

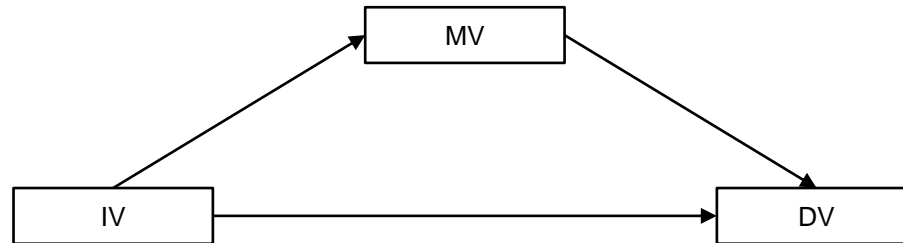
Mediation

Learning Centre

- 1** What is mediation?
- 2** Types of mediation models
- 3** SPSS example using PROCESS
Macro

What is mediation?

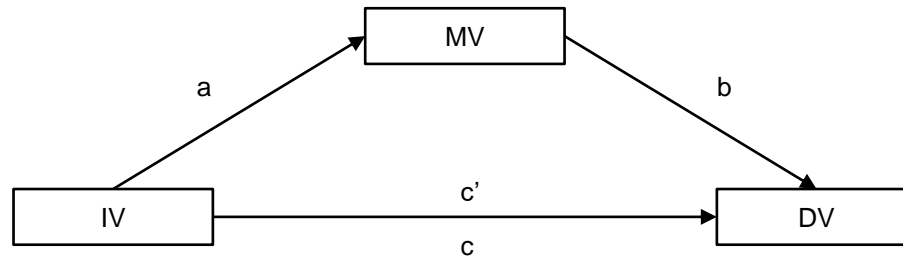
- Mediation occurs when a variable (MV) explains the relationship between an independent variable (IV) and a dependent variable (DV)
- In other words, the IV affects the MV, which in turn influences the DV
- For example, paying a higher salary (IV) leads to increased productivity (DV). However, upon further inspection, it was proposed that higher salary leads to higher morale, which then increases productivity.



What is mediation?

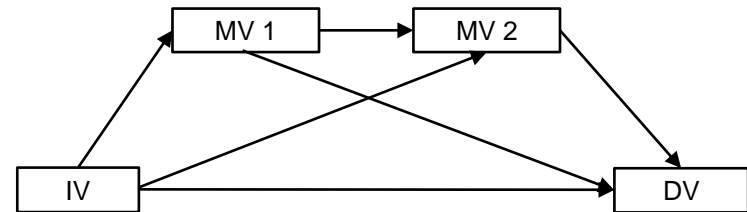
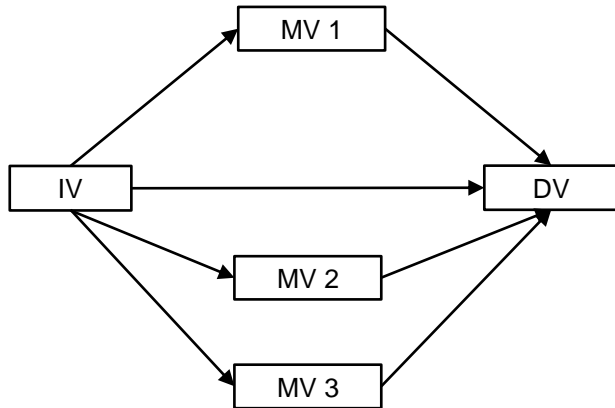
Typically, there are 5 key terms in mediation:

- 1) Path a – relationship between IV and MV
- 2) Path b – relationship between MV and DV while controlling for IV
- 3) Path c – relationship between IV and DV (also known as total effect)
- 4) Path c' – relationship between IV and DV while controlling for MV (direct effect)
- 5) Mediation effect – path a x path b (indirect effect)



Mediational Designs

- The mediational model shown in the previous slide is a single mediation design
- Other possible designs include multiple mediators, or sequential mediators
- Note that each design can have multiple paths a, b, c', but only 1 total effect (c)



Example

A company found that paying their employees better were associated with higher productivity. However, a manager pointed out that this could be due to the fact that better wages led to higher morale, which then led to higher productivity. In other words, do employees' morale mediate the relationship between salary and productivity?

Location of SPSS Data Files

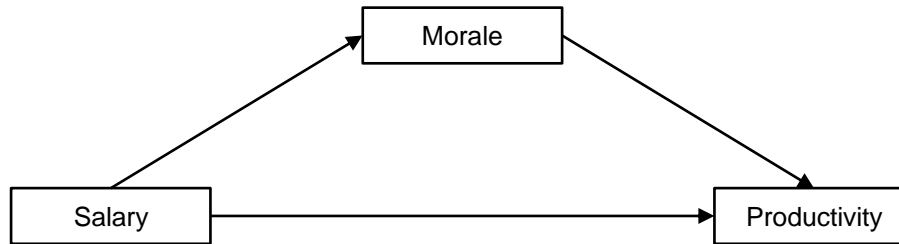


Example SPSS data for practice are available on LearnJCU:

Log in to LearnJCU -> Organisations -> Learning Centre JCU Singapore ->
Statistics Support -> Statistics Resources -> SPSS Data for Practice

Example

This is what the conceptual diagram of the proposed mediation model looks like...



PROCESS Macro on SPSS

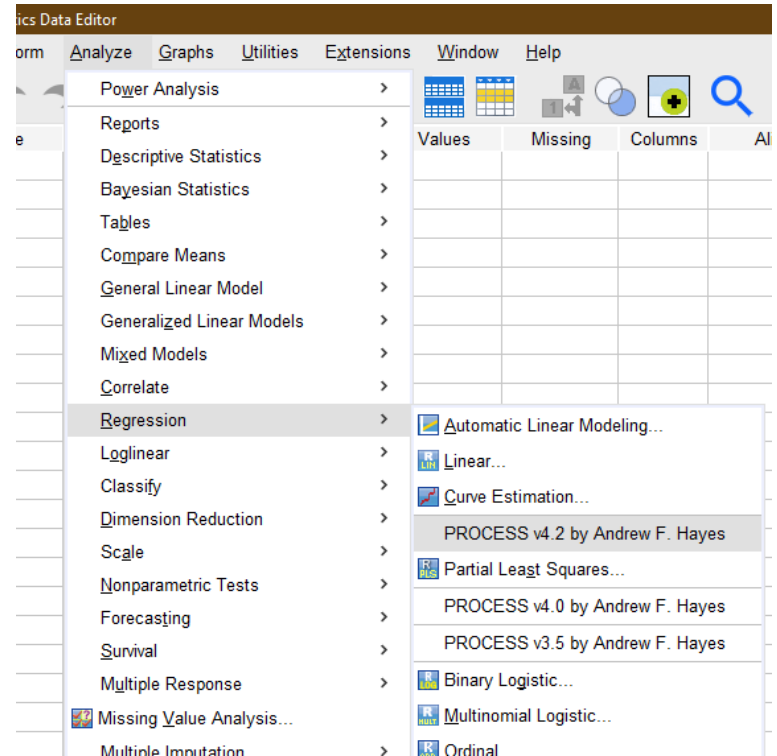


- We will be using the PROCESS macro (by Andrew Hayes) on SPSS to analyse the data
- PROCESS can be downloaded; instructions on installation can also be found in the downloaded file on **LearnJCU: Log in to LearnJCU -> Organisations -> Learning Centre JCU Singapore -> Statistics Support -> Statistics Resources -> Install PROCESS**

PROCESS Macro on SPSS

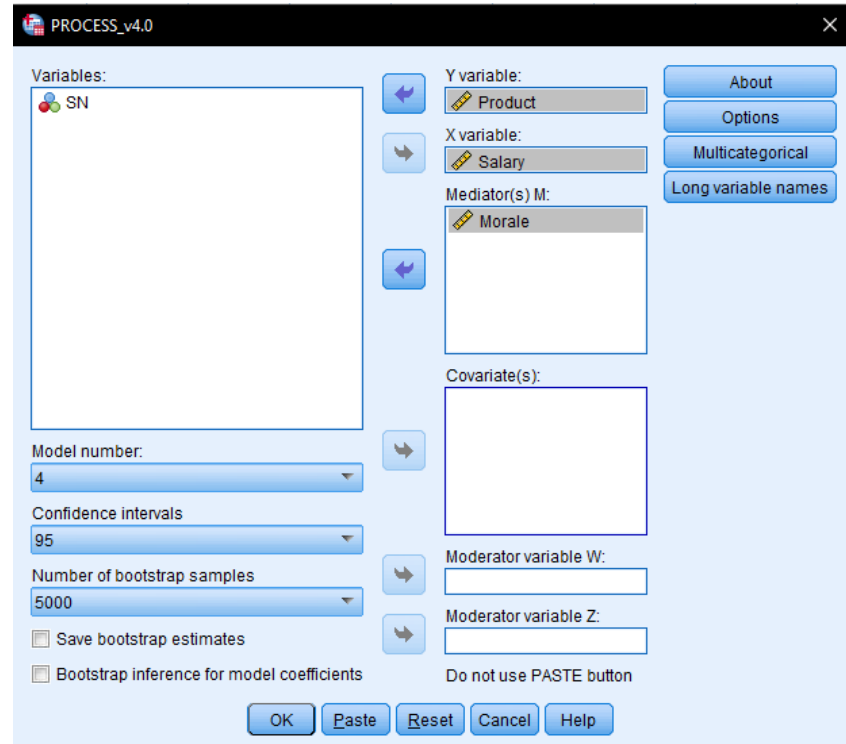
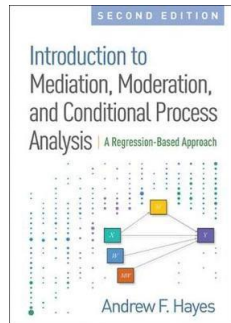
- Once installed, the macro can be found by going to...
- **Analyze -> Regression -> PROCESS v4.2 by Andrew F. Hayes**

Note that you should only have the latest version installed (v4.2 in this case) if this is your first time installing



PROCESS Macro on SPSS

- Select 'Salary' as X variable, 'Product' as Y variable, and 'Morale' as mediating variable
- Change model number to 4 (this is the model for single mediator)
- The templates for the model numbers are available in Appendix A of the Hayes' text



PROCESS_v4.0

Variables:
SN

Y variable:
Product

X variable:
Salary

Mediator(s) M:
Morale

Covariate(s):

Model number:
4

Confidence intervals:
95

Number of bootstrap samples:
5000

Save bootstrap estimates

Bootstrap inference for model coefficients

Moderator variable W:

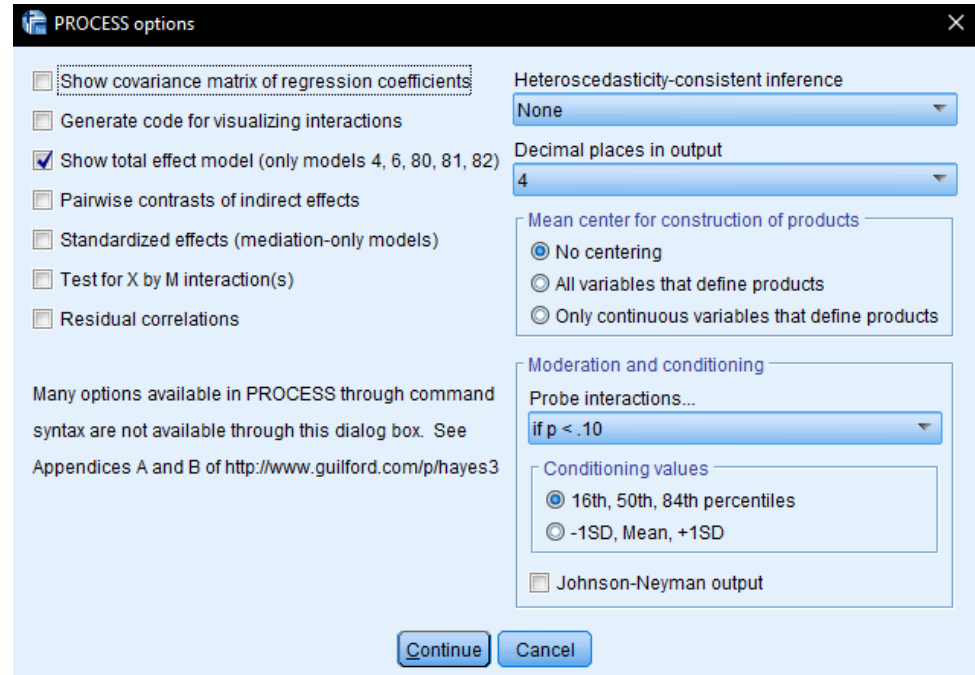
Moderator variable Z:

Do not use PASTE button

Buttons: About, Options, Multicategorical, Long variable names, OK, Paste, Reset, Cancel, Help

PROCESS Macro on SPSS

- Under **options**, select 'Show total effects model'
- Continue, and OK



PROCESS options

- Show covariance matrix of regression coefficients
- Generate code for visualizing interactions
- Show total effect model (only models 4, 6, 80, 81, 82)
- Pairwise contrasts of indirect effects
- Standardized effects (mediation-only models)
- Test for X by M interaction(s)
- Residual correlations

Many options available in PROCESS through command syntax are not available through this dialog box. See Appendices A and B of <http://www.guilford.com/p/hayes3>

Heteroscedasticity-consistent inference
None

Decimal places in output
4

Mean center for construction of products

- No centering
- All variables that define products
- Only continuous variables that define products

Moderation and conditioning

Probe interactions...
if p < .10

Conditioning values

- 16th, 50th, 84th percentiles
- 1SD, Mean, +1SD

Johnson-Neyman output

Continue Cancel

PROCESS Macro on SPSS

Summary of the model number and variables. Note that the sample size used is solely for illustration purposes

```

Written by Andrew F. Hayes, Ph.D.      www.afhayes.com
Documentation available in Hayes (2022). www.guilford.com/p/hayes3

*****
Model : 4
  Y : Product
  X : Salary
  M : Morale

Sample
Size: 40

*****
OUTCOME VARIABLE:
Morale

Model Summary
      R      R-sq      MSE      F      df1      df2      p
      .6822    .4654    1.3615    33.0805    1.0000    38.0000    .0000

Model
      coeff      se      t      p      LLCI      ULCI
constant  -2.1973    1.1060   -1.9866   .0542   -4.4363    .0418
Salary     .0017     .0003    5.7516   .0000    .0011    .0023
  
```

The model is significant, $R^2 = .47$, $F(1, 38) = 33.08$, $p < .001$

In this model, Salary is the predictor and Morale is the criterion ('Outcome Variable'), **also known as path a.**

Salary is a significant predictor of Morale, $p < .001$

PROCESS Macro on SPSS

Note that in the next part of the output, the outcome variable is now 'Product'

Shows the model summary, $R^2 = .46$, $F(2, 37) = 15.62$, $p < .001$

OUTCOME VARIABLE: Product							
Model Summary							
	R	R-sq	MSE	F	df1	df2	P
	.6766	.4578	160.3304	15.6232	2.0000	37.0000	.0000
Model							
	coeff	se	t	p	LLCI	ULCI	
constant	19.7487	12.6103	1.5661	.1258	-5.8025	45.2999	
Salary	.0060	.0044	1.3581	.1826	-.0030	.0150	
Morale	5.3483	1.7604	3.0381	.0043	1.7813	8.9152	

Morale predicts productivity even after controlling for salary, $B = 5.35$, $p = .004$. **This is path b**

Salary is not a significant predictor of Productivity when controlling for Morale, $B = .006$, $p = .18$ (**this is path c'**)

When the effect of morale is accounted for, salary no longer predicts productivity (as compared to path a in previous slide).

This suggests that morale is a mediator of the relationship between salary and productivity

PROCESS Macro on SPSS

Note that outcome variable is still *productivity*

The indirect effect (path a x path b) is .009, and the 95% confidence interval is between .0035 to .0154

If the confidence interval excludes 0, we say that the MV mediates the IV-DV relationship

This is also the primary way to telling if mediation occurs

```
***** TOTAL EFFECT MODEL *****
OUTCOME VARIABLE:
Product

Model Summary
  R      R-sq      MSE      F      df1      df2      P
.5680   .3226   195.0554   18.0967   1.0000   38.0000   .0001

Model
  coeff      se      t      p      LLCI      ULCI
constant   7.9971   13.2385   .6041   .5494  -18.8032   34.7974
Salary     .0152    .0036    4.2540   .0001   .0079    .0224

***** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y *****

Total effect of X on Y
  Effect      se      t      p      LLCI      ULCI
.0152    .0036    4.2540   .0001   .0079    .0224

Direct effect of X on Y
  Effect      se      t      p      LLCI      ULCI
.0060    .0044    1.3581   .1826  -.0030    .0150

Indirect effect(s) of X on Y:
  Effect      BootSE      BootLLCI      BootULCI
Morale     .0092      .0030      .0035      .0154
```

Model summary, $R^2 = .32$, $F(1, 38) = 18.10$, $p < .001$

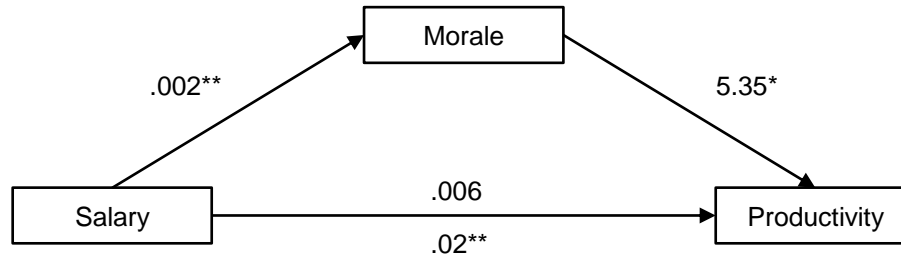
Salary is positively associated with productivity, $B = .02$, $p < .001$ (this is path c)

Note that values of total effect (path c) is the same as shown above (Total effect model)

Values of direct effect (path c') is also is the same as shown in the previous slide

Statistical Diagram of Example

Based on the analysis, this is how our single mediation statistical diagram looks like..



* $p < .05$, ** $p < .001$

Write-up

An example write-up can be found on page 213 in

Allen, P., Bennett, K., & Heritage, B. (2019). *SPSS Statistics: A Practical Guide* (4th ed.). Cengage Learning.

Questions?

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