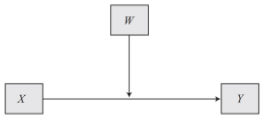
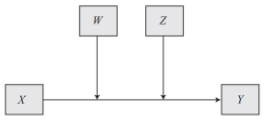
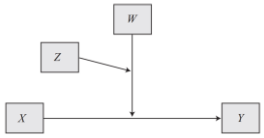
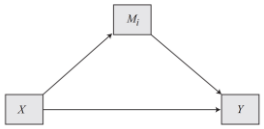
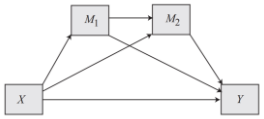
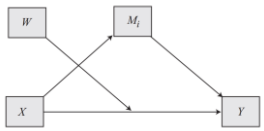
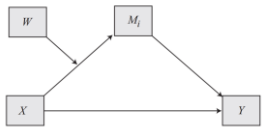
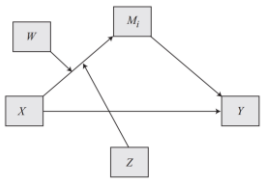
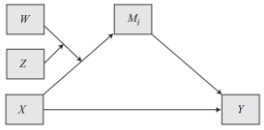
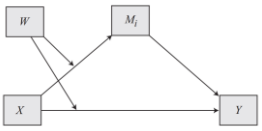
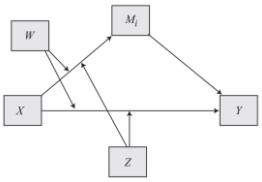
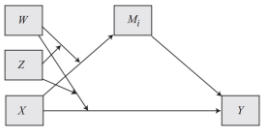
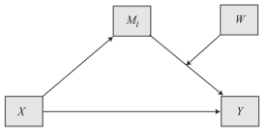
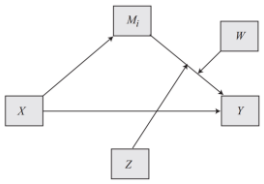
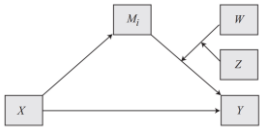
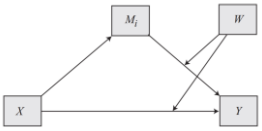
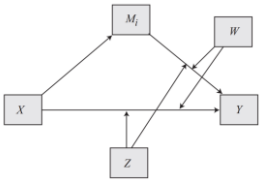
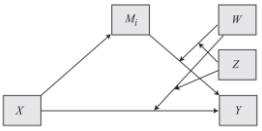
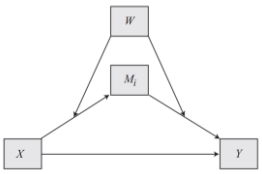
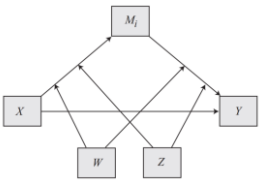
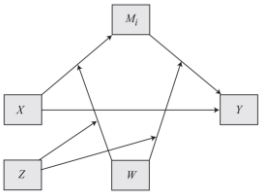
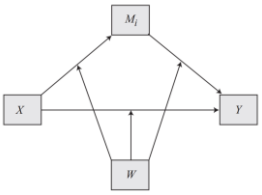
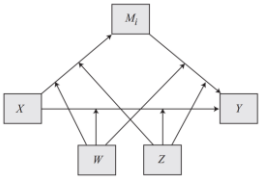
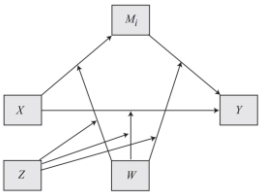
bruceR `PROCESS()` Function and SPSS `PROCESS` Macro

bruceR `PROCESS()` Function				SPSS `PROCESS` Macro*		Stats. Model**
meds	mods	med.type mod.type	mod.path	Model	Model Diagram	R Formula
–	1	–	–	1		Y ~ X*W *equivalent to:* Y ~ X + W + X:W
–	2	–	–	2		Y ~ X*W1 + X*W2
–	2	"3-way"	–	3		Y ~ X*W1*W2
1+	–	–	–	4		M ~ X Y ~ X + M
2~4	–	"serial"	–	6		M1 ~ X M2 ~ X + M1 Y ~ X + M1 + M2
1+	1~2	– "2-way" "3-way"	"x-y"	5 (5.2) (5.3)		M ~ X Y ~ X*W + M
1+	1	–	"x-m"	7		M ~ X*W Y ~ X + M + W
	2	–		9		M ~ X*W1 + X*W2 Y ~ X + M + W1 + W2
	2	"3-way"		11		M ~ X*W1*W2 Y ~ X + M + W1 + W2

1+	1	–	c("x-m", "x-y")	8		M ~ X*W Y ~ X*W + M
	2	–		10		M ~ X*W1 + X*W2 Y ~ X*W1 + X*W2 + M
	2	"3-way"		12		M ~ X*W1*W2 Y ~ X*W1*W2 + M
1+	1	–	"m-y"	14		M ~ X + W Y ~ X + M*W
	2	–		16		M ~ X + W1 + W2 Y ~ X + M*W1 + M*W2
	2	"3-way"		18		M ~ X + W1 + W2 Y ~ X + M*W1*W2
1+	1	–	c("m-y", "x-y")	15		M ~ X + W Y ~ X*W + M*W
	2	–		17		M ~ X + W1 + W2 Y ~ X*W1 + X*W2 + M*W1 + M*W2
	2	"3-way"		19		M ~ X + W1 + W2 Y ~ X*W1*W2 + M*W1*W2

1+	1	–	c("x-m", "m-y")	58		M ~ X*W Y ~ X + M*W
	2	–		75		M ~ X*W1 + X*W2 Y ~ X + M*W1 + M*W2
	2	"3-way"		72		M ~ X*W1*W2 Y ~ X + M*W1*W2
1+	1	–	"all"	59		M ~ X*W Y ~ X*W + M*W
	2	–		76		M ~ X*W1 + X*W2 Y ~ X*W1 + X*W2 + M*W1 + M*W2
	2	"3-way"		73		M ~ X*W1*W2 Y ~ X*W1*W2 + M*W1*W2

Note. By default, `med.type` is set to `"parallel"` and allows an *infinite number* of multiple mediators in parallel. By default, `mod.type` is set to `"2-way"`. The `bruceR::PROCESS()` function supports (generalized) linear models and (generalized) linear mixed models, or a mixture of various types of models. For other PROCESS models that are not supported by `bruceR::PROCESS()`, please use the official SPSS PROCESS macro, the official PROCESS R script "process.R" (currently *not* an R package), or the R packages "mediation", "interactions", and/or "lavaan".

* The SPSS PROCESS model numbers and diagrams are retrieved from *Introduction to Mediation, Moderation, and Conditional Process Analysis, Second Edition: A Regression-Based Approach* authored by Andrew F. Hayes. Copyright © 2018 The Guilford Press. (for FAQs about PROCESS, see https://www.processmacro.org/faq.html)

** The red part in R formula (`"+ W"`, `"+ W1 + W2"`) are moderator(s) *controlled as covariates* in the models, which differs from the official PROCESS but is more rigorous and rational. This is a technical limitation related to the `mediation::mediate()` function, which requires all moderators to be included in both "M" and "Y" models.

Variable Types Supported by bruceR `PROCESS()` and SPSS `PROCESS`

Variable				Software	
Y	X	Mediator(s)	Moderator(s)	bruceR PROCESS()	SPSS PROCESS
Continuous Dichotomous	Continuous Dichotomous	Continuous	Continuous Dichotomous Multicategorical	Yes	Yes
		Dichotomous		Yes	No
	Multicategorical	Continuous		No*	Yes
		Dichotomous		No*	No
	…	Multicategorical		No	No
Multicategorical	…	…		No	No

Note. `bruceR::PROCESS()` function also supports mediation and/or moderation analyses based on (generalized) linear mixed models (i.e., multilevel mediation/moderation).

* This is a limitation related to the `interactions::sim_slopes()` function, which does not support factor-type predictor. However, users could manually convert a multicategorical predictor (X) to numeric dummy variables.

Comparing Different Methods for Testing Indirect (Mediational) Effects

Method	Performance*		Software		
	Type I Error	Power	bruceR PROCESS()	SPSS PROCESS	jamovi jAMM
The "component" approach					
Joint-significance test	Very good	Good	Yes	Yes	Yes
The "index" approach					
Monte Carlo	Good	Good	`"mcmc"`	Yes	No
Percentile bootstrap	Good	Good	`"boot"`	Yes	Yes
Bias-corrected percentile bootstrap	Bad	Very good	`"bc.boot"`	Yes	No
Accelerated bias-corrected bootstrap	Bad	Very good	`"bca.boot"`	No	Yes

Note. The component approach is to test all component paths ("*a*" and "*b*") of an indirect effect. The index approach is to test a single mediation index ("*ab*") and its confidence interval using any resampling method (e.g., bootstrap).

* Yzerbyt, V., Muller, D., Batailler, C., & Judd, C. M. (2018). New recommendations for testing indirect effects in mediational models: The need to report and test component paths. *Journal of Personality and Social Psychology, 115*(6), 929–943. https://doi.org/10.1037/pspa0000132

Please update to the latest version of `bruceR` (https://CRAN.R-project.org/package=bruceR).

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2021-05-20