STRUCTURAL EQUATION MODELING WITH LAVAAN TO EXPLAIN THE EFFECTS OF CO-CREATION ON CONSUMER BEHAVIOR

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Introduction

- Traditionally, firms developed their products and consumers accepted them passively. Nowadays, consumers adopt a more active role, especially in the virtual environment (Grönroos, 2011).

- Firms are increasingly integrating customers in their innovation processes to better suit consumers' needs (Ostrom *et al.,* 2015).

- Diverse companies have implemented co-creation activities in recent years (Kristal *et al.,* 2016).

threadless®

LEGO®

Lay's

STARBUCKS COFFEE®

CITROËN

Oral-B®

Kellogg's®


Lay's
Français
What would be yummy as a chip?
Create it and you could win¹!
You could
WIN $50,000
1% OF YOUR FLAVOUR'S FUTURE SALES*.
Lay's
Kettle Cooked
cuites à la marmite
Lay's
Your Flavour Here
Votre saveur ici
Lay's
Wavy
Ondulees
Do us a Flavour!
Faites-nous une saveur!
CHOOSE YOUR CHIP
CHOISISSEZ VOS CROUSTILLES
WIN $/ GAGNER $
CREATE MY FLAVOUR

Co-creation

- **Co-creation:** Joint value creation through a process in which providers and customers systematically interact, share information, learn and integrate resources (Prahalad and Ramaswamy, 2004).

Goal of the study

- *To analyze the effects of failed (vs. successful) co-creation experiences on consumer responses.*

Hypotheses

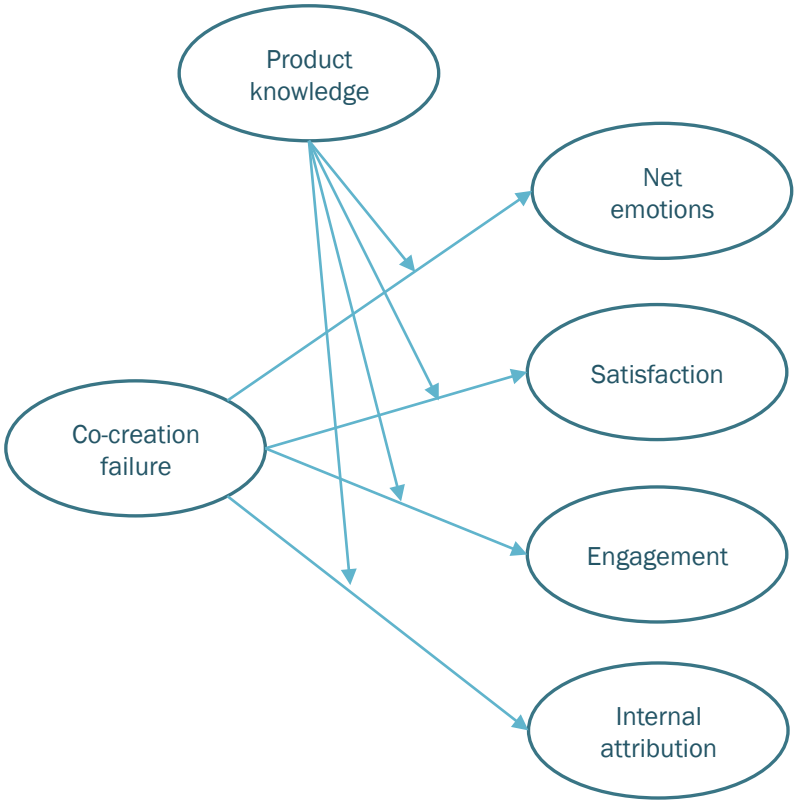
H1: Participation in co-creation activities leads to more positive emotions when the co-creation outcome is successful than when it is failed.

H2: Participation in co-creation activities leads to more satisfaction when the co-creation outcome is successful than when it is failed.

H3: Participation in co-creation activities leads to more consumer engagement when the co-creation outcome is successful than when it is failed.

H4: Participation in co-creation activities leads to more internal attributions when the co-creation outcome is successful than when it is failed.

Study: Hypotheses



Study: Methodology

- Between-subjects experimental design where we manipulated the co-creation outcome (successful vs. failed vs. control condition)
- 144 participants
- Data were collected using a self-administered online survey

Study: Methodology

- Dependent variables:
  - Satisfaction with the co-creation outcome
  - Positive and negative emotions felt while exposed to the outcome
  - Consumer engagement
  - Internal and external attributions
- Control variable:
  - Product knowledge
- Service performance was introduced to check the manipulation of the co-creation outcome

Study: Methodology

- CO-CREATION CONDITIONS

Nos gustaría que imaginases el siguiente escenario:

LA CROQUETERÍA GOURMET es una nueva croquetería que ha abierto en Murcia. **Está buscando ideas creativas para sus nuevas croquetas.** Le gustaría incluir en su carta una croqueta sabrosa, original y novedosa que cautive a los consumidores.

Para recibir las propuestas de los consumidores ha creado un **concurso de croquetas en Facebook.** La croqueta gourmet con más likes será la ganadora y obtendrá un premio de 250 euros.

LA CROQUETERÍA gourmet

Study: Methodology

- CO-CREATION CONDITIONS

Para ser realmente original en tu propuesta también puedes elegir otros ingredientes como **frutos secos, especias o frutas tropicales.**

Cualquier combinación de ingredientes es posible, pero recuerda que puedes elegir **un máximo de TRES ingredientes.**

A continuación, escribe los TRES ingredientes de tu croqueta.

Por último, escribe un NOMBRE para tu croqueta gourmet.

Study: Methodology

- SUCCESSFUL CO-CREATION OUTCOME

- FAILED CO-CREATION OUTCOME

Study: Methodology

- CONTROL CONDITION

Nos gustaría que imaginases el siguiente escenario:

LA CROQUETERÍA GOURMET es un nuevo restaurante de croquetas que ha abierto en Murcia. Imagina que planeas ir hoy a esta croquetería y puedes anticipar el pedido por Internet. Puedes elegir un máximo de **tres croquetas diferentes** para hacer tu pedido.

--> Haz clic para ver la carta de croquetas

Study: Methodology

- CONTROL CONDITION

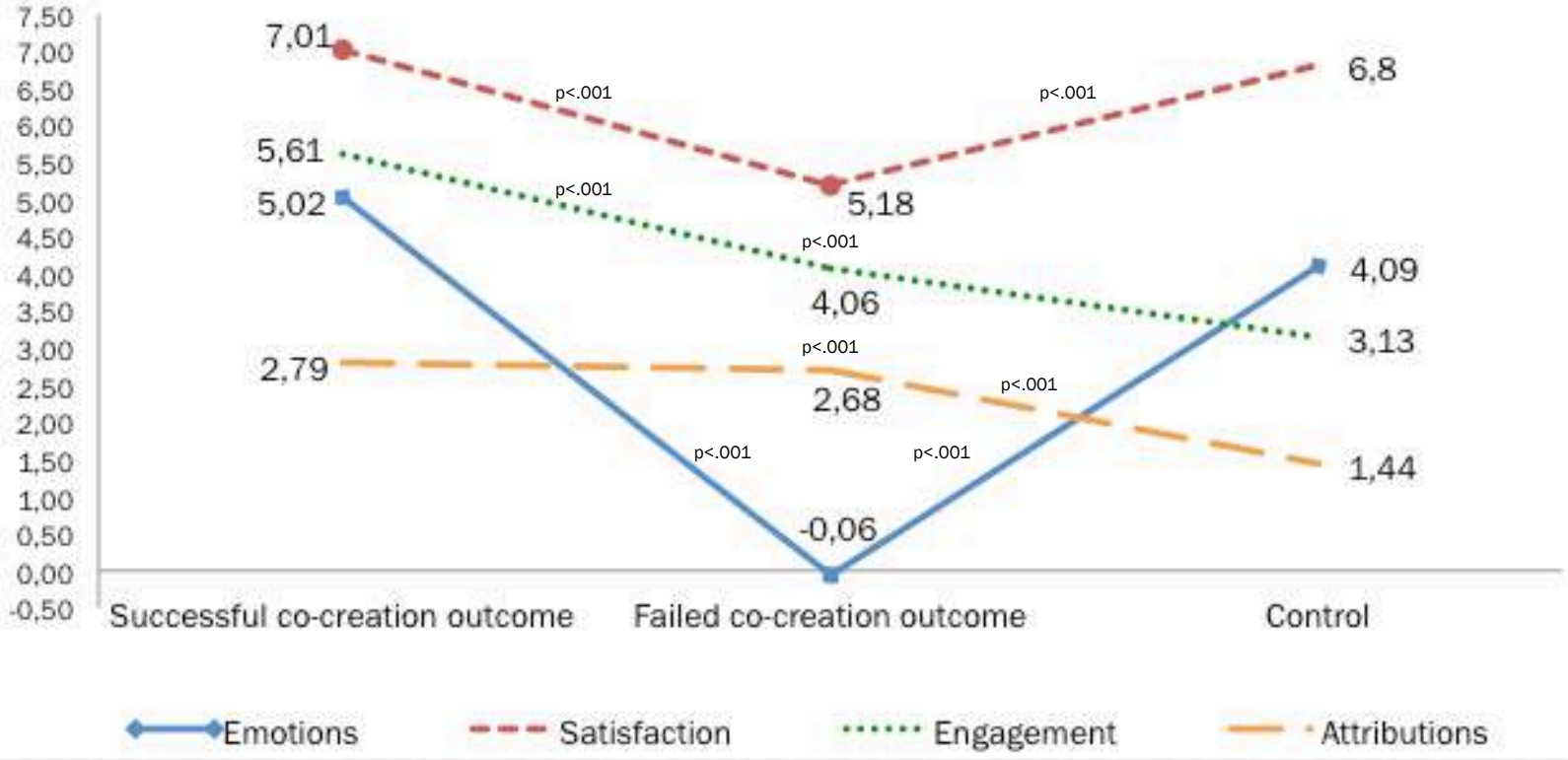
Señala las croquetas de LA CROQUETERÍA GOURMET que quieres probar.

Recuerda que puedes elegir un máximo de tres croquetas distintas.

- Croqueta de berenjena
- Croqueta de queso parmesano
- Croqueta de atún
- Croqueta de jamón de bellota
- Croqueta de secreto ibérico
- Croqueta de calabacín

Study: Results

- ANCOVA results. Covariate: Product knowledge

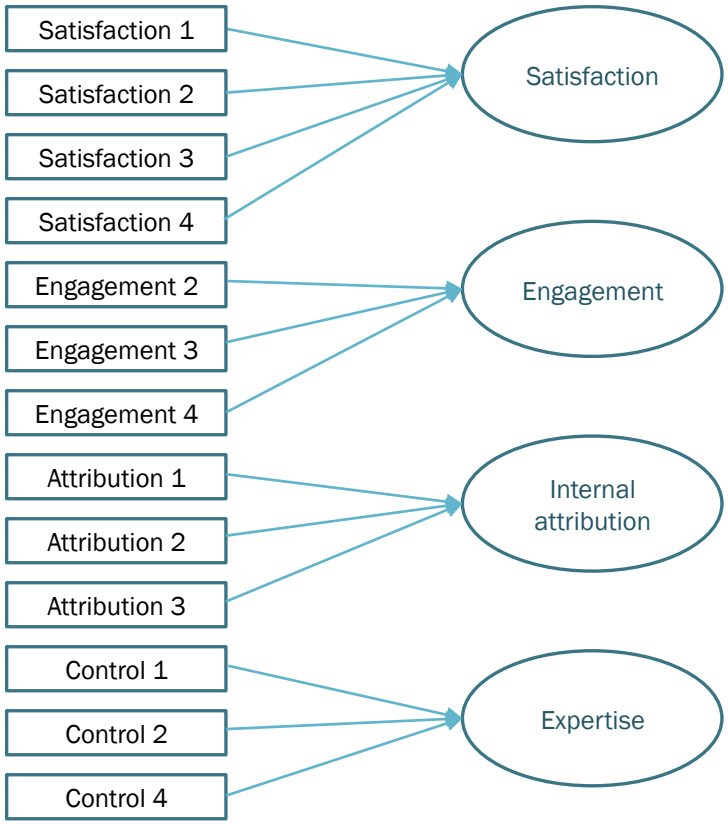


Study: Results

- Can we better understand the relationship among the variables?
- First we check reliability and validity through Confirmatory Factor Analysis (CFA)
- Yves Rosseel (2012). lavaan: An R Package for Structural Equation Modeling. Journal of Statistical Software, 48(2), 1-36

```
CFAmodel <- '
# measurement
satisfaction =~ satis1 + satis2 + satis3 + satis4
engagement =~ engage2 + engage3 + engage4
attribution =~ attribution1 + attribution2 + attribution3
expertise =~ control1 + control2 + control4
'
fitCFA <- cfa(CFAmodel, data = mydata)
summary(fitCFA, fit.measures = TRUE)
fitMeasures(fitCFA)
inspect (fitCFA, "cor.ov")
standardizedSolution(fitCFA)
MI <- modificationIndices(fitCFA)
subset(MI, mi > 10)
```

Study: Model


Satisfaction 1
Satisfaction 2
Satisfaction 3
Satisfaction 4
Engagement 2
Engagement 3
Engagement 4
Attribution 1
Attribution 2
Attribution 3
Control 1
Control 2
Control 4
Satisfaction
Engagement
Internal attribution
Expertise

Study: Results

- Reliability and validity through Confirmatory Factor Analysis (CFA)

Number of observations	144
Estimator	ML
Model Fit Test Statistic	98.043
Degrees of freedom	59
P-value (Chi-square)	0.001
Model test baseline model:	
Minimum Function Test Statistic	1669.684
Degrees of freedom	78
P-value	0.000
User model versus baseline model:	
Comparative Fit Index (CFI)	0.975
Tucker-Lewis Index (TLI)	0.968
Loglikelihood and Information Criteria:	
Loglikelihood user model (H0)	-3582.655
Loglikelihood unrestricted model (H1)	-3533.634
Number of free parameters	32
Akaike (AIC)	7229.310
Bayesian (BIC)	7324.344
Sample-size adjusted Bayesian (BIC)	7223.088
Root Mean Square Error of Approximation:	
RMSEA	0.068
90 Percent Confidence Interval	0.043 0.091
P-value RMSEA <= 0.05	0.110
Standardized Root Mean Square Residual:	
SRMR	0.060

Latent Variables:

	Estimate	Std.Err	z-value	P(>|z|)
satisfaction =~				
satis1	1.000			
satis2	0.937	0.055	17.145	0.000
satis3	0.997	0.048	20.896	0.000
satis4	1.071	0.046	23.429	0.000
engagement =~				
engage2	1.000			
engage3	0.968	0.039	24.795	0.000
engage4	1.010	0.044	23.041	0.000
attribution =~				
attribution1	1.000			
attribution2	1.210	0.224	5.398	0.000
attribution3	1.623	0.341	4.765	0.000
expertise =~				
control1	1.000			
control2	0.887	0.070	12.634	0.000
control4	0.810	0.083	9.749	0.000

Study: Results

- Reliability and validity through Confirmatory Factor Analysis (CFA)

$$CR = \frac{(\sum \lambda)^2}{[(\sum \lambda)^2 + \sum(1 - \lambda^2)]}$$

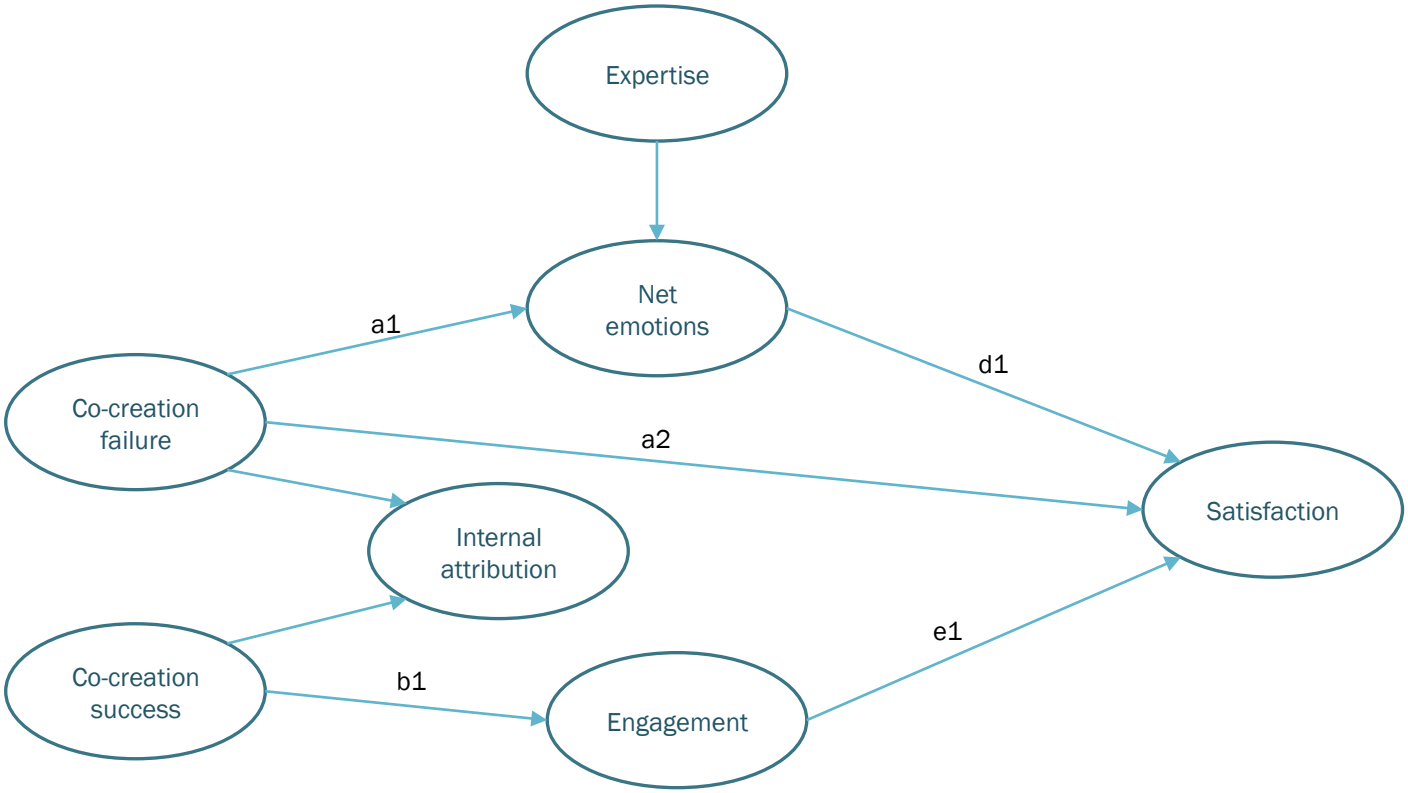
$$AVE = \frac{\sum \lambda^2}{[\sum \lambda^2 + \sum(1 - \lambda^2)]}$$

```
# CR and AVE
sl <- standardizedSolution(fitCFA)
sl <- sl$est.std[sl$op == "=~"]
sl  # These are the standardized factor loadings for each item
# summaryzed calculations
crsatisfaction <- sum(sl[c(1:4)])^2 / (sum(sl[c(1:4)])^2 + sum(1 - sl[c(1:4)]^2))
crsatisfaction
avesatisfaction <- sum(sl[c(1:4)]^2) / (sum(sl[c(1:4)]^2) + sum(1 - sl[c(1:4)]^2))
avesatisfaction

crengagement <- sum(sl[c(5:7)])^2 / (sum(sl[c(5:7)])^2 + sum(1 - sl[c(5:7)]^2))
crengagement
aveengagement <- sum(sl[c(5:7)]^2) / (sum(sl[c(5:7)]^2) + sum(1 - sl[c(5:7)]^2))
aveengagement

crattribution <- sum(sl[c(8:10)])^2 / (sum(sl[c(8:10)])^2 + sum(1 - sl[c(8:10)]^2))
crattribution
aveattribution <- sum(sl[c(8:10)]^2) / (sum(sl[c(8:10)]^2) + sum(1 - sl[c(8:10)]^2))
aveattribution

crexpertise <- sum(sl[c(11:13)])^2 / (sum(sl[c(11:13)])^2 + sum(1 - sl[c(11:13)]^2))
crexpertise
aveexpertise <- sum(sl[c(11:13)]^2) / (sum(sl[c(11:13)]^2) + sum(1 - sl[c(11:13)]^2))
aveexpertise
```

Study: Results

- Estimate the model by Structural Equation Modeling (SEM) with lavaan
- Check for total effects
- Use bootstrapping to get confidence intervals for the estimations
- Set random seed so results can be reproduced
- Center the binary independent variables (Kraemer and Blasey, 2004)
- 1 0 0 -> 2/3 -1/3 -1/3

Study: Model


Expertise
Net emotions
a1
d1
Co-creation failure
a2
Satisfaction
Internal attribution
e1
Co-creation success
b1
Engagement

Study: Results

- SEM estimation
- Including total effects

```
SEMmodelFBI <- '
# measurement
satisfaction =~ satis1 + satis2 + satis3 + satis4
engagement =~ engage2 + engage3 + engage4
attribution =~ attribution1 + attribution2 + attribution3
expertise =~ control1 + control2 + control4
diffemotions =~ diffem3
failure =~ failurecentered
success =~ successcentered

# regressions
diffemotions ~  a1*failure + expertise
satisfaction ~ a2*failure + d1*diffemotions
attribution ~  failure + success
engagement ~ a3*failure + b1*success + e1*satisfaction

# total effect of failure on satisfaction
failuresatisf := a2 + (a1*d1)

# total effect of failure on engagement
failureengage := a3 + (a1*d1*e1) + (a2*e1)

# total effect of success on engagement
successengage := b1
'
fitSEMFBI <- sem(SEMmodelFBI, data = mydata,
                 se = "bootstrap", bootstrap = 10000)
summary(fitSEMFBI, fit.measures = TRUE, standardized = TRUE, rsquare=TRUE,
        estimates = TRUE, ci = TRUE)
parameterEstimates(fitSEMFBI, boot.ci.type="bca.simple")
fitMeasures(fitSEMFBI)
inspect (fitSEMFBI, "cor.lv")
```

: Results

```
lavaan 0.6-3 ended normally after 161 iterations

  Optimization method                           NLMINB
  Number of free parameters                         42

  Number of observations                           144

  Estimator                                         ML
  Model Fit Test Statistic                     166.865
  Degrees of freedom                                94
  P-value (Chi-square)                           0.000

Model test baseline model:

  Minimum Function Test Statistic             1906.456
  Degrees of freedom                               120
  P-value                                        0.000

User model versus baseline model:

  Comparative Fit Index (CFI)                    0.959
  Tucker-Lewis Index (TLI)                       0.948

Loglikelihood and Information Criteria:

  Loglikelihood user model (H0)              -4105.474
  Loglikelihood unrestricted model (H1)      -4022.041

  Number of free parameters                         42
  Akaike (AIC)                               8294.947
  Bayesian (BIC)                             8419.680
  Sample-size adjusted Bayesian (BIC)        8286.781

Root Mean Square Error of Approximation:

  RMSEA                                          0.073
  90 Percent Confidence Interval          0.055  0.091
  P-value RMSEA <= 0.05                          0.021

Standardized Root Mean Square Residual:

  SRMR                                           0.073
```

Study: Results

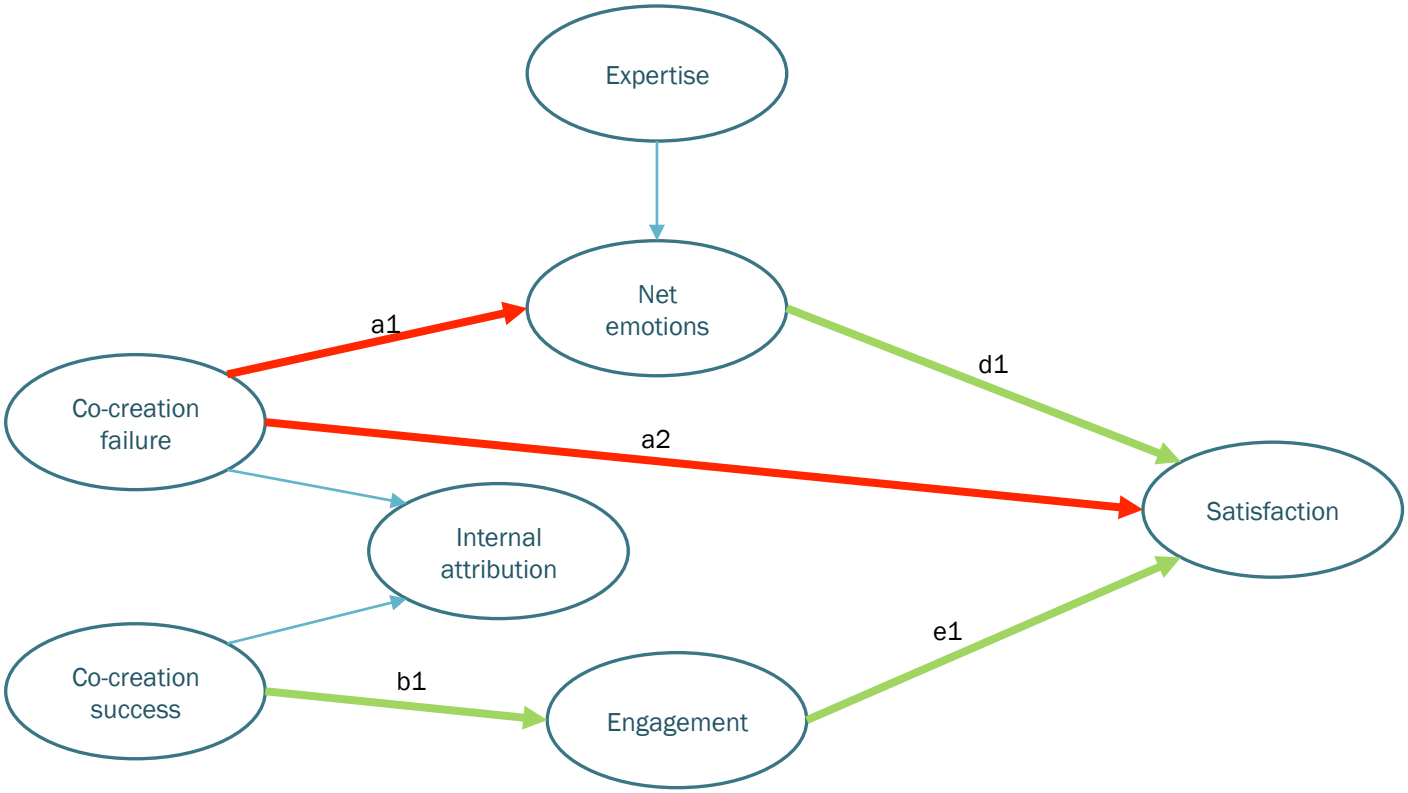
Regressions:

	Estimate	Std.Err	z-value	P(>|z|)	ci.lower	ci.upper	Std.lv	Std.all
attribution ~								
failure	1.016	0.344	2.949	0.003	0.358	1.707	0.384	0.384
success	0.859	0.434	1.981	0.048	0.088	1.784	0.323	0.323
engagement ~								
success (b1)	1.888	0.473	3.995	0.000	0.974	2.817	0.318	0.318
netemotions ~								
failure (a1)	-4.518	0.715	-6.324	0.000	-5.896	-3.094	-0.499	-0.499
expertise	0.396	0.131	3.020	0.003	0.129	0.648	0.226	0.226
satisfaction ~								
failure (a2)	-0.839	0.348	-2.413	0.016	-1.541	-0.166	-0.190	-0.190
engagemnt (e1)	0.153	0.069	2.208	0.027	0.014	0.286	0.204	0.204
netemotns (d1)	0.183	0.049	3.696	0.000	0.089	0.284	0.374	0.374

Defined Parameters:

	Estimate	Std.Err	z-value	P(>|z|)	ci.lower	ci.upper	Std.lv	Std.all
failuresatisf	-1.664	0.370	-4.494	0.000	-2.415	-0.951	-0.377	-0.377
successatisf	0.288	0.141	2.044	0.041	0.026	0.583	0.065	0.065

Study: Model


Expertise
Net emotions
a1
d1
Co-creation failure
a2
Satisfaction
Internal attribution
e1
Co-creation success
b1
Engagement

Conclusion

- Co-creation can be an effective strategy to enhance **consumer's** engagement and satisfaction
- But co-creation with negative output favors negative emotions and less satisfaction

THANKS!

QUESTIONS?