MEDYAD: An Analytical Tool for Assessing Mediation in Distinguishable Dyads

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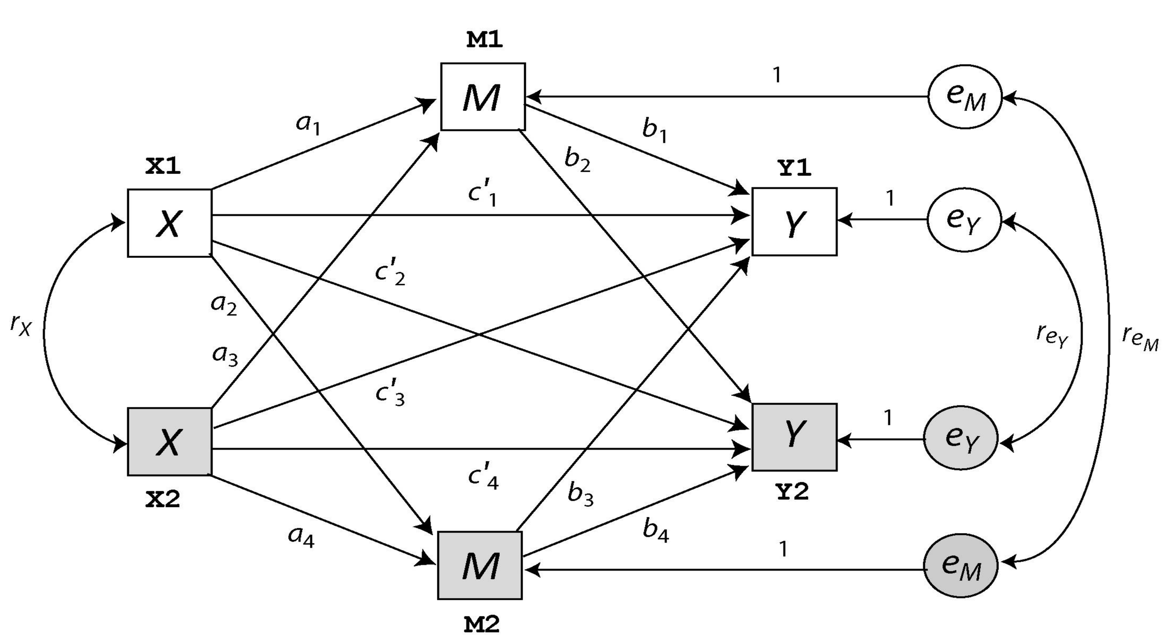
The APIMeM

The dyad is the fundamental unit of interpersonal interaction (Kenny, Kashy, & Cook, 2006). Consequently, it is important for researchers to measure dyads as they seek to understand social phenomenon. Constructs such as love, conflict, and friendship not only say something about one specific individual, but rather both persons involved.

Dyadic data analysis has grown in popularity in recent years, and continues to grow as quantitative methods develop and become more accessible for substantive researchers. Mediation analysis is a popular analytical technique in the social sciences that investigates how one variable causes another through one or more mediating variable(s) (Hayes, 2018). The **A**ctor **P**artner **I**nterdependence **M**odel **E**xtended to **M**ediation (APIMeM) applies this methodology to a dyadic framework and is an extension of the Actor Partner Interdependence Model, a model commonly used in dyadic data literature. A statistical diagram of the APIMeM, with the corresponding regression equations, is presented below. In the basic APIMeM, there are three constructs measured by six mixed variables. This results in eight indirect effects, four total effects, and four direct effects that can be estimated.

The APIMeM is typically estimated using a structural equation modeling (SEM) program, or through a series of regression equations. While the estimation procedure differs between SEM and OLS regression, the substantive conclusions reached are often (if not always) identical (Hayes, Montoya, & Rockwood, 2017).



$$\widehat{M1} = i_{M1} + a_1X1 + a_3X2$$
$$\widehat{M2} = i_{M2} + a_2X1 + a_4X2$$
$$\widehat{Y1} = i_{Y1} + c'_1X1 + c'_3X2 + b_1M1 + b_3M2$$
$$\widehat{Y2} = i_{Y2} + c'_2X1 + c'_4X2 + b_2M1 + b_4M2$$

MEDYAD Overview

The estimation of the APIMeM can be difficult/tedious and requires that the researcher be familiar with statistical programming in software such as Mplus. This difficulty is amplified when comparing indirect effects with each other. However, with just one line of code, MEDYAD allows researchers to estimate these types of models in SPSS and SAS with a bevy of other features.

In its current form, MEDYAD allows for the specification of one or two *X*s and one or two *Y*s depending on whether they are between-dyad variables or mixed variables. MEDYAD also allows users to enter up to 12 mediators, *M*(s) (12 between-dyad mediators, 6 mixed mediators, or any combination thereof).

MEDYAD estimates the direct and indirect effects of each actor's *X* on their own and their partner's *Y* through their own and their partner's *M*(s). Additionally, MEDYAD estimates total effects of each actor's *X* on their own and their partner's *Y*. All estimates are obtained via ordinary least squares (OLS) regression and inference about indirect effects and contrasts between them are obtained via percentile bootstrap confidence intervals. Contrasts are calculated within and between dyad members and within and between mediators.

By default, MEDYAD will print descriptive statistics for the variables entered in the model (e.g., correlations, means, standard deviations) and a correlation matrix for the residuals of the *M*s and *Y*s. MEDYAD is designed to handle the APIMeM and special cases/extensions of this model with just small changes to the syntax command.

(SPSS) Syntax Structure*

MEDYAD y = y var(s)/x = x var(s)/m = m var(s)
/mb = [...]
/boot = **[5000*]**
/maxboot = **[10000*]**
/cov = [cov(s)]
/cmatrix = [...]
/contrast = **[0*]** [1] [2] [3] [4]
/save = **[0*]** [1]
/conf = **[95*]**
/hc= [0] [1] [2] [3] [4] **[5*]**
/seed = **[random*]**
/decimals = **[F10.4*]**
/describe = [0] **[1*]**
/total = [0] **[1*]**.

*Everything in brackets is optional and not needed in order for the MEDYAD syntax to run. The bolded text in each subcommand is the default value and each command is described in detail in the documentation (details for obtaining MEDYAD and its documentation are available by scanning the QR Code at the bottom of the poster).

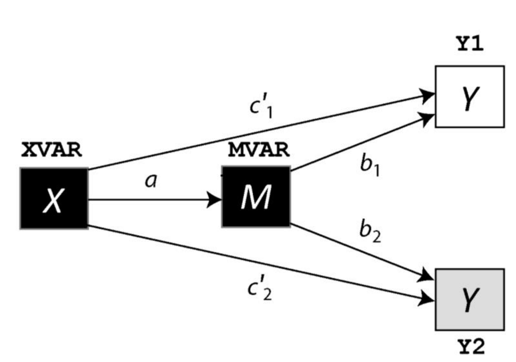
A dialog box for MEDYAD exists and can be permanently installed for those familiar with the graphical user interface of SPSS. The SAS syntax structure is similar to the SPSS version and the documentation is available in the same download folder.

Other Models

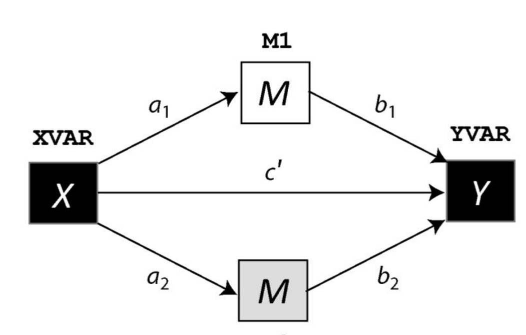
The APIMeM can take on many different forms depending on whether the *X*(s), *M*(s), and/or *Y*(s) are between-dyad or mixed variables, and depending on whether multiple mediators are entered. The conceptual diagrams of all seven variants of the APIMeM with one mediator and one example with two mediators are presented below with the corresponding MEDYAD commands.

Our notation:

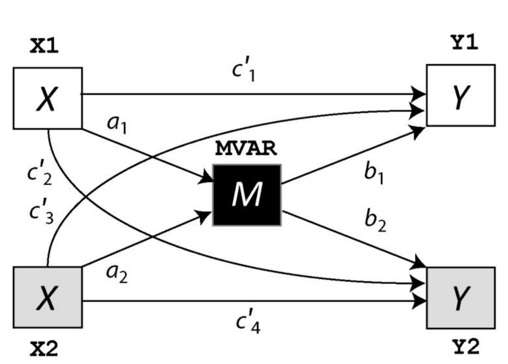
- □ Measurement of a characteristic of dyad member 1 (between or mixed)
- ▒ Measurement of a characteristic of dyad member 2 (between or mixed)
- ■ Measurement of a characteristic of the dyad (always between)



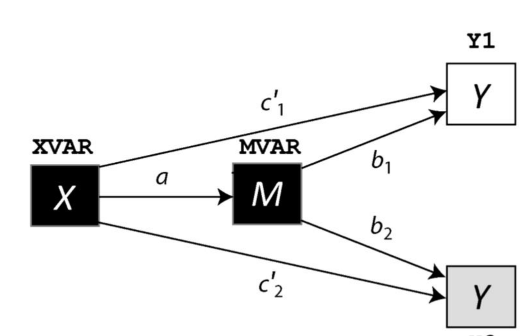
medyad y=Y1 Y2/x=XVAR/m=MVAR.



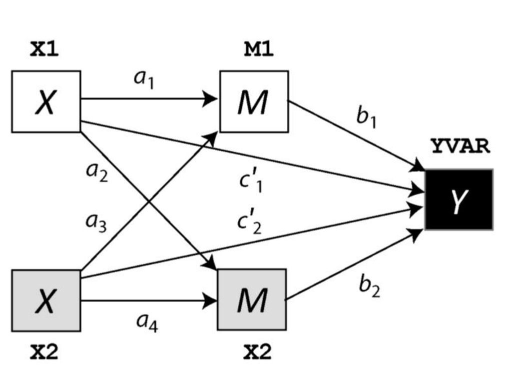
medyad y=YVAR/x=XVAR/m=M1 M2.



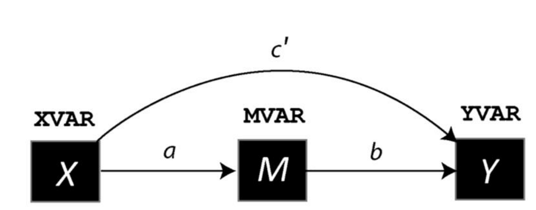
medyad y=Y1 Y2/x=X1 X2/m=MVAR.



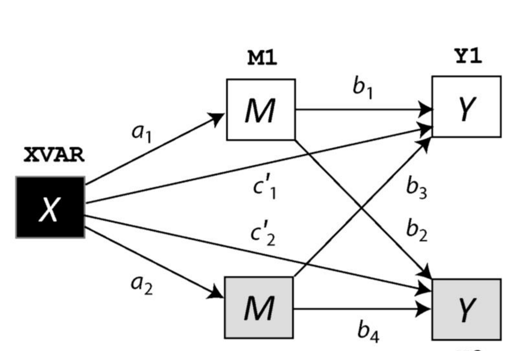
medyad y=Y1 Y2/x=XVAR/m=MVAR.



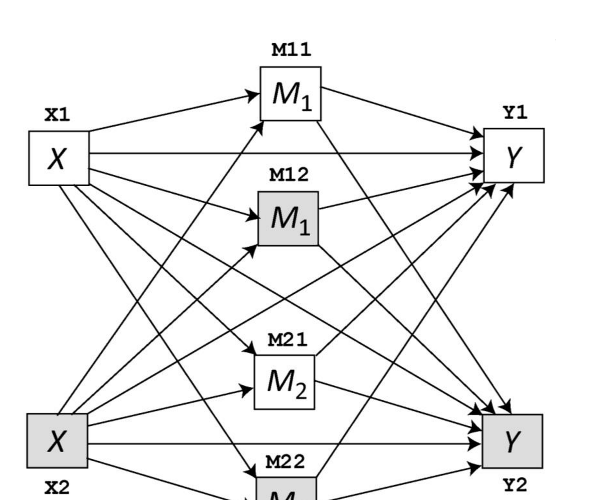
medyad y=YVAR/x=X1 X2/m=M1 M2.



medyad y=YVAR/x=XVAR/m=MVAR.



medyad y=Y1 Y2/x=XVAR/m=M1 M2.



medyad y=Y1 Y2/x=X1 X2/m=M11 M12 M21 M22.

Example Output

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******************** MEDYAD Procedure for SPSS Beta Version 1.1 *********************

         Written by Jacob J. Coutts, Andrew F. Hayes, Ph.D., and Tao Jiang

**************************************************************************************

Model Variables:
  X1 : X1
  X2 : X2
  Y1 : Y1
  Y2 : Y2

Paired Mediators:
  M1 : M1
  M2 : M2


N:  319

************************ DESCRIPTIVES FOR MODEL VARIABLES ************************

Descriptive Statistics of Model Variables
         Mean          SD         Min         Max
X1     1.5611       .8982       .0000      4.0000
X2     1.7962       .9107       .0000      4.0000
M1     8.3504      7.0800       .0000     41.0000
M2     7.8063      6.8506       .0000     43.0000
Y1    37.6270      6.7247     17.0000     50.0000
Y2    37.3605      7.1624     15.0000     50.0000

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Correlation Matrix of Antecedents and Consequents
           X1          X2          M1          M2          Y1          Y2
X1     1.0000       .1095       .4684       .0590      -.3068      -.1899
X2      .1095      1.0000       .0980       .4558      -.1881      -.2857
M1      .4684       .0980      1.0000       .0454      -.4454      -.3188
M2      .0590       .4558       .0454      1.0000      -.2250      -.3723
Y1     -.3068      -.1881      -.4454      -.2250      1.0000       .5612
Y2     -.1899      -.2857      -.3188      -.3723       .5612      1.0000

**************************************************************************************
Outcome:
 M1

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .4708      .2216    39.2641    44.9883     2.0000   316.0000      .0000

Model
              coeff         se          t          p       LLCI       ULCI
constant     1.9890      .9450     2.1049      .0361      .1298     3.8482
X1           3.6514      .3936     9.2776      .0000     2.8770     4.4257
X2            .3680      .3882      .9481      .3438     -.3957     1.1317

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Outcome:
 M2

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .4559      .2078    37.4125    41.4536     2.0000   316.0000      .0000

Model
              coeff         se          t          p       LLCI       ULCI
constant     1.5515      .9224     1.6820      .0936     -.2633     3.3664
X1            .0704      .3842      .1832      .8548     -.6855      .8262
X2           3.4210      .3789     9.0287      .0000     2.6755     4.1665

**************************************************************************************
Outcome:
 Y1

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .5036      .2537    34.1812    26.6793     4.0000   314.0000      .0000

Model
              coeff         se          t          p       LLCI       ULCI
constant    44.0674      .8918    49.4147      .0000    42.3128    45.8221
X1           -.8419      .4142    -2.0324      .0430    -1.6569     -.0269
X2           -.4370      .4067    -1.0746      .2834    -1.2372      .3632
M1           -.3600      .0525    -6.8592      .0000     -.4633     -.2568
M2           -.1710      .0538    -3.1800      .0016     -.2768     -.0652

**************************************************************************************
Outcome:
 Y2

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .4914      .2415    39.4073    24.9931     4.0000   314.0000      .0000

Model
              coeff         se          t          p       LLCI       ULCI
constant    44.2061      .9575    46.1664      .0000    42.3221    46.0901
X1           -.2214      .4448     -.4977      .6191    -1.0965      .6538
X2           -.9128      .4367    -2.0903      .0374    -1.7720     -.0536
M1           -.2839      .0564    -5.0373      .0000     -.3948     -.1730
M2           -.3190      .0577    -5.5245      .0000     -.4326     -.2054

************************* RESIDUAL CORRELATION MATRIX ****************************

           M1          M2          Y1          Y2
M1     1.0000      -.0045       .0000       .0000
M2     -.0045      1.0000       .0000       .0000
Y1      .0000       .0000      1.0000       .4482
Y2      .0000       .0000       .4482      1.0000

**************************** TOTAL EFFECT(S) MODEL(S) *****************************
Outcome:
 Y1

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .3439      .1183    40.1267    21.1902     2.0000   316.0000      .0000

Model
              coeff         se          t          p       LLCI       ULCI
constant    43.0860      .9553    45.1031      .0000    41.2065    44.9656
X1          -2.1685      .3979    -5.4503      .0000    -2.9513    -1.3857
X2          -1.1545      .3924    -2.9421      .0035    -1.9265     -.3824

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Outcome:
 Y2

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .3272      .1071    46.0971    18.9476     2.0000   316.0000      .0000

Model
              coeff         se          t          p       LLCI       ULCI
constant    43.1466     1.0239    42.1401      .0000    41.1321    45.1611
X1          -1.2804      .4264    -3.0025      .0029    -2.1194     -.4414
X2          -2.1084      .4206    -5.0131      .0000    -2.9359    -1.2809

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Correlation between residuals:
      .5202

********************** TOTAL, DIRECT, AND INDIRECT EFFECTS **********************

TOTAL, DIRECT, AND INDIRECT EFFECTS OF
 X1

Total effect(s) on
       effect         se          t          p       LLCI       ULCI
Y1    -2.1685      .3979    -5.4503      .0000    -2.9513    -1.3857
Y2    -1.2804      .4264    -3.0025      .0029    -2.1194     -.4414

Direct effect(s) on
       effect         se          t          p       LLCI       ULCI
Y1     -.8419      .4142    -2.0324      .0430    -1.6569     -.0269
Y2     -.2214      .4448     -.4977      .6191    -1.0965      .6538

Indirect Effect(s):
           effect     BootSE   BootLLCI   BootULCI
Ind1      -1.3146      .2519    -1.8438     -.8709
Ind2       -.0120      .0641     -.1356      .1224
Ind3      -1.0366      .2396    -1.5230     -.5790
Ind4       -.0224      .1157     -.2444      .2149

Indirect Effect Key:
 Ind1     :         X1        -->       M1        -->       Y1
 Ind2     :         X1        -->       M2        -->       Y1
 Ind3     :         X1        -->       M1        -->       Y2
 Ind4     :         X1        -->       M2        -->       Y2

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TOTAL, DIRECT, AND INDIRECT EFFECTS OF
 X2

Total effect(s) on
       effect         se          t          p       LLCI       ULCI
Y1    -1.1545      .3924    -2.9421      .0035    -1.9265     -.3824
Y2    -2.1084      .4206    -5.0131      .0000    -2.9359    -1.2809

Direct effect(s) on
       effect         se          t          p       LLCI       ULCI
Y1     -.4370      .4067    -1.0746      .2834    -1.2372      .3632
Y2     -.9128      .4367    -2.0903      .0374    -1.7720     -.0536

Indirect Effect(s):
           effect     BootSE   BootLLCI   BootULCI
Ind5       -.1325      .1574     -.4472      .1624
Ind6       -.5850      .2054     -.9959     -.1873
Ind7       -.1045      .1288     -.3803      .1215
Ind8      -1.0911      .2419    -1.5931     -.6389

Indirect Effect Key:
 Ind5     :         X2        -->       M1        -->       Y1
 Ind6     :         X2        -->       M2        -->       Y1
 Ind7     :         X2        -->       M1        -->       Y2
 Ind8     :         X2        -->       M2        -->       Y2
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References

Hayes, A. F. (2018). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York: The Guilford Press.

Hayes, A. F., Montoya, A. K., & Rockwood, N. J. (2017). The analysis of mechanisms and their contingencies: PROCESS versus structural equation modeling. *Australasian Marketing Journal (AMJ)*, *25*(1), 76-81.

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

Obtaining MEDYAD

In order to download MEDYAD and its documentation, please visit jjcoutts.com or scan the following QR Code:

If you wish to download a copy of this poster, scan the following code: