การวิเคราะห์อิทธิพลการกำกับด้วยโปรแกรม PROCESS

*

บทคัดย่อ

Pick-a-Point
Johnson-Neyman region bootstrapping
t-test

คำสำคัญ : , , , Bootstrapping

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Analysis of Moderation Effects Through PROCESS

Montree Piriyakul*

Abstract

Moderation effect analysis or interaction analysis is an analysis aim to investigate whether the causal relationship between pair of variables, antecedent and outcome, was changed subject to change in specified values of moderators in pick-a-point fashion or in a range of values from Johnson-Neyman region. Test could be conducted through bootstrapping algorithm or t-test. In order to test for conditional effects of moderators, t-test and/or bootstrapping still being adapted with some mathematical manipulation and also with much helpful of line graph.

Keyword : Moderation effect, Direct effect, Conditional effect, Bootstrapping

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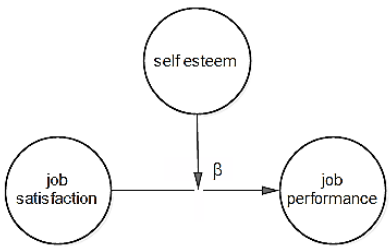
1. บทนำ

(Moderation Effect)

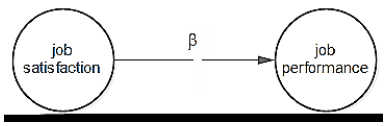
(Antecedent X) [1]
(Outcome variable Y)
(Moderator (Reward Contingency)
W) (Significant) (Job complexity)
(when) X (Self-Esteem) [1]
Y
W
/ /

(Job Satisfaction: JS) 1 2
(Job Performance: JP)
1

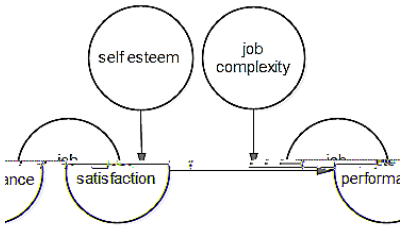


รูปที่ 2

(Job Complexity)
2



รูปที่ 1 3

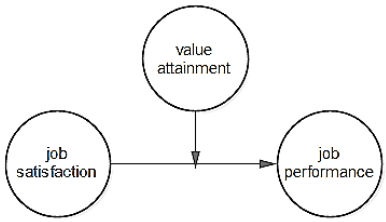


รูปที่ 3

1

(value Attainment)

[2] 4



รูปที่ 4

(Negative Affection)

(positive Affection)

5

รูปที่ 5

(who)

(Significant)

X→Y (Enhancing)

X→Y

(Buffering)

X→Y

(Antagonistic)

(Conditional effect

a.k.a Simple Slope)

( )

(Conditional Effect)

( )

(X W 6)

W

(XW$_1$ W$_2$ 11)

W$_2$

2. อิทธิพลการกำกับ (Moderation Effect)

X→Y W

$$Y = \beta_0 + \beta_1 X + u \quad (1)$$

β_0

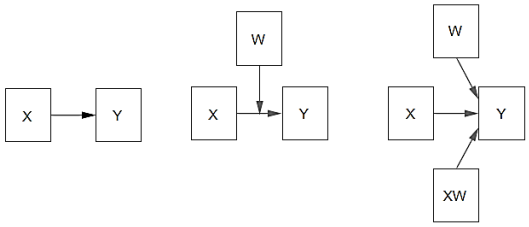
X= 0 β_1

X Y u

identification error (1) (2)

$$Y = \beta_0 + \beta_1 X + \beta_2 W + \beta_3 XW + u \quad (2)$$

β_3



( ) ( ) ( )

รูปที่ 6 ( )

( ) ( )

หมายเหตุ error term (u)

Y

(2) 6 ( )

6 ( )

(Antecedent)

6 ( )

X→Y 6 ( ) W

SEM

(Path Analysis)

(Data Manipulation)

(Mean)

(Standardized)

(Factor Score)

(Total)

SEM (Structural Equation Modeling) PA

(Path Analysis) SEM PA

MRA (Multiple

Regression Analysis) SEM PA

PA

(Measurement Model)

(Structural Model)

(Convergence)

(Threshold)

SEM

X Y X Y

(0.20) [3]

VAF (Variable Account For) 0.20

$$VAF = \frac{\quad}{+} > 0.20$$

0.80

(Partial Mediation) VAF > 0.80

(Full Mediation) VAF ≤

0.20 [4]

X Y

X Y

X Y

X Y

W

Multiple Mediation

Multiple Moderation Moderation Model

Moderate Mediated Model

Sequential

Exploratory Analysis

3. การวิเคราะห์ Moderation Effect

Moderation Model

Moderation Model

(Conditional Moderation Effect)

3

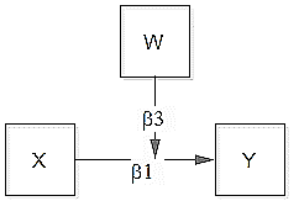
(Moderation

Model) (Statistical

Model)

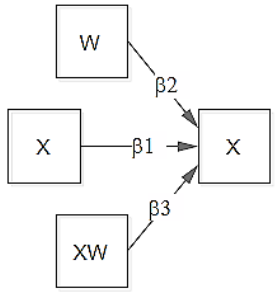
Simple Intercept-Simple Slope Model

3.1 Single Moderator (Two Way Interaction Model)



รูปที่ 7

8



รูปที่ 8

8

Simple Ntercept- Simple Slope Model

(Mean Centered)

(Multicollinearity)

$x = X - X, w = W - W$ (

PROCESS

)

$$Y = \beta_0+\beta_1 X+\beta_2 W+\beta_3 XW + u \quad (3)$$

simple intercept-simple slope model

$$Y = (\beta_0 +\beta_2 W) + (\beta_1+\beta_3 W) X + u \quad (4)$$

$$Y = \omega_0+ \omega_1 X + u \quad (5)$$

$\omega_0 = (\beta_0 +\beta_2 W)$ $\omega_1 = (\beta_1+\beta_3 W)$

(3)

β_1 X Y

β_3

$H_0: \beta_3 = 0$ vs $H_1: \beta_3 \neq 0$

H_1

$X \rightarrow Y$ (X

Y) W

$X \rightarrow Y$ W

X Y W

(4)

β_3

$X \rightarrow Y$ W

$X \rightarrow Y$ W

(4)

$H_0: (\beta_1+\beta_3 W) = 0$ vs $H_1: (\beta_1+\beta_3 W) \neq 0$

W

W $H_1: (\beta_1+\beta_3 W) \neq 0$

W $X \rightarrow Y$

W

$X \rightarrow Y$ W

W

$(\beta_1+\beta_3 W)$

$X \rightarrow Y$ W

$X \rightarrow Y$

W simple intercept $\omega_0 = (\beta_0$

$+\beta_2 W)$ X

Y

Pick-a-Point [6] W = 10

W-W Simple Intercept-Simple Slope Model

W 0 0 – SD ((Mean

0 - $\overline{-1}$ SD) 0 + SD (0 + $\overline{-1}$ SD) Centered)

(5) (Multicollinearity)

$$Y = \beta_0+\beta_1X+\beta_2W_1+\beta_3W_2+\beta_4x_{\ 1}+\beta_5XW_2 + u \quad (6)$$

(4) simple intercept-simple slope model

$$Y = (\beta_0+\beta_2W_1+\beta_3W_2) + (\beta_1+\beta_4{}_{\ 1}+\beta_5W_2)\,x + u \quad (7)$$

3.2 Two Moderator Two Way Interaction

$$Y = \omega_0+\omega_1X + u \quad (8)$$

9

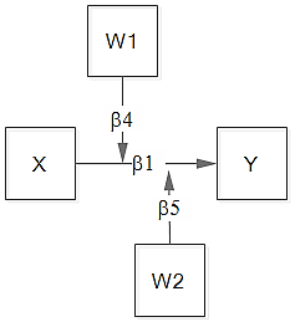
(8)

H_0:

$(\beta_1+\beta_4{}_{\ 1}+\beta_5W_2) = 0$ vs H_1: $(\beta_1+\beta_4{}_{\ 1}+\beta_5W_2) \neq 0$

W

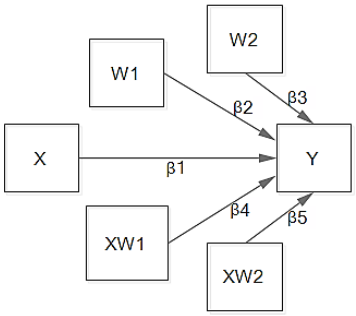
W



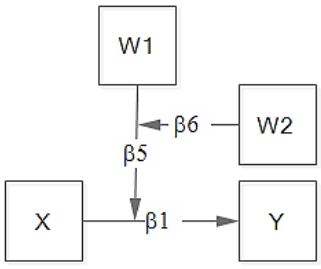
รูปที่ 9

3.3 Single Moderator Two-Way Moderation Model

11 1

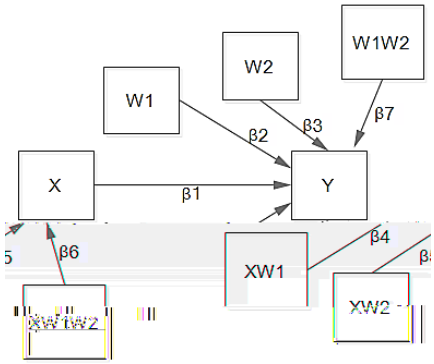


รูปที่ 10



รูปที่ 11 3-ways interaction

12



รูปที่ 12

3-ways Interaction

12

Simple Intercept-Simple Slope Model

(Mean Centered)

(Multicollinearity)

$$Y = \beta_0+\beta_1X+\beta_2W_1+\beta_3W_2+\beta_4x_{1}+\beta_5XW_2 + \beta_6XW_1W_2+\beta_7W_1W_2+u \quad (9)$$

Simple Intercept-Simple Slope Model

$$Y = (\beta_0+\beta_2W_1+\beta_3W_2+\beta_7W_1W_2) + (\beta_1+\beta_4{}_1+\beta_5W_2+\beta_6W_1W_2)X + u \quad (10)$$

$$Y = \omega_0+\omega_1X+u \quad (11)$$

(10) (11)

$H_0: (\beta_1+\beta_4{}_1+\beta_5w_2+\beta_6w_1w_2) = 0$ vs

$H_1: (\beta_1+\beta_4{}_1+\beta_5w_2+\beta_6w_1w_2) \neq 0$

w

w

4. วิธีทดสอบสมมุติฐานการกำกับ

7

(3), (4) (5)

V(1) t-test

bootstrapping

4.1 ประมาณค่าสมการที่ (3) สมการประมาณค่าคือ

$$Y = \beta_0+\beta_1X+\beta_2W+\beta_3WX \quad (12)$$

$H_0: \beta_3 = 0$ vs $H_1: \beta_3 \neq 0$

t-test $t = \frac{\beta_3}{se_{\beta_3}}$

$|t| \geq t_{\frac{\alpha}{2},\nu}$ $|t| \geq 1.96$ W

(1.96 t

0.05)

4.2 การทดสอบอิทธิพลการกำกับอย่างมีเงื่อนไข จากสมการ (4)

$$Y = (\beta_0+\beta_2W)+(\beta_1+\beta_3W)X \quad (13)$$

$H_0: (\beta_1+\beta_3W) = 0$ vs $H_1: (\beta_1+\beta_3W) \neq 0$

2

วิธีที่ 1 $H_0: (\beta_1+\beta_3W) = 0$ vs $H_1: (\beta_1+\beta_3W) \neq 0$

t-test

(3)

$$V(\beta) = s^2(X^tX)^{-1}$$

$$V(\ _1) = V(\beta_1+\beta_3w)$$

$$= V(\beta_1)+2wCov(\beta_1,\beta_3)+W^2\ \hat{V}(\beta_3)$$

$$t = \frac{\omega_1}{se_{\omega 1}} = \frac{\beta_1+\beta_3 w}{V(\beta_1) + 2w\ Cov(\beta_1,\beta_3) +\ \ ^2V(\beta_3)} \quad (14)$$

t n-4

(14)

(13)

w (13) (14) $w = -SD_w$

w

w (13) (14) $w = 0$

w

w (13) (14) $w = +SD_w$

w

วิธีที่ 2 $H_0: (\beta_1+\beta_3w) = 0$ vs $H_i: (\beta_1+\beta_3w) \neq 0$

bootstrapping

Bootstrapping

n

n (Resampling with Replacement)

(Resample)

n 5,000 [5]

(3) (3)

(13)

Bootstrapping

1. (3) 1 simple slope

$$_1 = (\beta_1 + \beta_3w) \quad (15)$$

2. w (15) $_1$ 3

3. 1. – 2. 2, 3, ..., 5,000 $_1$ w 5,000

4. $_1$ 3. 2.5 97.5

5. $H_i: (\beta_1+\beta_3w) \neq 0$ w 95% 0 $H_0: (\beta_1+\beta_3w) = 0$

2 J-N Method (Johnson-Neyman method)

2 [6]

ก. การวิเคราะห์ตัวแปรคั่นกลาง 1)

X→Y

(PROCESS

Total Effect) 2) (1) (Standardize) OJ, WE, JP,
0 0 JS 9, 9, 8 16 (
OJ, WE, JP, JS
0)
(2)

(3)
(VAF)
Partial Mediation Full Mediation
ข. การวิเคราะห์ตัวแปรกำกับ 1)
X→Y

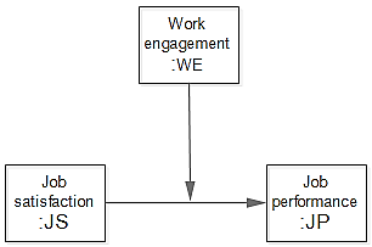
2)
(Statistical Model) (1)
(2) (
) (3)
(ω_1)
(4) W
(5)

$$Y = (\beta_0 + \beta_2 W) + (\beta_1 + \beta_3 W) X$$

1
[7] PROCESS
Y
X W

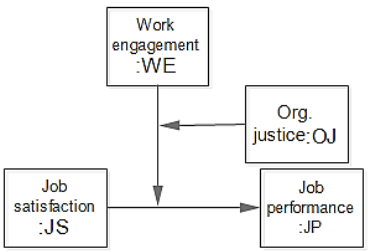
ตัวอย่าง

(work Engagement)
(Organizational Justice) 13
14



รูปที่ 13

[7]

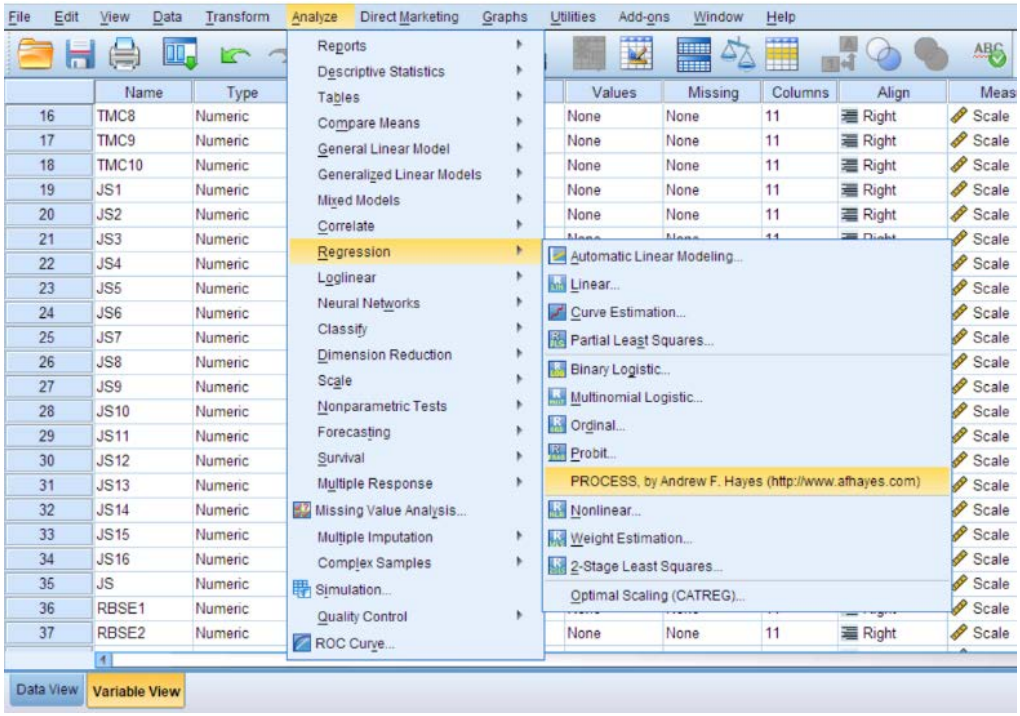


รูปที่ 14 2

5. ผลการวิเคราะห์ข้อมูล

5.1 การวิเคราะห์ปฏิสัมพันธ์ 2 ทาง

13 PROCESS
(Dialog)
Regression SPSS (SAS)



รูปที่ 15 SPSS Regression PROCESS

PROCESS [5]

Add-on Regression Unstandardized Coefficient (β) Standardized Coefficient (ρ)

13 Model 1 14 Model 3 Model Templates [8]

1. $JP = \beta_0 + \beta_1 JS + u$ JS JP ($\beta = 0.335$, $p = 0.000 < 0.01$) $R^2 = 0.354$
2. PROCESS 16 1

รูปที่ 16 PROCESS (2-way interaction)

ตารางที่ 1 PROCESS (2-way Interaction) [8]

PROCESS Procedure for SPSS Release 2.15							
Model = 1, Y = JP, X = JS, M = WE : Sample size 470							
Outcome: JP	R	R-sq	MSE	F	df1	df2	p
Model Summary	.6782	.4600	8.8362	132.3231	3.0000	466.0000	.0000
Model	coeff	se	t	p	LLCI	ULCI	
Constant	29.3202	.1487	197.1230	.0000	29.0279	29.6125	
WE	.3141	.0329	9.5528	.0000	.2495	.3788	
JS	.2254	.0227	9.9149	.0000	.1807	.2700	
Int_1	.0046	.0031	1.4946	.1357	-.0014	.0106	
Product terms key : int_1 JS x WE							
R-square increase due to interaction(s):							
	R2-chng	F	Df1	Df2	p		
Int_1	.0026	2.2338	1.0000	466.0000	.1357		
Conditional effect of X on Y at values of the moderator(s):							
	WE	Effect	se	t	p	LLCI	ULCI
	-4.9609	0.2027	0.0260	7.8082	0.0000	0.1517	0.2537
	0.0000	0.2254	0.0227	9.9149	0.0000	0.1807	0.2700
	4.9609	0.2481	0.0287	8.6538	0.0000	0.1918	0.3044
Values for quantitative moderators are the mean and plus/minus one SD from mean. Values for dichotomous moderators are the two values of the moderator.							
Data for visualizing conditional effect of X on Y Paste text below into a SPSS syntax window and execute to produce plot.							
	JS	WE	JP				
	-7.1647	-4.9609	26.3098				
	0.0000	-4.9609	27.7618				
	7.1647	-4.9609	29.2137				
	-7.1647	0.0000	27.7055				
DATA LIST FREE BEGIN DATA	0.0000	0.0000	29.3202				
	7.1647	0.0000	30.9350				
	-7.1647	4.9609	29.1012				
	0.0000	4.9609	30.8787				
	7.1647	4.9609	32.6562				
END DATA. GRAPH/SCATTERPLOT=JS WITH JP BY WE.							

Note : Level of confidence for all confidence intervals in output: 95.00

The following variables were mean centered prior to analysis: JS WE

1. (Int_1) β = 0.0046 (t = 1.4946, p = 0.1357 > 0.05 95% 0 R^2_change = 0.0026 F = 2.233 8, p = 0.1357 > 0.05) WE JS JP

2. pick-a-point WE (-4.9609) (0.0000) WE (4.9609) WE WE JS JP WE JS JP Pick-a-point P_{10}, P_{25} P_{50} P_{75}, P_{90} J-N (Johnson-Neyman region)

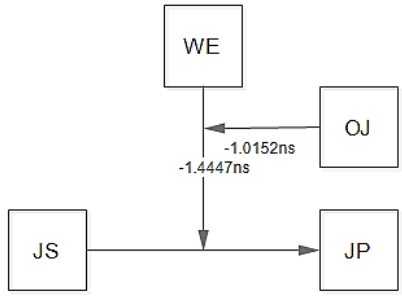
3. Data for visualizing Conditional Effect of X on Y JS JP $Y = {}_0 + \omega_1 X$ w x x $Y = {}_0 + \omega_1 X$ ${}_0 = (\beta_0 + \beta_2 W)$ ${}_1 = (\beta_1 + \beta_3 W)$ Y 3 3 JP 3 WE (JS, JP) scatter plot 17 (Effect Simple Slope) 0.2027, 0.2254 0.2481 WE JS JP WE

รูปที่ 17 Job satisfaction (JS) Job performance (JP) Work engagement (WE)

5.2 การวิเคราะห์ปฏิสัมพันธ์ 3 ทาง

14

18 2



รูปที่ 19 WE OJ

1) WE OJ

(1) WE

JS→JP (2) OJ JS

WE JS→JP

19 t (

t

รูปที่ 18 PROCESS Bootstrapping R^2-Changed

3 way Interaction 3)

ตารางที่ 2 PROCESS 2 (3-way interaction) [8]

PROCESS Procedure for SPSS Release 2.15							
Model = 3, Y = JP, X = JS, M = WE : Sample size 470							
Outcome: JP	R	R-sq	MSE	F	df1	df2	p
Model Summary	.6782	.4715	8.7228	58.8847	7.0000	462.0000	.0000
Model	coeff	se	t	p	LLCI	ULCI	
Constant	29.2429	.1603	182.4153	.0000	28.9279	29.5580	
WE	.3033	.0395	7.6830	.0000	.2457	.3809	
JS	.2122	.0255	8.3161	.0000	.1621	.2624	
Int_1	.0078	.0054	-1.4447	.1492	-.0184	.0028	
OJ	.0654	.0355	1.8429	.0660	-.0043	.0352	
Int_2	.0083	.0048	1.7328	.0838	-.0011	.0178	

ตารางที่ 2 PROCESS 2 (3-way Interaction) [8] ( )

PROCESS Procedure for SPSS Release 2.15

Model = 3, Y = JP, X = JS, M = WE : Sample size 470

Model	coeff	se	t	p	LLCI	ULCI
Int_3	.0065	.0050	1.3080	.1915	-.0033	.0164
Int_4	-.0004	.0004	-1.0152	.3105	-.0011	.0004

Product terms key : int_1 JS x WE, int_2 JS x OJ, int_3 WE x OJ, int_1 JS x WE x OJ

R-square increase due to interaction(s):

	R2-chng	F (1,df2)	Df2	p
Int_4	.0012	1.0306	462.0000	.3105

Conditional effect of X on Y at values of the moderator(s):

OJ	WE	Effect	se	t	p	LLCI	ULCI
-5.4299	-4.9609	.1953	.0308	6.3435	.0000	.1348	.2559
-5.4299	.0000	.1670	.0372	4.4923	.0000	.0940	.2401
-5.4299	4.9609	.1387	.0563	2.4635	.0141	.0281	.2493
.0000	-4.9609	.2509	.0358	7.0096	.0000	.1806	.3212
.0000	.0000	.2122	.0255	8.3161	.0000	.1621	.2624
.0000	4.9609	.1735	.0381	4.5491	.0000	.0986	.2485
5.4299	-4.9609	.3065	.0551	5.5601	.0000	.1982	.4148
5.4299	.0000	.2574	.0358	7.1920	.0000	.1871	.3278
5.4299	4.9609	.2084	.0381	5.4622	.0000	.1334	.2833

Values for quantitative moderators are the mean and plus/minus one SD from mean.

Values for dichotomous moderators are the two values of the moderator.

Conditional effect of X*M interaction at values of W:

OJ	Effect	se	t	p	LLCI	ULCI
-5.4299	-.0057	.0052	-1.0887	.2769	-.0160	.0046
.0000	-.0078	.0054	-1.1492	.1492	-.0184	.0028
5.4299	-.0099	.0063	-1.5783	.1152	-.0222	.0024

2) Pick-a-point JP 2. OJ (0.0000)

ก. เมื่อวิเคราะห์ในรายละเอียดเป็น 9 จุด WE (-4.9609,

1. OJ (-5.4299) WE 0.0000, 4.9609) JS JP 3.

(-4.9609, 0.0000, 4.9609) JS OJ (5.4299) WE

(-4.9609, 0.0000, 4.9609) JS JP OJ (Effect)
pick-a-point WE JS
9 JP OJ WE
3

ตารางที่ 3 simple slope 3-way Interaction

Conditional effect of X on Y at values of the moderator(s):							
OJ	WE	Effect	se	t	p	LLCI	ULCO
-5.4299	-4.9609	.1953	.0308	6.3435	.0000	.1348	.2559
-5.4299	.0000	.1670	.0372	4.4923	.0000	.0940	.2401
-5.4299	4.9609	.1387	.0563	2.4635	.0141	.0281	.2493
.0000	-4.9609	.2509	.0358	7.0096	.0000	.1806	.3212
.0000	.0000	.2122	.0255	8.3161	.0000	.1621	.2624
.0000	4.9609	.1735	.0381	4.5491	.0000	.0986	.2485
5.4299	4.9609	.3065	.0551	5.5601	.0000	.1982	.4148
5.4299	.0000	.2574	.0358	7.1920	.0000	.1871	.3278
-5.4299	-4.9609	.2084	.0381	5.4622	.0000	.1334	.2833

ข. เมื่อวิเคราะห์รวมเพียง 3 จุด OJ (JS→JP
w) OJ JS x WE OJ WE*
OJ JS JP 4
WE ( ) JS

ตารางที่ 4 Simple Slope 3-way Interaction

Conditional effect of X*M interaction at values of W:						
OJ	Effect	se	t	p	LLCI	ULCO
-5.4299	-.0057	.0052	-1.0887	.2769	-.0160	.0046
.0000	-.0078	.0054	-1.4447	.1492	-0182	.0028
5.4299	-.0099	.0063	-1.5783	.1152	-.0222	.0024

6. สรุปผล

(Sequential Exploratory Analysis)

7. กิตติกรรมประกาศ

8. เอกสารอ้างอิง

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