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statistical consultancy and training

Mplus code for mediation, moderation, and moderated mediation models

This webpage contains links to Mplus code for testing different configurations of mediation, moderation and moderated-mediation models, including those corresponding in type to the 76 configurations listed and indexed by Andrew Hayes in the documentation for his SPSS PROCESS macro and seminal text Introduction to Mediation, Moderation, and Conditional Process Analysis (Hayes, 2013), which I **strongly** recommend reading as a primer before undertaking such analyses.

Note that Mplus, whilst obviously requiring extra labour and skills, provides a completely flexible modelling environment that enables you to test unlimited configurations of moderation and mediation, not just the 76 PROCESS model types. Specifically, PROCESS is limited to a single primary IV and DV, continuous mediators, either parallel or serial mediators but not both, and dichotomous or continuous outcomes, where the assumptions of standard multiple regression/logistic regression as appropriate are satisfied. Mplus, on the other hand, can handle all of these scenarios, and can also handle models with multiple IVs and DVs, mediators in serial or in parallel, and models with non-normal DVs. Also, unlike PROCESS, it can handle mediation and moderation where the data structure is multilevel, and can incorporate latent variables.

Therefore, in recognition of this:

- **Further types of models that can't (yet!) be fitted by PROCESS have been added** (models 77 onwards), such as mediation with both serial and parallel mediators, moderated serial mediation, and moderated mediation with both serial and parallel mediators, and I will continue to add a selection of model types in the months and years ahead.
- For each model **I have also produced the code required for when constructs are measured by latent variables** as opposed to observed variables.

However producing examples of every modelling scenario that Mplus can handle would be a task of infinite length! For a few examples and some great papers regarding multilevel mediation modelling, see Kris Preacher's website. But my best advice is to try to **understand** the code I have provided as well as copying it - that way you will soon learn how to adapt it to your own ends...

For each of the models I have provided diagrams, the model equations, and most relevantly, the Mplus code for the requisite DEFINE:, ANALYSIS:, MODEL:, and OUTPUT: principal commands, as well as a preceding USEVARIABLES: subcommand that lists my hypothetical variables. To apply these examples to your data you will need to write the DATA: and VARIABLE: commands and change my hypothetical variable names to match yours.

We have found that, compared to the PROCESS macro, the more complex models can take a considerable amount of time to run (upwards of an hour), especially when bootstrapping is used (we tested the models using a relatively powerful laptop with an 8i processor). **Mplus also struggles to fit models (i.e. you get convergence failures) where measures are on scales with high variance** - where this is the case, rescaling predictors e.g. standardising them usually solves the problem.

This code and guidance to mediation and moderation testing is designed for people with some basic previous knowledge of Mplus. Before trying to use this code you need beginner's Mplus skills, specifically to know how to read your data into Mplus, how missing data is coded and treated, how models are estimated, how different outcome distributions are specified, how the BY, ON, WITH, and XWITH statements, and the @ and () symbols work, and how MODEL CONSTRAINT: enables functions of parameters to be tested.

To that end (shameless plug time!) I run occasional public courses on the basics of Mplus and on testing mediation, moderation and moderated-mediation models using Mplus or SPSS, and also offer these on an inhouse basis - though there are one or two good books on Mplus (I recommend Christian Geiser's 'Data Analysis with Mplus'), and a few other course providers run similar intro courses. Note also that from July 2016, statmodel.com (the programmers of Mplus) will be selling a book outlining the Mplus coding for various regression scenarios, including mediation models.

Anyway, I hope that you find this code helpful. Corrections to any code errors are very much welcomed. Best of luck with your analyses.

These pages were developed by Dr Chris Stride, with assistance from Sarah Gardner (programming/checking), Nick Catley (equation expansion/checking) and Ffion Thomas (diagram drawing, based on the original PROCESS diagrams by Andrew Hayes). To cite this page and/or any code used, please use:

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Model number	Arrangement of mediators and moderators	Number of distinct mediators	Number of distinct moderators	Code for observed variable example	Code for latent variable example

Model Template Selection

The model templates 1-76 linked to below match the equivalently numbered models associated with Andrew Hayes' PROCESS macro, though with two adaptations:

- First, where Andrew Hayes' templates specify a model and equation generalised from 1 to multiple mediators, then, for the purposes of providing specific example code in Mplus that matches a diagram, my code and diagrams have been written for a model with 2 mediators in mediator-only models (4 and 6) and 1 mediator in moderated mediation models (though the code could, of course, be edited to extend to as many mediators as is desired).
- Second, all my models and code exclude covariates - though of course these could easily be added by specifying them as predictors of the outcome and mediators by adding extra ON statements.

You can select the appropriate model to match the analysis you wish to perform by browsing the descriptions of the configurations in the Model Index table below and then clicking on the 'Link to code' column. **Further model configurations (over and above the PROCESS 'set' of 76) that I have written code for are numbered from 77 onwards.**

Model Index

All models have one primary IV and one DV. For the purposes of the calculation of indirect effects and conditional effects:

- The primary IV (variable X) is assumed to be continuous or dichotomous (or, for the latent variable model versions, a continuous factor)
- Moderators (variables W,V,Q,Z) are assumed to be continuous (or, for the latent variable model versions, continuous factors), though the only adaptation required to handle observed dichotomous moderators is in MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation)
- Mediators (variable M, or M1, M2, etc. in the multiple mediator examples) are assumed to be continuous (or, for the latent variable model versions, continuous factors)
- The DV (variable Y) is assumed to be continuous (or, for the latent variable model versions, a continuous factor) and to satisfy the assumptions of standard multiple regression - an example of how to handle an observed dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

If you would rather look through all the models at once, or need to work offline, then rather than using the index and individual files below, you can instead **download the index and files as a pdf file** (large!).

Model number	Arrangement of mediators and moderators	Number of distinct mediators	Number of distinct moderators	Code for observed variable example	Code for latent variable example
1a	1 moderator [BASIC MODERATION], continuous moderator	0	1	Mplus code	Mplus code
1b	1 moderator [BASIC MODERATION], dichotomous moderator	0	1	Mplus code	Coming soon
1c	1 moderator [BASIC MODERATION], dichotomous moderator (using multigroup method)	0	1	Mplus code	Coming soon
1d	1 moderator [BASIC MODERATION], categorical moderator with > 2 categories	0	1	Mplus code	Coming soon
1e	1 moderator [BASIC MODERATION], dichotomous outcome (logistic regression)	0	1	Mplus code	Coming soon
2	2 moderators, 2-way interactions with predictor only	0	2	Mplus code	Mplus code
3	2 moderators, all 2-way and 3-way interactions	0	2	Mplus code	Mplus code
4a	1 mediator [BASIC MEDIATION]	1	0	Mplus code	Mplus code
4b	2 mediators in parallel [BASIC MEDIATION]	1+	0	Mplus code	Mplus code
4c	1 or more mediators, in parallel if multiple (example uses 1) [BASIC MEDIATION], dichotomous mediator	1+	0	Mplus code	Coming soon
4d	1 or more mediators, in parallel if multiple (example uses 1) [BASIC MEDIATION], dichotomous outcome	1+	0	Mplus code	Coming soon
5	1 or more mediators, in parallel if multiple, 1 moderator of direct IV-DV path only	1+	1	Mplus code	Mplus code
6	2 or more mediators, in series (example uses 2)	2+	0	Mplus code	Mplus code
7	1 or more mediators, in parallel if multiple (example uses 1), 1 moderator of IV-Mediator path only	1+	1	Mplus code	Mplus code

Model number	Arrangement of mediators and moderators	Number of distinct mediators	Number of distinct moderators	Code for observed variable example	Code for latent variable example
8	1 or more mediators, in parallel if multiple (example uses 1), 1 moderator moderating both the IV-Mediator path and direct IV-DV path	1+	1	Mplus code	Mplus code
9	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the IV-Mediator path only	1+	2	Mplus code	Mplus code
10	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating both the IV-Mediator path and direct IV-DV path	1+	2	Mplus code	Mplus code
11	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the IV-Mediator path only, all 2-way and 3-way interactions	1+	2	Mplus code	Mplus code
12	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the IV-Mediator path and direct IV-DV path, all 2-way and 3-way interactions	1+	2	Mplus code	Mplus code
13	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating the IV-Mediator path, 3-way interaction, 1 also moderating direct IV-DV path	1+	2	Mplus code	Mplus code
14	1 or more mediators, in parallel if multiple (example uses 1), 1 moderator of Mediator-DV path only	1+	1	Mplus code	Mplus code
15	1 or more mediators, in parallel if multiple (example uses 1), 1 moderator of both Mediator-DV and direct IV-DV path	1+	1	Mplus code	Mplus code
16	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the Mediator-DV path only	1+	2	Mplus code	Mplus code
17	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating both the Mediator-DV and direct IV-DV path	1+	2	Mplus code	Mplus code
18	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the Mediator-DV path only, all 2-way and 3-way interactions	1+	2	Mplus code	Mplus code
19	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the Mediator-DV path and direct IV-DV path, all 2-way and 3-way interactions	1+	2	Mplus code	Mplus code
20	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating the Mediator-DV path, 3-way interaction, 1 also moderating direct IV-DV path	1+	2	Mplus code	Mplus code
21	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, 1 moderating the IV-Mediator path, 1 moderating the Mediator-DV path	1+	2	Mplus code	Mplus code
22	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, 1 moderating the IV-Mediator path and direct IV-DV path, 1 moderating the Mediator-DV path	1+	2	Mplus code	Mplus code
23	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path, 1 moderating the Mediator-DV path	1+	3	Mplus code	Mplus code
24	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating both the IV-Mediator path and direct IV-DV path, 1 moderating the Mediator-DV path	1+	3	Mplus code	Mplus code

Model number	Arrangement of mediators and moderators	Number of distinct mediators	Number of distinct moderators	Code for observed variable example	Code for latent variable example
25	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path with all 2-way and 3-way interactions, 1 moderating the Mediator-DV path	1+	3	Mplus code	Coming soon
26	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating both the IV-Mediator path and direct IV-DV path with all 2-way and 3-way interactions, 1 moderating the Mediator-DV path	1+	3	Mplus code	Coming soon
27	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path with all 2-way and 3-way interactions, one of which also moderates the direct IV-DV path, 1 moderating the Mediator-DV path	1+	3	Mplus code	Coming soon
28	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, 1 moderating the IV-Mediator path, 1 moderating the Mediator-DV path and direct IV-DV path	1+	2	Mplus code	Coming soon
29	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, 1 moderating the IV-Mediator path, 1 moderating the Mediator-DV path, both moderating the direct IV-DV path	1+	2	Mplus code	Coming soon
30	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path, 1 moderating both the Mediator-DV path and the direct IV-DV path	1+	3	Mplus code	Coming soon
31	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating both the IV-Mediator path and the direct IV-DV path, 1 moderating both the Mediator-DV path and the direct IV-DV path	1+	3	Mplus code	Coming soon
32	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path with all 2-way and 3-way interactions, 1 moderating both the Mediator-DV path and the direct IV-DV path	1+	3	Mplus code	Coming soon
33	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating both the IV-Mediator path and the direct IV-DV path with all 2-way and 3-way interactions, 1 moderating both the Mediator-DV path and the direct IV-DV path	1+	3	Mplus code	Coming soon
34	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path with all 2-way and 3-way interactions, one of which also moderates the direct IV-DV path, 1 moderating the Mediator-DV path and the direct IV-DV path	1+	3	Mplus code	Coming soon
35	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating the IV-Mediator path, 2 moderating the Mediator-DV path	1+	3	Mplus code	Coming soon
36	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating the IV-Mediator path, 2 moderating both the Mediator-DV path and the IV-DV path	1+	3	Mplus code	Coming soon
37	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating the IV-Mediator path, 2 moderating the Mediator-DV path with all 2-way and 3-way interactions	1+	3	Mplus code	Coming soon
38	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating the IV-Mediator path, 2 moderating both the Mediator-DV path and the IV-DV path, with all 2-way and 3-way interactions	1+	3	Mplus code	Coming soon

Model number	Arrangement of mediators and moderators	Number of distinct mediators	Number of distinct moderators	Code for observed variable example	Code for latent variable example
39	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating the IV-Mediator path, 2 moderating the Mediator-DV path with all 2-way and 3-way interactions, 1 of which also moderates the direct IV-DV path	1+	3	Mplus code	Coming soon
40	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating both the IV-Mediator path and the direct IV-DV path, 2 moderating the Mediator-DV path	1+	3	Mplus code	Coming soon
41	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating both the IV-Mediator path and the direct IV-DV path, 2 moderating both the Mediator-DV path and the direct IV-DV path	1+	3	Mplus code	Coming soon
42	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating both the IV-Mediator path and the direct IV-DV path, 2 moderating the Mediator-DV path all 2-way and 3-way interactions	1+	3	Mplus code	Coming soon
43	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating both the IV-Mediator path and the direct IV-DV path, 2 moderating both the Mediator-DV path and the direct IV-DV path with all 2-way and 3-way interactions	1+	3	Mplus code	Coming soon
44	1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating both the IV-Mediator path and the direct IV-DV path, 2 moderating the Mediator-DV path with all 2-way and 3-way interactions, 1 of which also moderates the direct IV-DV path	1+	3	Mplus code	Coming soon
45	1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path, with the other 2 moderating the Mediator-DV path	1+	4	Mplus code	Coming soon
46	1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path with all 2-way and 3-way interactions, with the other 2 moderating the Mediator-DV path	1+	4	Mplus code	Coming soon
47	1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path, with the other 2 moderating the Mediator-DV path with all 2-way and 3-way interactions	1+	4	Mplus code	Coming soon
48	1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path with all 2-way and 3-way interactions, with the other 2 moderating the Mediator-DV path with all 2-way and 3-way interactions	1+	4	Mplus code	Coming soon
49	1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate both the IV-Mediator path and the direct IV-DV path, with the other 2 moderating the Mediator-DV path	1+	4	Mplus code	Coming soon
50	1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path, with the other 2 moderating both the Mediator-DV path and the direct IV-DV path	1+	4	Mplus code	Coming soon
51	1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate both the IV-Mediator path and the direct IV-DV path with all 2-way and 3-way interactions, with the other 2 moderating the Mediator-DV path	1+	4	Mplus code	Coming soon

Model number	Arrangement of mediators and moderators	Number of distinct mediators	Number of distinct moderators	Code for observed variable example	Code for latent variable example
52	1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path with all 2-way and 3-way interactions, with the other 2 moderating both the Mediator-DV path and the direct IV-DV path	1+	4	Mplus code	Coming soon
53	1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate both the IV-Mediator path and the direct IV-DV path, with the other 2 moderating the Mediator-DV path with all 2-way and 3-way interactions	1+	4	Mplus code	Coming soon
54	1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path, with the other 2 moderating both the Mediator-DV path and the direct IV-DV path with all 2-way and 3-way interactions	1+	4	Mplus code	Coming soon
55	1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate both the IV-Mediator path and the direct IV-DV path with all 2-way and 3-way interactions, with the other 2 moderating the Mediator-DV path with all 2-way and 3-way interactions	1+	4	Mplus code	Coming soon
56	1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path with all 2-way and 3-way interactions, with the other 2 moderating both the Mediator-DV path and the direct IV-DV path with all 2-way and 3-way interactions	1+	4	Mplus code	Coming soon
57	1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate both the IV-Mediator path and the direct IV-DV path with all 2-way and 3-way interactions, with the other 2 moderating both the Mediator-DV path and the direct IV-DV path with all 2-way and 3-way interactions	1+	4	Mplus code	Coming soon
58	1 or more mediators, in parallel if multiple (example uses 1), 1 moderators, which moderates both the IV-Mediator path and the Mediator-DV path	1+	1	Mplus code	Coming soon
59	1 or more mediators, in parallel if multiple (example uses 1), 1 moderators, which moderates all of the IV-Mediator path, the Mediator-DV path and the direct IV-DV path	1+	1	Mplus code	Coming soon
60	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV-Mediator path, 1 of which also moderates the Mediator-DV path	1+	2	Mplus code	Coming soon
61	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV-Mediator path, 1 of which also moderates both the Mediator-DV path and the direct IV-DV path	1+	2	Mplus code	Coming soon
62	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV-Mediator path, 1 of which also moderates the Mediator-DV path, the with the other moderating the direct IV-DV path	1+	2	Mplus code	Coming soon
63	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV-Mediator path and the direct IV-DV path, 1 of which also moderates the Mediator-DV path	1+	2	Mplus code	Coming soon
64	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the Mediator-DV path, 1 of which also moderates the IV-Mediator path	1+	2	Mplus code	Coming soon

Model number	Arrangement of mediators and moderators	Number of distinct mediators	Number of distinct moderators	Code for observed variable example	Code for latent variable example
65	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the Mediator-DV path, 1 of which also moderates both the IV-Mediator path and the direct IV-DV path	1+	2	Mplus code	Coming soon
66	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the Mediator-DV path, 1 of which also moderates the IV-Mediator path, the with the other moderating the direct IV-DV path	1+	2	Mplus code	Coming soon
67	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the Mediator-DV path and the direct IV-DV path, 1 of which also moderates the IV-Mediator path	1+	2	Mplus code	Coming soon
68	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating the IV-Mediator path with all 2-way and 3-way interactions, 1 of which also moderates the Mediator-DV path	1+	2	Mplus code	Coming soon
69	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both of the IV-Mediator path and the direct IV-DV path, with all 2-way and 3-way interactions, 1 of which also moderates the Mediator-DV path	1+	2	Mplus code	Coming soon
70	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating the Mediator-DV path with all 2-way and 3-way interactions, 1 of which also moderates the IV-Mediator path	1+	2	Mplus code	Coming soon
71	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both of the Mediator-DV path and the direct IV-DV path, with all 2-way and 3-way interactions, 1 of which also moderates the IV-Mediator path	1+	2	Mplus code	Coming soon
72	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV-Mediator path and the Mediator-DV path, with all 2-way and 3-way interactions	1+	2	Mplus code	Coming soon
73	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating each of the IV-Mediator path, the Mediator-DV path and the direct IV-DV path, with all 2-way and 3-way interactions	1+	2	Mplus code	Coming soon
74	1 or more mediators, in parallel if multiple (example uses 1), IV also moderates the Mediator-DV path	1+	(1)	Mplus code	Coming soon
75	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV-Mediator path and the Mediator-DV path	1+	2	Mplus code	Coming soon
76	1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating each of the IV-Mediator path, the Mediator-DV path and the direct IV-DV path	1+	2	Mplus code	Coming soon
77	3 or more mediators, both in parallel and in series	3+	0	Mplus code	Coming soon
78	2 or more mediators, in series, 1 moderator moderating path between mediators	2+	1	Mplus code	Coming soon
79	3 or more mediators, both in parallel and in series, 2 moderators, 1 moderating paths between predictor and mediator, the second moderating paths between mediators, and between mediator and DV	3+	2	Mplus code	Coming soon
80	1 mediator, predictor has non-linear effect on mediator and outcome	1	0	Mplus code	Coming soon