Interaction Effects

in MPlus

Intro

Today's goal:

Teach how to test condition*factor and factor*factor interaction effects

Outline:

- Overview of interaction effects and approaches
- The random slopes approach
- The multiple groups approach

Overview

of interaction effects

Interaction effects

What is the combined effect of x1 and x2 on y?

Possibilities:

- **Additive effect**
- Super-additive effect
- Sub-additive effect
- Cross-over

	x1 = low	**x1 = high**
x2 = low	0	5
x2 = high	5	10

Interaction effects

What is the combined effect of x1 and x2 on y?

Possibilities:

- Additive effect
- **Super-additive effect**
- Sub-additive effect
- Cross-over

	x1 = low	**x1 = high**
x2 = low	0	5
x2 = high	5	**15**

Interaction effects

What is the combined effect of x1 and x2 on y?

Possibilities:

- Additive effect
- Super-additive effect
- **Sub-additive effect**
- Cross-over

	x1 = low	**x1 = high**
x2 = low	0	5
x2 = high	5	**5**

Interaction effects

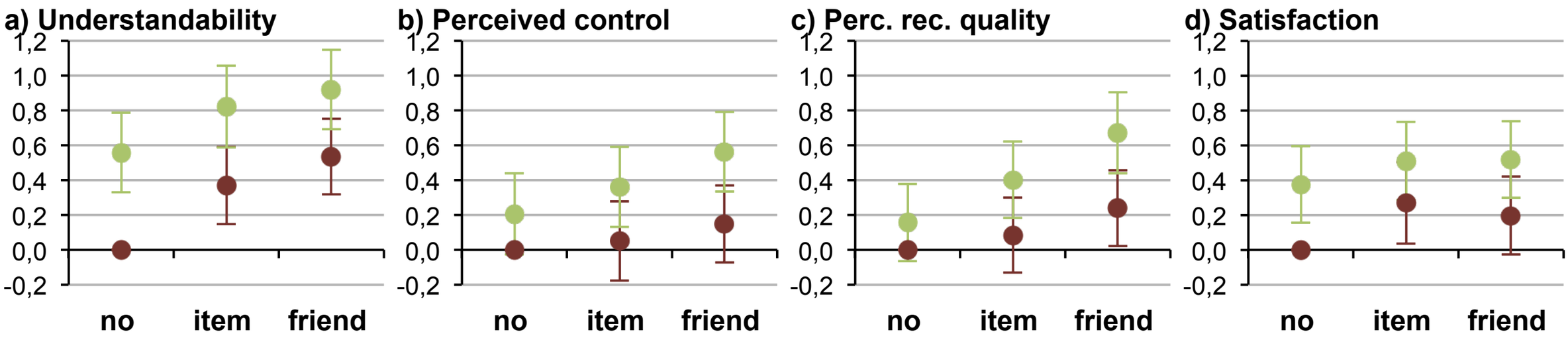
What is the combined effect of x1 and x2 on y?

Possibilities:

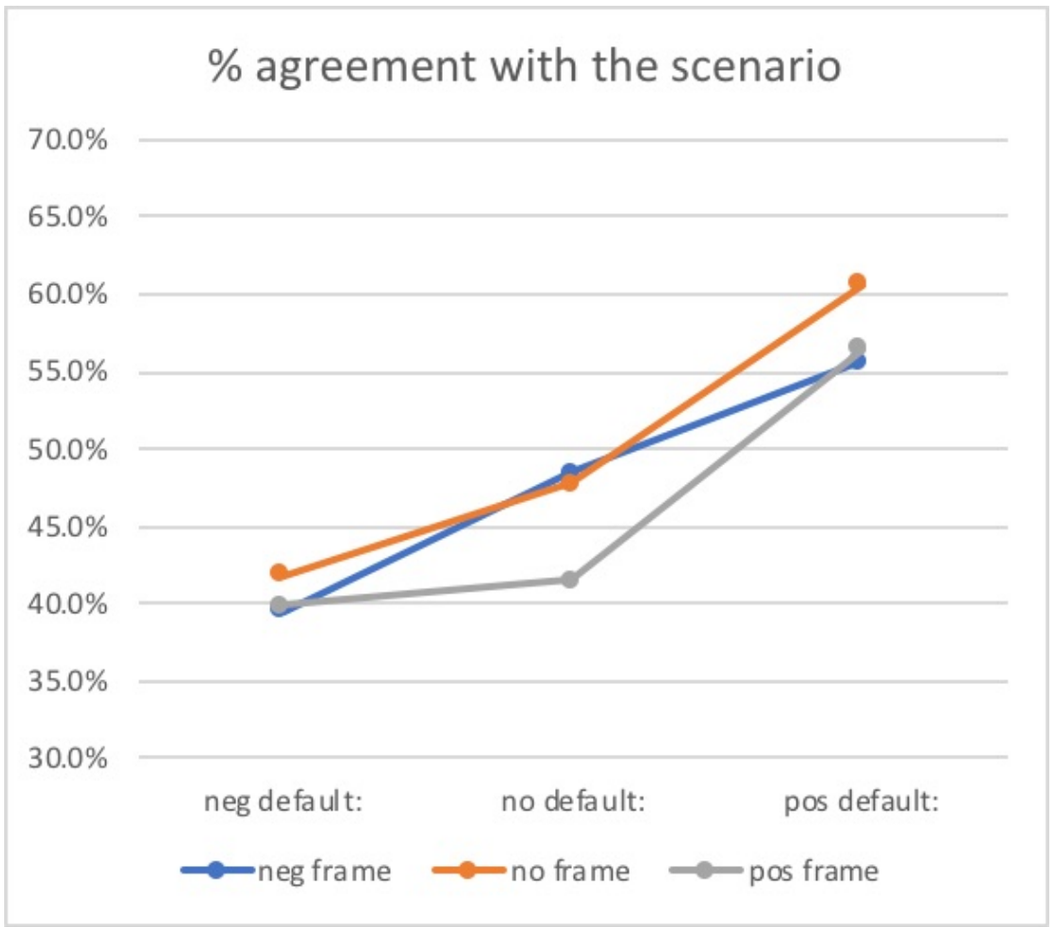
- Additive effect
- Super-additive effect
- Sub-additive effect
- **Cross-over**

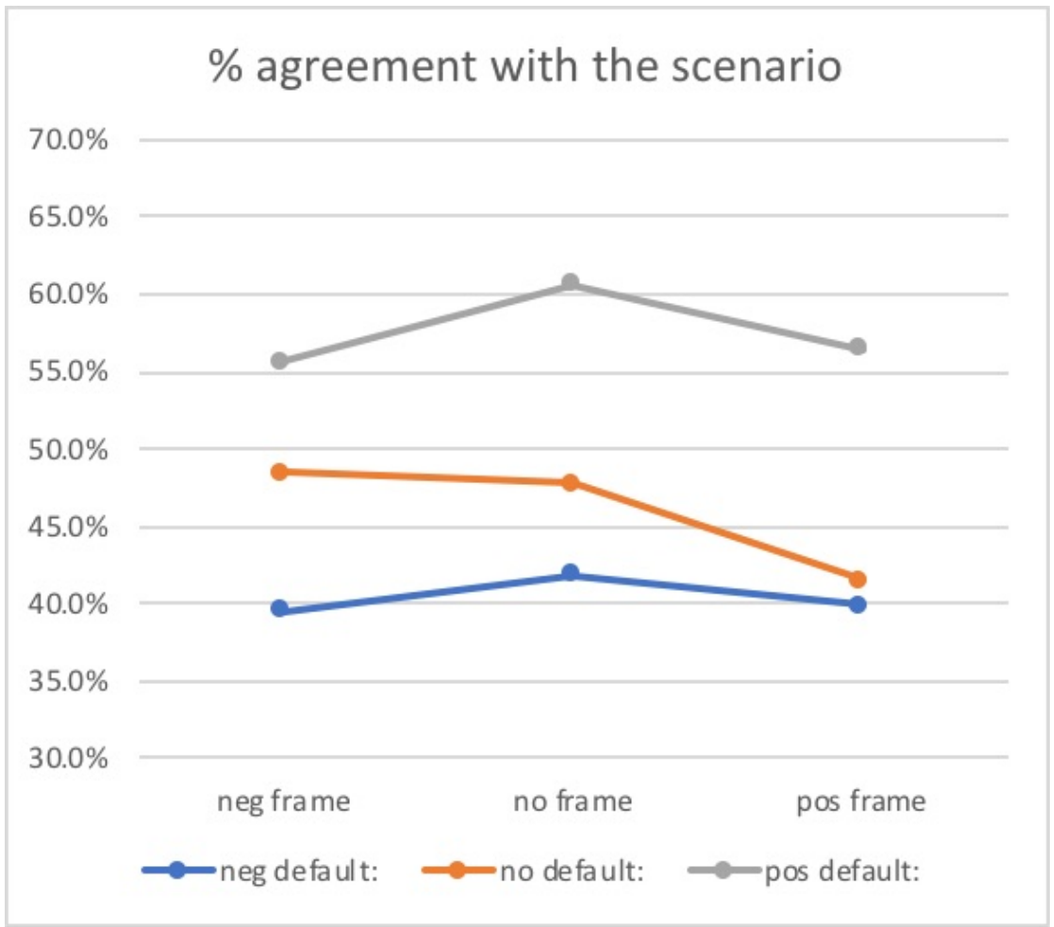
	x1 = low	**x1 = high**
x2 = low	0	5
x2 = high	5	**0**

Examples


a) Understandability
b) Perceived control
c) Perc. rec. quality
d) Satisfaction
1,2
1,0
0,8
0,6
0,4
0,2
0,0
-0,2
no
item
friend

Fresh example





Outputs

```
Additive effect
x1        5.000
x2        5.000
x1*x2     0.000 (n.s.)

Super-additive effect
x1        5.000
x2        5.000
x1*x2     5.000 (sig)

Sub-additive effect
x1        5.000
x2        5.000
x1*x2    -5.000 (sig)

Cross-over effect
x1        5.000
x2        5.000
x1*x2   -10.000 (sig)
```

Model specification

This is easy in regressions

Just multiply the dependent variables!

y ~ x1*x2

More difficult in SEM

Depends on type of variables:

manipulation * manipulation

manipulation * factor

factor * factor

Model specification

manipulation * manipulation is easy:

Just create the dummies!

See SEM slides and homework for an example

manipulation * factor:

Multiple groups model or predicted random slopes model

factor * factor:

Predicted random slopes model

Two approaches

"Predicted random slopes model"

Pro: Works for all types of variables

Con: Cannot use categorical indicators

Con: Can take a long time to estimate

"Multiple groups model"

Pro: Easier to estimate

Pro: Can sometimes use categorical indicators*

Con: Does not work for factor * factor interactions

Random slopes approach

for factor*condition and factor*factor interaction effects

Random slopes

Under ANALYSIS:

Specify random slopes (type = random)

Specify integration (algorithm = integration)

Under MODEL:

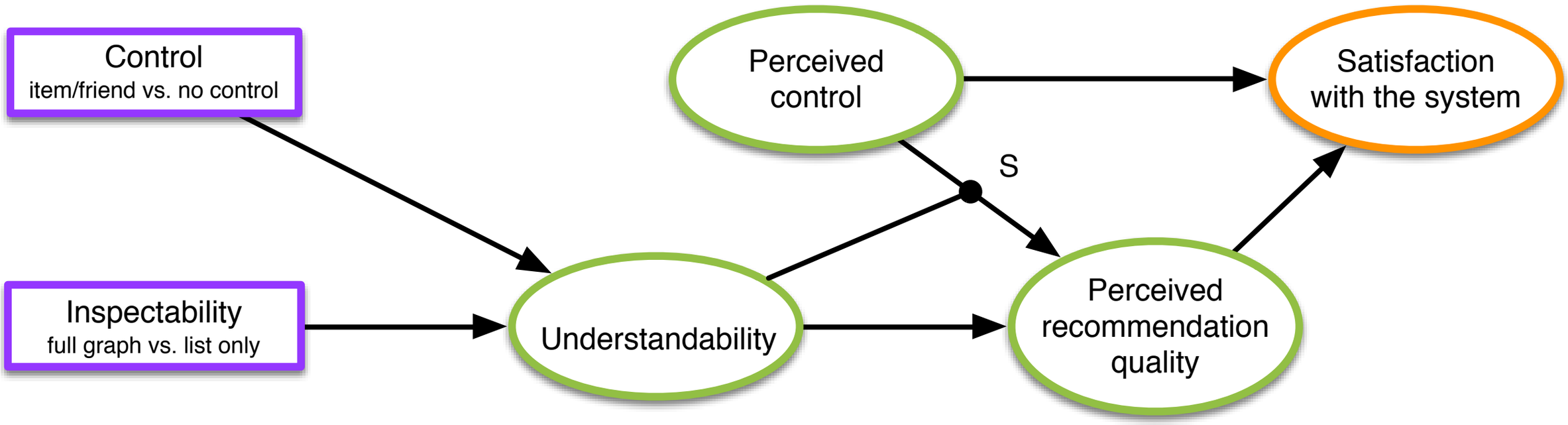
Specify the moderated effect as random: s | y on x;

Regress the slope on the moderator: s on m;

Add main effect of moderator: y on m;

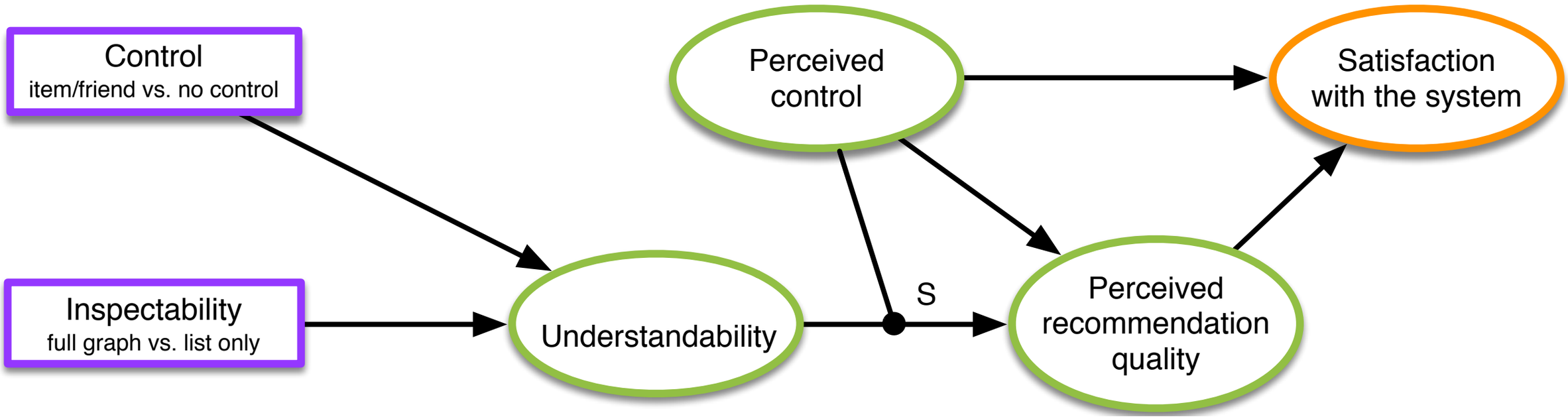
Factor * factor

Example: is the effect of perceived control on perceived recommendation quality dependent on understandability?



Factor * factor

Equivalent: is the effect of understandability on perceived recommendation quality dependent on perceived control?



Factor * factor

slopes1.inp

Specify the model as UVI

Under model, add:

s | quality ON control;

s ON underst;

quality ON underst;

In regression terms, this would simply be:

quality ~ control*underst

Factor * factor

SATISF	ON				
	QUALITY	0.401	0.097	4.114	0.000
	CONTROL	-0.924	0.155	-5.979	0.000
S	ON				
	UNDERST	**0.047**	0.081	0.579	0.563
QUALITY	ON				
	UNDERST	**0.061**	0.078	0.776	0.438
UNDERST	ON				
	CITEM	0.348	0.160	2.180	0.029
	CFRIEND	0.474	0.164	2.888	0.004
	CGRAPH	0.535	0.135	3.969	0.000
Intercepts:					
	S	**-0.771**	0.111	-6.962	0.000

Factor * factor

slopes1a.inp

Under model, add:

s | quality ON underst;

s ON control;

quality ON control;

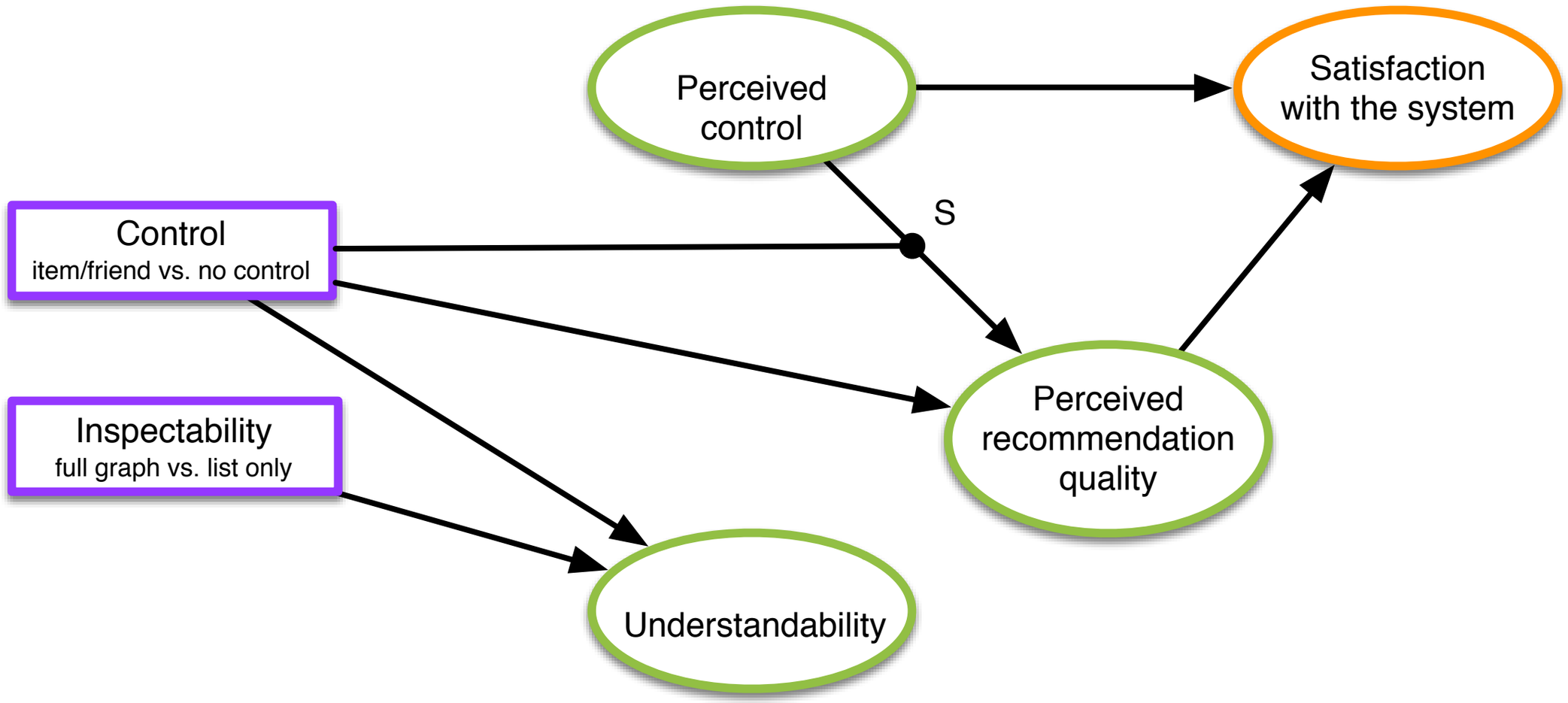
This model is equivalent

Factor * factor

SATISF	ON				
	QUALITY	0.280	0.106	2.655	0.008
	CONTROL	-0.916	0.158	-5.814	0.000
S	ON				
	CONTROL	**0.094**	0.119	0.790	0.429
QUALITY	ON				
	CONTROL	**-1.094**	0.347	-3.153	0.002
UNDERST	ON				
	CITEM	0.257	0.153	1.686	0.092
	CFRIEND	0.367	0.169	2.172	0.030
	CGRAPH	0.452	0.139	3.247	0.001
Intercepts:					
	S	**0.056**	0.110	0.506	0.613

Factor * condition

Example: is the effect of perceived control on perceived recommendation quality dependent on the control condition?



Factor * condition

slopes2.inp

Under model, add:

s | quality ON control;

s ON citem cfriend;

quality ON citem cfriend;

Factor * condition

SATISF	ON			
QUALITY		0.373	4.041	0.000
CONTROL		-0.909	-5.733	0.000
S	ON			
CITEM		-0.108	-0.634	0.526
CFRIEND		**0.565**	3.418	0.001
QUALITY	ON			
CITEM		0.052	0.329	0.742
CFRIEND		0.288	1.674	0.094
UNDERST	ON			
CITEM		0.327	2.044	0.041
CFRIEND		0.486	3.019	0.003
CGRAPH		0.509	3.815	0.000
Intercepts:				
S		**-0.955**	-6.583	0.000

Multiple group approach

for factor*condition interaction effects

Multiple groups

Under VARIABLE:

Specify the moderating manipulation as a “grouping” variable: grouping = cctrl(0=none 1=item 2=friend)

Add a MODEL section for all groups except the baseline

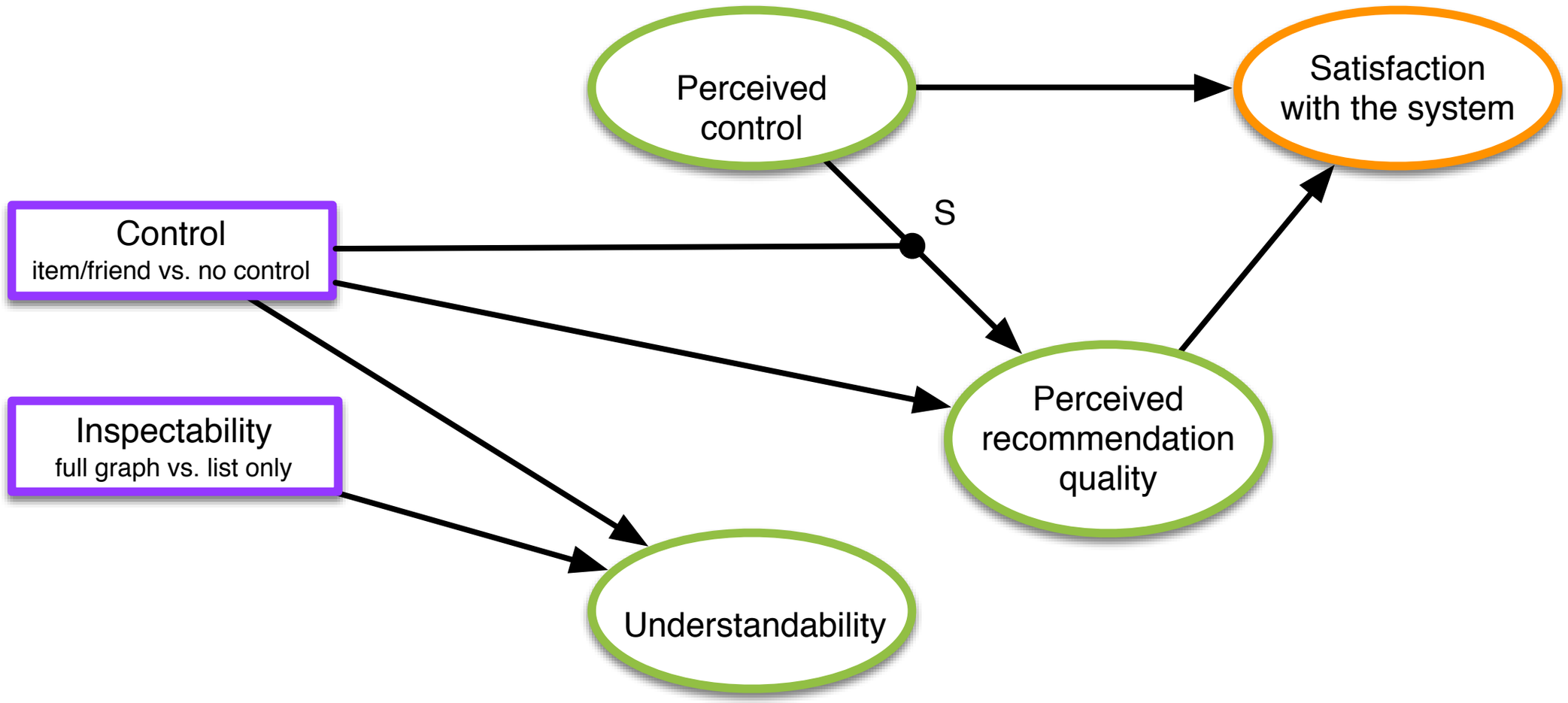
Model item:

Model friend:

Add corresponding labels to each MODEL to restrict the moderation

Factor * condition

Example: is the effect of perceived control on perceived recommendation quality dependent on the control condition?



Factor * condition

multi.inp

```
MODEL:
 satisf BY s1* s2-s7;
 quality BY q1* q2-q6;
 control BY c1* c2-c4;
 underst BY u2* u4-u5;
 satisf-underst@1;

 satisf ON quality control (1-2);
 quality ON control (p1);
 control ON underst (4);
 underst ON cgraph (5);

MODEL item:
 satisf ON quality control (1-2);
 quality ON control (p2);
 control ON underst (4);
 underst ON cgraph (5);

 [satisf] (p4);
 [control] (p5);
```

```
MODEL friend:
 satisf ON quality control (1-2);
 quality ON control (p3);
 control ON underst (4);
 underst ON cgraph (5);

 [satisf] (p4);
 [control] (p5);


MODEL CONSTRAINT:
 p4=0;
 p5=0;

MODEL TEST:
p1=p3;
```

Factor * condition

```
*** ERROR
  Based on Group 2: Group 0 contains
  inconsistent categorical value for Q6:  2
```

Problem:

There are three groups (0=none, 1=item and 2=friend)

Q6 has 5 possible values (-2, -1, 0, 1, 2)

Mplus tries to estimate the same thresholds in each group

But in group 0, nobody has the value 2 on Q6!

Factor * condition

Possible solutions:

Collapse values 1 and 2

Under DEFINE: if(Q6 EQ 2) then Q6 = 1;

Repeat for other variables, see multi-alt.inp

Simply run the model without categorical variables

Remove categorical are s1-u5;

Factor * condition

Group NONE

SATISF ON				
QUALITY	0.391	0.081	4.855	0.000
CONTROL	−0.880	0.121	−7.247	0.000
QUALITY ON				
CONTROL	**−0.871**	**0.128**	**−6.821**	**0.000**
CONTROL ON				
UNDERST	−0.352	0.070	−5.022	0.000
UNDERST ON				
CGRAPH	0.530	0.132	4.025	0.000
Intercepts				
QUALITY	**0.000**	**0.000**	**999.000**	**999.000**
UNDERST	**0.000**	**0.000**	**999.000**	**999.000**

Factor * condition

Group NONE

SATISF ON				
QUALITY	0.391	0.081	4.855	0.000
CONTROL	−0.880	0.121	−7.247	0.000
QUALITY ON				
CONTROL	**−1.001**	**0.146**	**−6.850**	**0.000**
CONTROL ON				
UNDERST	−0.352	0.070	−5.022	0.000
UNDERST ON				
CGRAPH	0.530	0.132	4.025	0.000
Intercepts				
QUALITY	**0.017**	**0.169**	**0.098**	**0.922**
UNDERST	**0.347**	**0.160**	**2.174**	**0.030**

Factor * condition

Group NONE

SATISF ON				
QUALITY	0.391	0.081	4.855	0.000
CONTROL	−0.880	0.121	−7.247	0.000
QUALITY ON				
CONTROL	**−0.359**	**0.117**	**−3.056**	**0.002**
CONTROL ON				
UNDERST	−0.352	0.070	−5.022	0.000
UNDERST ON				
CGRAPH	0.530	0.132	4.025	0.000
Intercepts				
QUALITY	**0.368**	**0.170**	**2.166**	**0.030**
UNDERST	**0.475**	**0.158**	**3.004**	**0.003**

“It is the mark of a truly intelligent person
to be moved by statistics.”

T H A N K S !

George Bernard Shaw