	Upper	p_value	Beta_(o)	Beta_(s)	r
Satisfaction	Women	Intercept	3.568	3.494	to	3.641	<.001			
	Men		3.628	3.567	to	3.689	<.001			
Other Positivity	Women	Actor	0.362	0.219	to	0.504	<.001	0.389	0.376	.379
		Partner	0.365	0.212	to	0.519	<.001	0.393	0.344	.377
		k	1.010	0.514	to	1.917				
	Men	Actor	0.400	0.258	to	0.543	<.001	0.430	0.449	.451
		Partner	0.258	0.104	to	0.411	<.001	0.277	0.322	.335
		k	0.644	0.323	to	1.130				
Self Positivity	Women	Actor	0.119	-0.062	to	0.300	.200	0.103	0.096	.093
		Partner	-0.235	-0.418	to	-0.052	.013	-0.203	-0.182	-.200
		k	-1.974	-19.56	to	15.134				
	Men	Actor	-0.062	-0.243	to	0.119	.421	-0.054	-0.059	-.067
		Partner	-0.033	-0.217	to	0.150	.662	-0.029	-0.033	-.034
		k	0.537	-9.637	to	9.836				
Years Married	Women		-0.003	-0.012	to	0.006	.543	-0.047	-0.043	-.043
	Men		-0.005	-0.012	to	0.003	.220	-0.079	-0.088	-.100

Table 3: Overall Effect Estimates for the Actor-Partner Interdependence Model

Variable	Effect	Estimate	Lower	CI_95	Upper	p value	Beta	r
Satisfaction	Intercept	3.598	3.598	to	3.598	<.001		
Other Positivity	Actor	0.381	0.288	to	0.474	<.001	0.409	.411
	Partner	0.311	0.217	to	0.406	<.001	0.336	.358
	k	0.817	0.579	to	1.117			
Self Positivity	Actor	0.028	-0.088	to	0.144	.634	0.025	.020
	Partner	-0.134	-0.250	to	-0.018	.025	-0.120	-.126

k	-4.740	-34.931	to	33.477		
Years Married	-0.004	-0.011	to	0.003	.299	-0.063 -.069

Table 4: Tests of Distinguishability

Eq. Ints.	Eq Actor	Eq. Partner	Eq. Covs.	Eq. Err. Vars.	chi square	df	p
Yes	Yes	Yes	Yes	Yes	13.669	7	.034
Yes	No	No	No	No	0.300	1	.584
No	Yes	Yes	No	No	4.568	4	.335
No	Yes	No	No	No	2.322	2	.313
No	No	Yes	No	No	3.653	2	.161
No	No	No	Yes	No	0.194	1	.660
No	No	No	No	Yes	6.105	1	.013
No	Yes	Yes	Yes	Yes	10.849	6	.093

Table 5: Partition of Nonindependence

Source of Correlation	Amount	% of Total	Amount	% of Total
Overall Correlation	.621	100.00		
Total Due the APIM	.323	51.97		
Spurious Due to A&P Effects			.283	45.58
Correlation of the A&P Variables			.064	10.26
Correlation between the Mixed Variables			-.024	-3.86
Total Due to the Covariate	-.010	-1.65		
Effect of the Covariate			.004	0.61
r's between the Cov. and the Mixed Vars.			-.014	-2.26
Unexplained Correlation	.308	49.68		

Computer Output (correlation of parameters omitted)

Two-Intercept Model with Distinguishable Dyads

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

gls(outvar ~ act11 + part11 + act21 + part21 + 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 CoupleID in the original dataset, the variable "outvar" is the outcome variable that was originally called Satisfaction_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 Other Positivity, 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 effect of Years Married for Women is "cci11", and for Men is "cci21."

```
Generalized least squares fit by REML
  Model: dogy
  Data: MaDa
       AIC     BIC    logLik
  308.5624 363.191 -139.2812

Correlation Structure: Compound symmetry
 Formula: ~1 | Dyad_ID
 Parameter estimate(s):
      Rho
0.4659472
Variance function:
 Structure: Different standard deviations per stratum
 Formula: ~1 | distvar
Nb b Parameter estimates:
       -1         1
1.0000000 0.8299517

Coefficients:
           Value  Std.Error   t-value p-value
act11   0.361809 0.07264918   4.98023  0.0000
part11  0.365297 0.07844285   4.65686  0.0000
act21   0.400293 0.06579656   6.08380  0.0000
part21  0.257695 0.06046042   4.26221  0.0000
act12   0.118813 0.09239476   1.28593  0.1995
part12 -0.234574 0.09338965  -2.51177  0.0126
act22  -0.062266 0.07732443  -0.80526  0.4213
part22 -0.033466 0.07648367  -0.43755  0.6620
d1      3.567518 0.03761872  94.83358  0.0000
d2      3.627993 0.03106261 116.79617  0.0000
cci11  -0.002815 0.00461935  -0.60944  0.5427
cci21  -0.004733 0.00385354  -1.22832  0.2204

Standardized residuals:
       Min         Q1        Med         Q3        Max
-3.3635939 -0.4432108  0.1476701  0.6242881  2.0555376

Residual standard error: 0.4200377
Degrees of freedom: 294 total; 282 residual
```

Interaction Model with Distinguishable Dyads

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

gls(outvar ~ act11 + part11 + act21 + part21 + 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

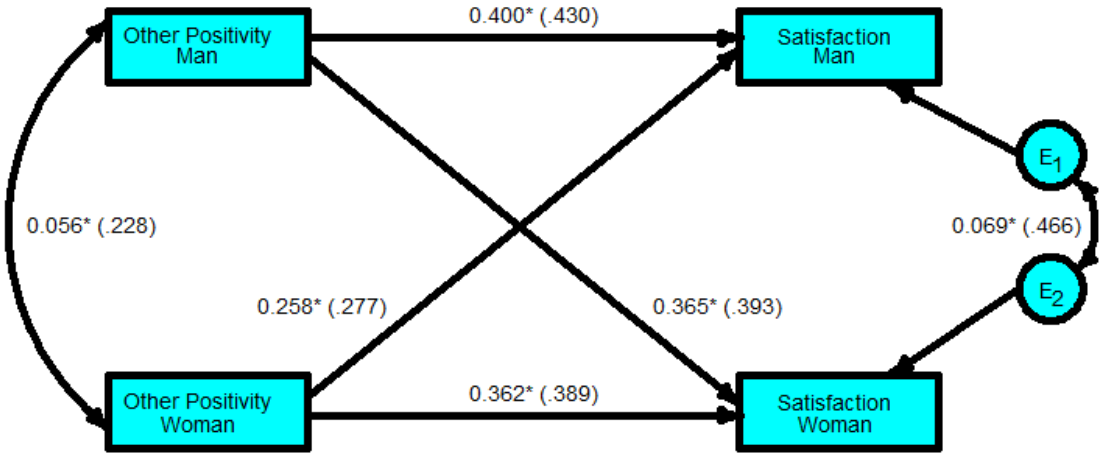
The "DyadID" variable in R syntax is CoupleID in the original dataset, the variable "outvar" is the outcome

variable that was originally called Satisfaction_A, and MaDa is the new dataset created by R. The variable "distvar" is the distinguishing variable which originally was Gender_A in the original dataset. For mixed variable Other Positivity the variables adi1 and pdi1 are the interaction product terms for the actor and partner variables with "distvar." The interaction of Years Married with "distvar" is cd1.

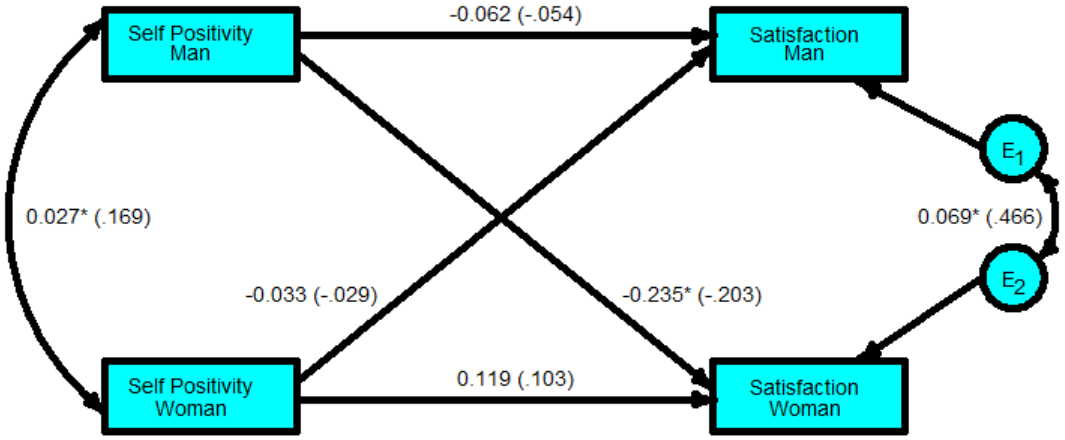
```
Generalized least squares fit by REML
  Model: dog
  Data: MaDa
       AIC      BIC    logLik
  316.8801 371.5087 -143.4401

Correlation Structure: Compound symmetry
 Formula: ~1 | Dyad_ID
 Parameter estimate(s):
      Rho
0.4659472
Variance function:
 Structure: Different standard deviations per stratum
 Formula: ~1 | distvar
 Parameter estimates:
       -1         1
1.0000000 0.8299517

Coefficients:
                Value  Std.Error   t-value p-value
(Intercept)  3.597756 0.02941554 122.30800  0.0000
adi1         0.019242 0.05044531   0.38144  0.7032
pdi1        -0.053801 0.05094270  -1.05611  0.2918
adi2        -0.090540 0.06122377  -1.47883  0.1403
pdi2         0.100554 0.06133697   1.63937  0.1023
distvar      0.135777 0.25310010   0.53646  0.5921
OtherPos_A   0.381051 0.04752700   8.01757  0.0000
OtherPos_P   0.311496 0.04805427   6.48217  0.0000
SelfPos_A    0.028273 0.05924169   0.47726  0.6335
SelfPos_P   -0.134020 0.05935879  -2.25779  0.0247
Yearsmar    -0.003774 0.00362709  -1.04059  0.2990
cd1         -0.000959 0.00222223  -0.43159  0.6664

Standardized residuals:
       Min         Q1        Med         Q3        Max
-3.3635939 -0.4432108  0.1476701  0.6242881  2.0555376

Residual standard error: 0.4200377
Degrees of freedom: 294 total; 282 residual
```

Figures

Other Positivity: APIM (Standardized Estimates)



Self Positivity: APIM (Standardized Estimates)



New Dataset

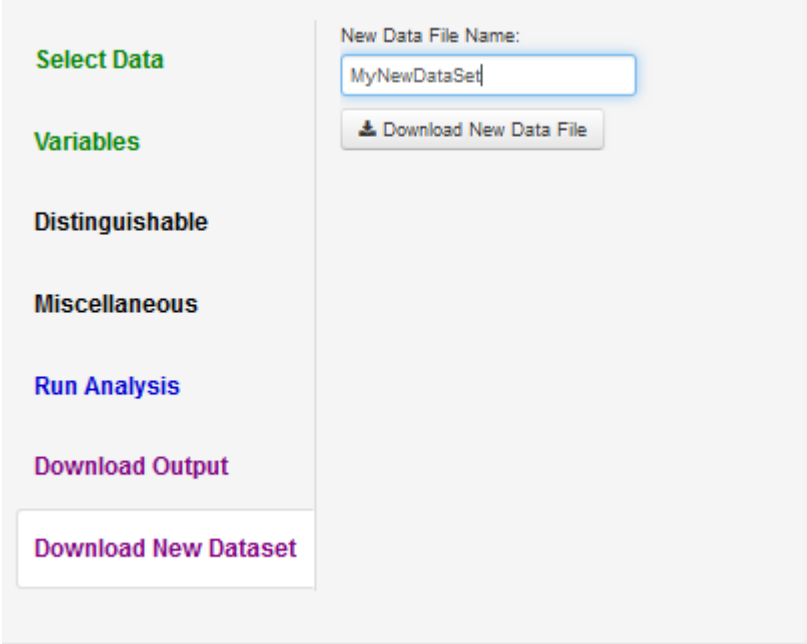
The first few cases of the dataset used in the analyses are presented below. The "DyadID" variable is CoupleID in the original dataset, and the variable "outvar" is the outcome variable that was originally called Satisfaction_A. Also the variable "sres" is the standardized residual error and "outl" denotes whether the observation is considered an outlier or not. The variable "distvar" is the distinguishing variable which originally was Gender_A in the original dataset. The variables d1 and d2 are dummy variables for the Women and Men, respectively. The variables adi1 and pdi1 are the interaction product terms for the Other Positivity actor and partner variables with the distinguishing variable dummies; additionally, 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 interaction of Years Married with "distvar" is cd1, and The effect of Years Married for Women is "cci11", and for Men is "cci21."

(some of the data below)

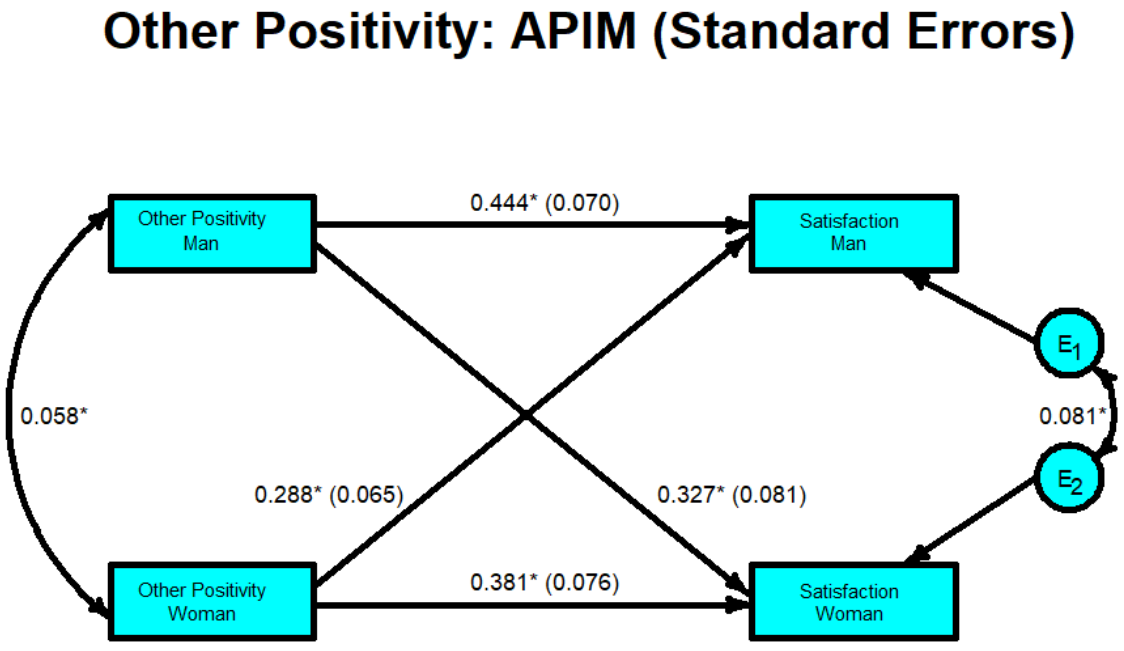
Dyad_ID	outvar	distvar	OtherPos_A	OtherPos_P	Yearsmar	adi1	pdi1	cd1
3	4.000000	-1	0.33061224	-0.26938776	8.26105442	-4.6	-4.0	-8.20266667
3	3.666667	1	-0.26938776	0.33061224	8.26105442	4.0	4.6	8.20266667
10	3.166667	-1	-0.46938776	-0.26938776	10.51105442	-3.8	-4.0	-10.4526667
10	3.666667	1	-0.26938776	-0.46938776	10.51105442	4.0	3.8	10.4526667
11	3.833333	-1	0.13061224	0.53061224	-8.23894558	-4.4	-4.8	8.29733333
11	3.833333	1	0.53061224	0.13061224	-8.23894558	4.8	4.4	-8.29733333

The user can request that all of this output can be written to a file. The docx (davidakenny.net/doc/APIM_MM_Output_Run2.docx), html (davidakenny.net/doc/APIM_MM_Output_Run2.html), and pdf (davidakenny.net/doc/APIM_MM_Output_Run2.pdf) versions of this output can be downloaded.

The user can also download the dataset used for the analysis which has in it the dummy variables for the distinguishing variables, the interaction terms, and terms created to test the actor-partner interaction effect.



If standard errors are requested, the figure looks as follows:



Moderation Example

APIM_MM can be used to test actor and partner interactions with a between-dyads variable. (The Output file from this example can be downloaded here.) The example uses Years Married as the between-dyads moderator of the effect of Other Positivity on Satisfaction. Within the dyad dataset, there are three predictors, Yearsmar, OtherPos_A, and OtherPos_P, and one outcome variable, Satisfaction_A. The Years Married variable is centered (M = 11.214 years) and dyad members are distinguishable, husbands and wives, 148 of each. Two new variables are created: the product of Yearsmar and OtherPos_A or YO_A and the product of Yearsmar and OtherPos_P or YO_P. Using APIM_MM, the variables OtherPos_A and YO_A are actor variables, OtherPos_P and YO_P are partner variables, and YearsMar is a covariate. The resulting analysis yields results separately for wives and husbands (Table 2) and then pooled across both (Table 3):

Table 2: Separate Effect Estimates for the Actor-Partner Interdependence Model for Wives and Husbands

Variable	Role	Effect	Estimate	Lower	CI	Upper	p	Beta (o)	Beta (s)	r
Satisfaction	Wives	Intercept	0.480	-0.376	to	1.335	.273			
	Husbands		0.651	-0.054	to	1.356	.071			
Other Positivity	Wives	Actor	0.388	0.236	to	0.541	<.001	0.390	0.383	.386
		Partner	0.342	0.174	to	0.511	<.001	0.344	0.306	.316
		k	0.882	0.392	to	1.793				
	Husbands	Actor	0.427	0.275	to	0.579	<.001	0.429	0.438	.451
		Partner	0.268	0.099	to	0.437	<.001	0.269	0.303	.331
		k	0.627	0.299	to	1.161				
YM X OP	Wives	Actor	-0.003	-0.023	to	0.017	.764	-0.204	-0.191	-.025
		Partner	-0.002	-0.024	to	0.021	.881	-0.116	-0.109	-.013
		k	0.570	-13.670	to	13.532				
	Husbands	Actor	-0.001	-0.021	to	0.018	.886	-0.092	-0.099	-.012
		Partner	0.007	-0.016	to	0.030	.398	0.474	0.511	.071
		k	-5.131	-13.821	to	13.634				
Years Married	Wives		0.014	-0.095	to	0.124	.796	0.224	0.210	.022
	Husbands		-0.032	-0.122	to	0.058	.493	-0.490	-0.528	-.058

Table 3: Overall Effect Estimates for the Actor-Partner Interdependence Model

Variable	Effect	Estimate	Lower	CI 95	Upper	p value	Beta	r
Satisfaction	Intercept	0.565	0.371	to	0.760	.099		
Other Positivity	Actor	0.408	0.310	to	0.505	<.001	0.409	.414
	Partner	0.305	0.205	to	0.405	<.001	0.306	.322
	k	0.749	0.506	to	1.049			
Years Married X OP	Actor	-0.002	-0.015	to	0.010	.733	-0.148	-.019
	Partner	0.003	-0.010	to	0.016	.689	0.179	.022
	k	-1.208	-13.232	to	14.262			
Years Married		-0.009	-0.094	to	0.077	.845	-0.133	-.014

The text from APIM_MM for the actor and partner effects for the interaction is as follows (comments added are in red):

The actor effect for Wives equals -0.003 and is not statistically significant (p = .764) and the standardized effect equals -0.204 (r = -.025 less than small). The actor effect for Husbands equals -0.001 and is not statistically significant (p = .886) and the standardized effect equals -0.092 (r = -.012 less than small). The test that the two actor effects are statistically significantly different is not significant, Z = 0.112 (p = .911). (Interaction effects are small and not significant for Husbands; the same also for Wives and for the pooled analysis.) The partner effect from Husbands to Wives equals -0.002 and is not statistically significant (p = .881) and the standardized effect equals -0.116 (r = -.013 less than small). The partner effect for Wives to Husbands equals 0.007 and is not statistically significant (p = .398) and the standardized partner equals 0.474 (r = .071 less than small). The test that the two partner effects are statistically significantly different is not significant, Z = 0.579 (p = .563). (Partner effect interactions are also not statistically significant.)

The combined actor effect across both Wives and Husbands equals -0.002 and is not statistically significant (p = .733) and the standardized effect equals -0.148 (r = -.019 less than small). (Interaction effect of Years Married and Actor is negative: The longer you are married the actor effect of Other Positivity on Satisfaction is weaker.) The combined partner effect across both Wives and Husbands equals 0.003 and is not statistically significant (p = .689) and the standardized effect equals 0.179 (r = .022 less than small). (Interaction effect of Years Married and Partner is positive: The longer you are married the partner effect of Other Positivity on Satisfaction is stronger.) The overall k, the ratio of the partner effect to the actor effect, equals -1.208. (The negative k value reflects that the actor and partner interaction effects are opposite in sign.) The 95% confidence interval for k using the Monte Carlo Method (i.e., the parametric bootstrap) is from -13.232 to 14.262. The confidence interval for k is very wide and it cannot be determined what model is the most likely.

Next are considered are the relative sizes of actor and partner effects. The value of k for Wives equals 0.570 and its 95% confidence interval using the Monte Carlo Method (i.e., the parametric bootstrap) is from -13.670 to 13.532. The confidence interval for k is very wide and it cannot be determined what model is the most likely. The value of k for Husbands equals -5.131 and its 95% confidence interval using the Monte Carlo Method (i.e., the parametric bootstrap) from -13.821 to 13.634. The confidence interval for k is very wide and it cannot be determined what model is the most likely. The 95% confidence interval using the Monte Carlo Method (i.e., the parametric bootstrap) for the difference between the k for Husbands minus the k for Wives is from -28.078 to 28.927. Because zero is in the confidence interval, it can be concluded that the k for Wives is not different from the k for Husbands. (In some cases, not this one because the k's are so unstable, it is important to know if the k's are the same.)

To assist in the interpretation, the analysis was repeated by adding 10 years to the centered Years Married variable, and so zero on this new variable refers to people married about 1 years. APIMM_MM was run with this new moderator, and the actor and partner effects for Other Positivity refer to their effects when Years Married was about 1 year. The analysis was repeated but this time subtracting 10 years from Years Married, and in this analysis, actor and partner effects of Other Positivity refer to those married about 21 years. The results from the pooled analysis are as follows:

	Years Married		
	M – 10	Mean	M + 10
Actor	0.429	0.408	0.386
Partner	0.279	0.305	0.332

We see that for people married over 20 years the actor and partner effects are nearly the same. They get more different when they have been recently married.

The pdf version of this output can be downloaded at davidakenny.net/doc/APIM_MM_Output_Run3.pdf.

User Input

I invite others to help in this effort. Most importantly, please notify me or any errors that you find in the program. I am also interested in suggestions to improve the program. As mentioned above, I am looking for better measures of outliers and a way of adding Satterthwaite degrees of freedom to the tests of the effects of actor, partner and covariates. Finally, if you want add new options to the program, I urge you share with me your suggestions and ideally R code.

Several published papers have used APIM_MM. Among them are:

Raihala, C., & Kranz, D. (2018). Choose it or lose it: The implicit power motive in children and their resource control behavior. *Motivation Science*, http://dx.doi.org/10.1037/mot0000093.

Strelan, P. & Pagoudis, S. (2018). Birds of a feather flock together: The interpersonal process of objectification within intimate heterosexual relationships. *Sex Roles 79*, 72.

Vadgama, D. P. (2017). *Father involvement among Asian-Indian immigrants in the United States: Actor-Partner Interdependence Model*. Dissertation, Syracuse University.

Velten, J., Brailovskaia, J. & Margraf, J. (2018). Exploring the impact of personal and partner traits on sexuality: Sexual excitation, sexual inhibition, and Big Five predict sexual function in couples. *The Journal of Sex Research*, in press.

Volmer, L., Rösner, S., Toth, B., Strowitzki, T. & Wischmann, T. (2017). Infertile partners' coping strategies are interrelated - Implications for targeted psychological counseling. *Geburtshilfe und Frauenheilkunde*, *77*, 52-58.

Zhang, F., Fung, H., & Kwok, T. (2017) Spouse's subjective social status predicts older adults' prospective cognitive functioning. *Aging & Mental Health*, DOI: 10.1080/13607863.2017.1406449.