A Latent State-Trait Model for Analyzing States, Traits, Situations, Method Effects, and Their Interactions

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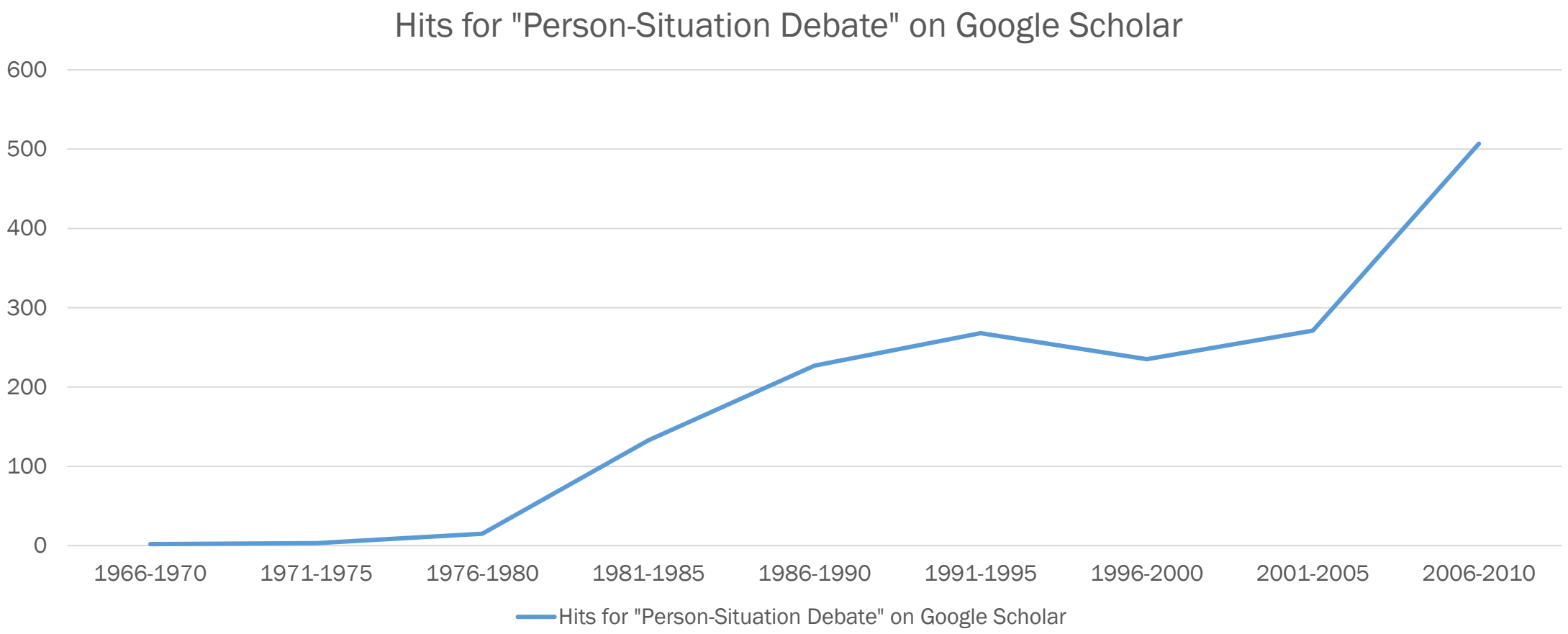
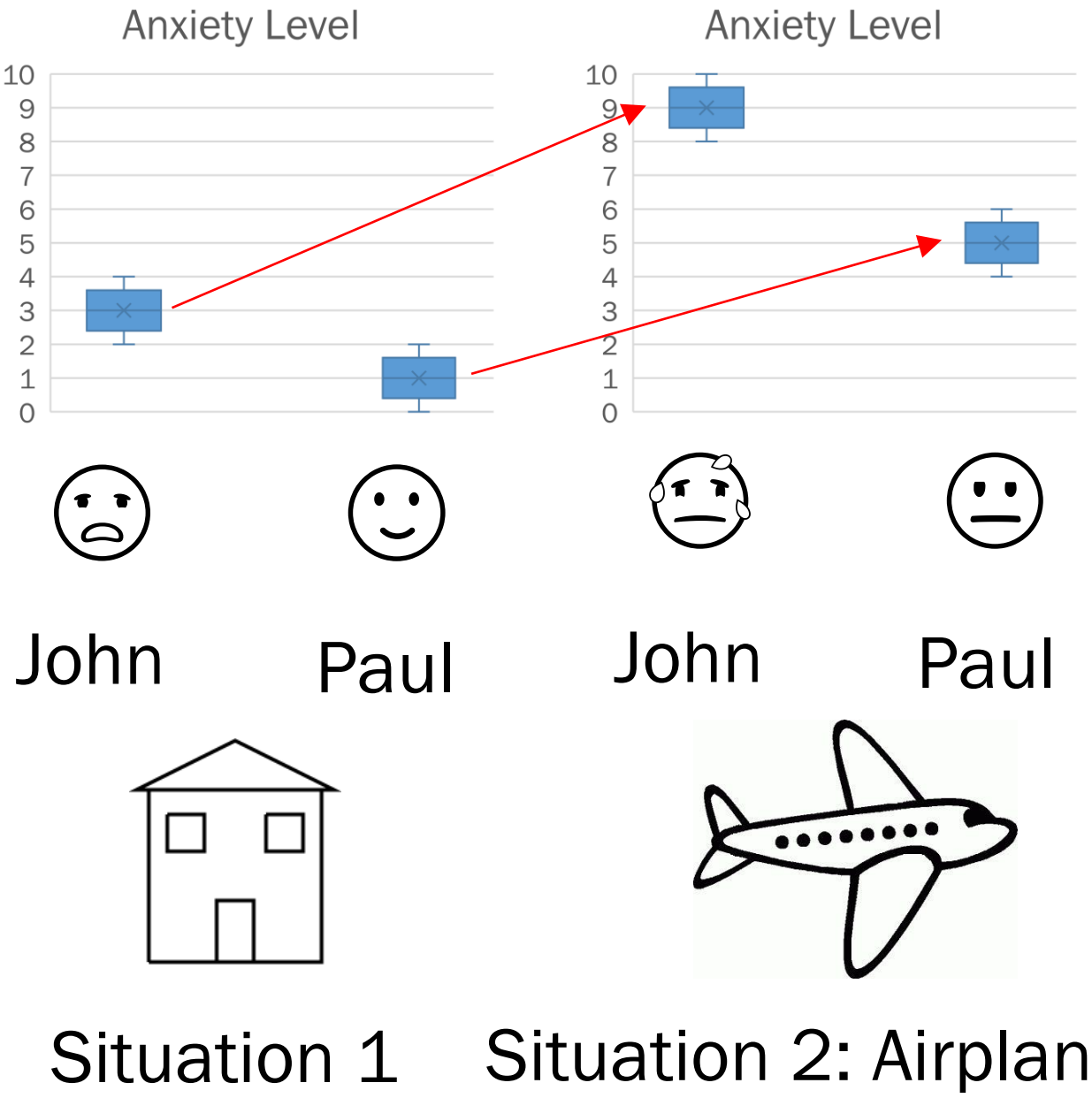
The Person-Situation Debate



Many leading personality theorists view personality traits as a distribution of individual behaviors in situations (Fleeson, 2001; Funder, 1991). Traits may not be universal across all situations.

Person-Situation Interactions
Home anxiety level predicts increase. Not always true, but can be true.



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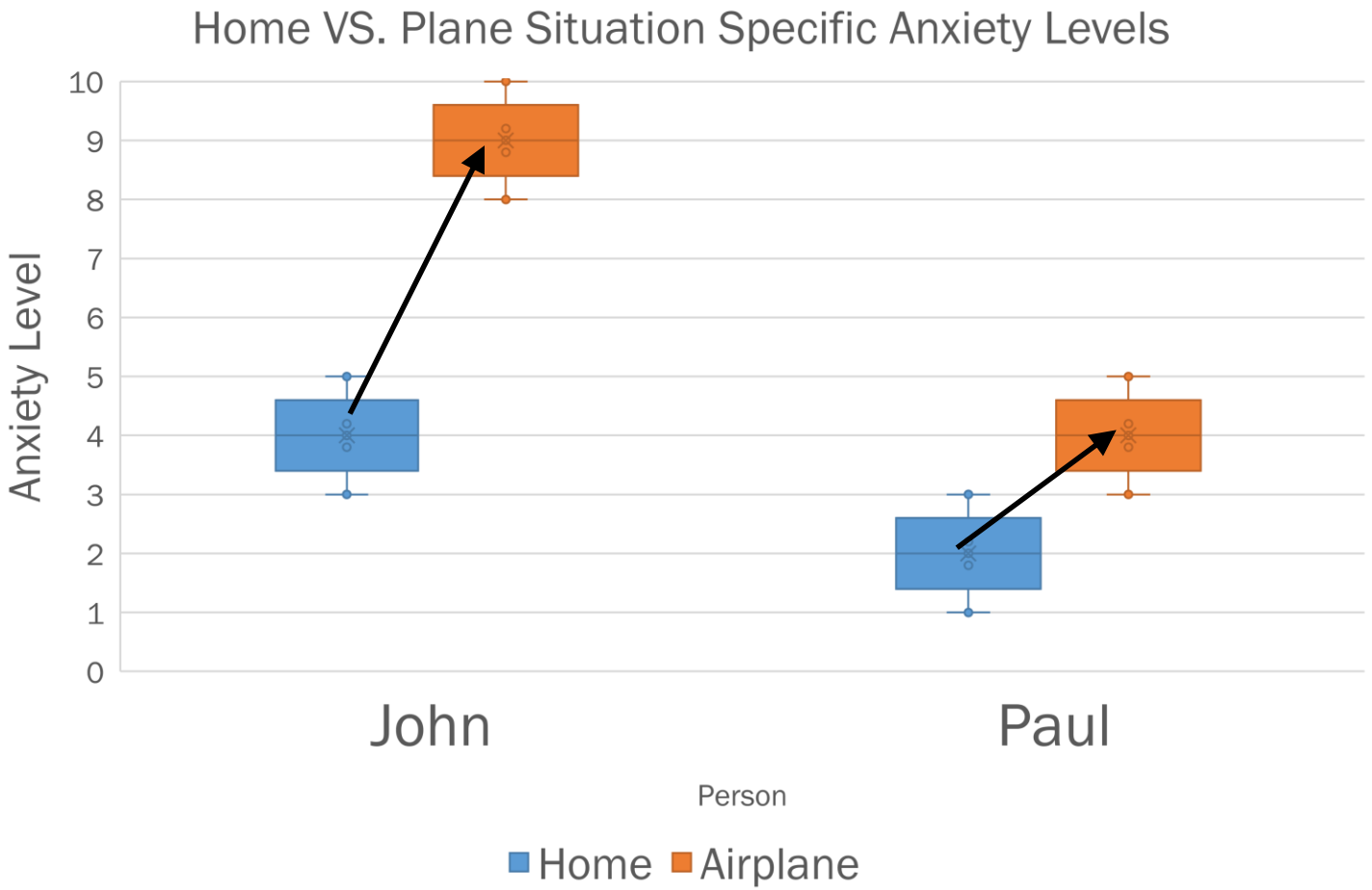
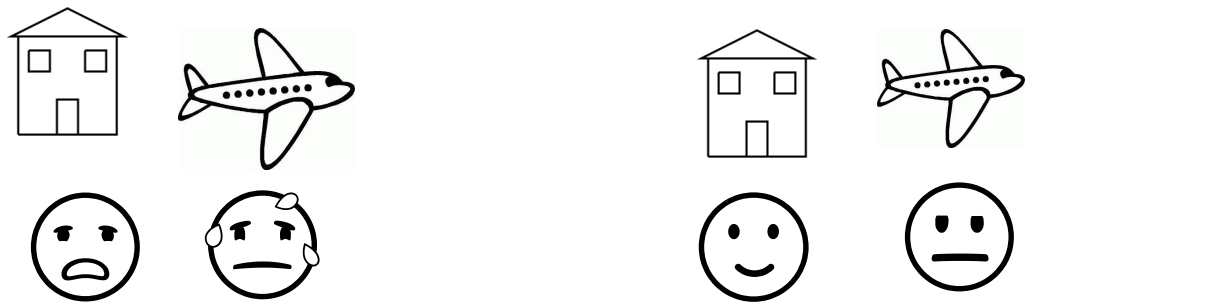




Situation 1 Situation 2: Airplane

Multi-method Designs

- Multiple Viewpoints
- Examples:
  - Multiple Informants (Peer, Parent, Teacher, Supervisor)
  - Physiological measures (hormones, heart rate)
  - Different wording / measurements
- Accounts for method bias

Method Effects in Situation Research

- Are situation effects simply methodological artifacts?
- Are method effects constant across situations?
- Do method effects interact with situations?
- These have been crucial questions in investigating the distinction between persons and situations (Kenrick & Funder, 1988).
- Theorists have argued that the interactions of method effects and situations should be better researched (Schmitt, 2006).

The Model

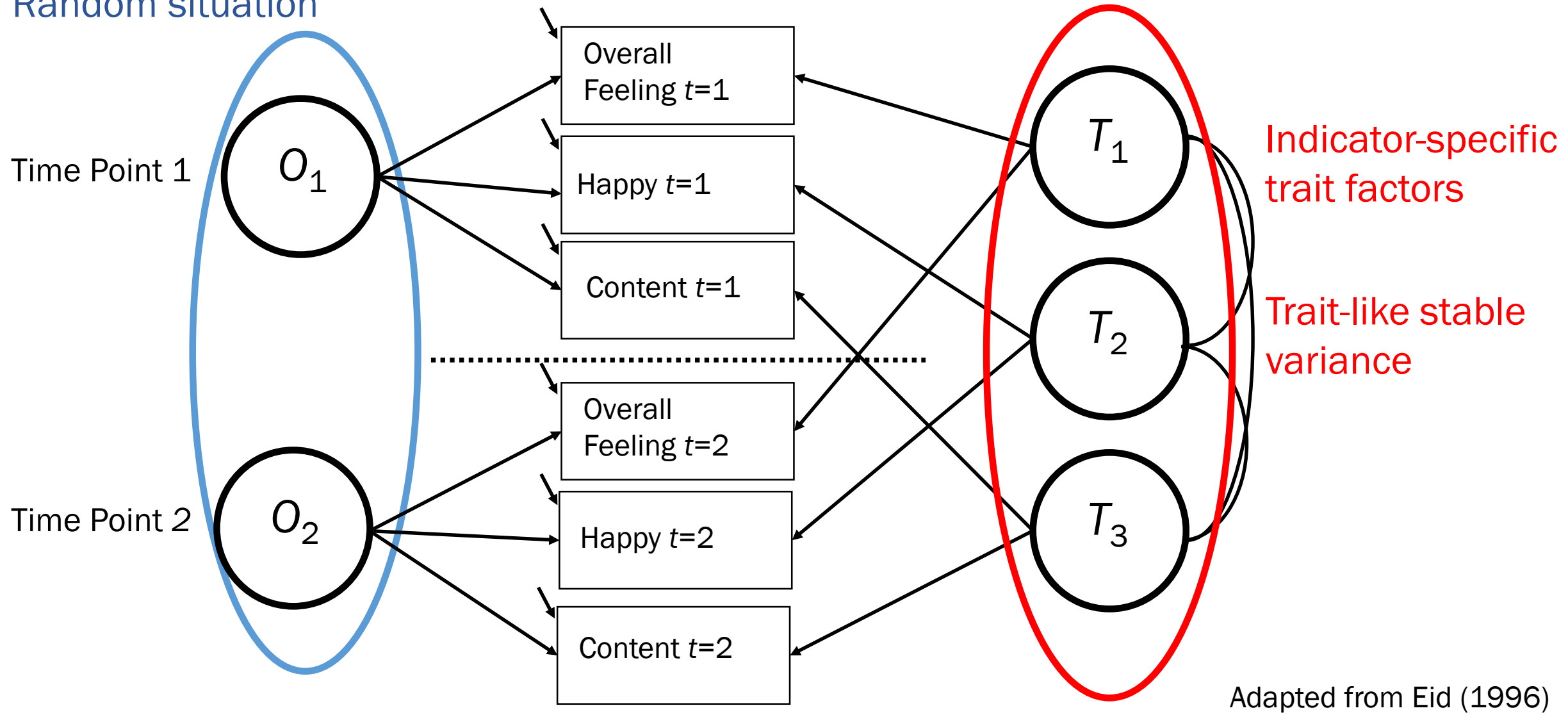
- Extension of existing latent variable techniques
- Combines analyzing person-situation interaction modeling (LST-RF) and multi-trait multi-method modeling (CTC(M-1)).

Latent State-Trait Models

- Identify portions of measurement variance that are due to trait-like variance, occasion-specific residual variance, and measurement error.
- Individuals measured at multiple time points
- Steyer, Ferring, & Schmitt (1992); Kenny & Zautra (1995); Eid (1996); Steyer et al. (2015)

Classical LST Model

Occasion-specific unstable variance "Random situation"



Indicator-specific trait factors

Trait-like stable variance

Adapted from Eid (1996)

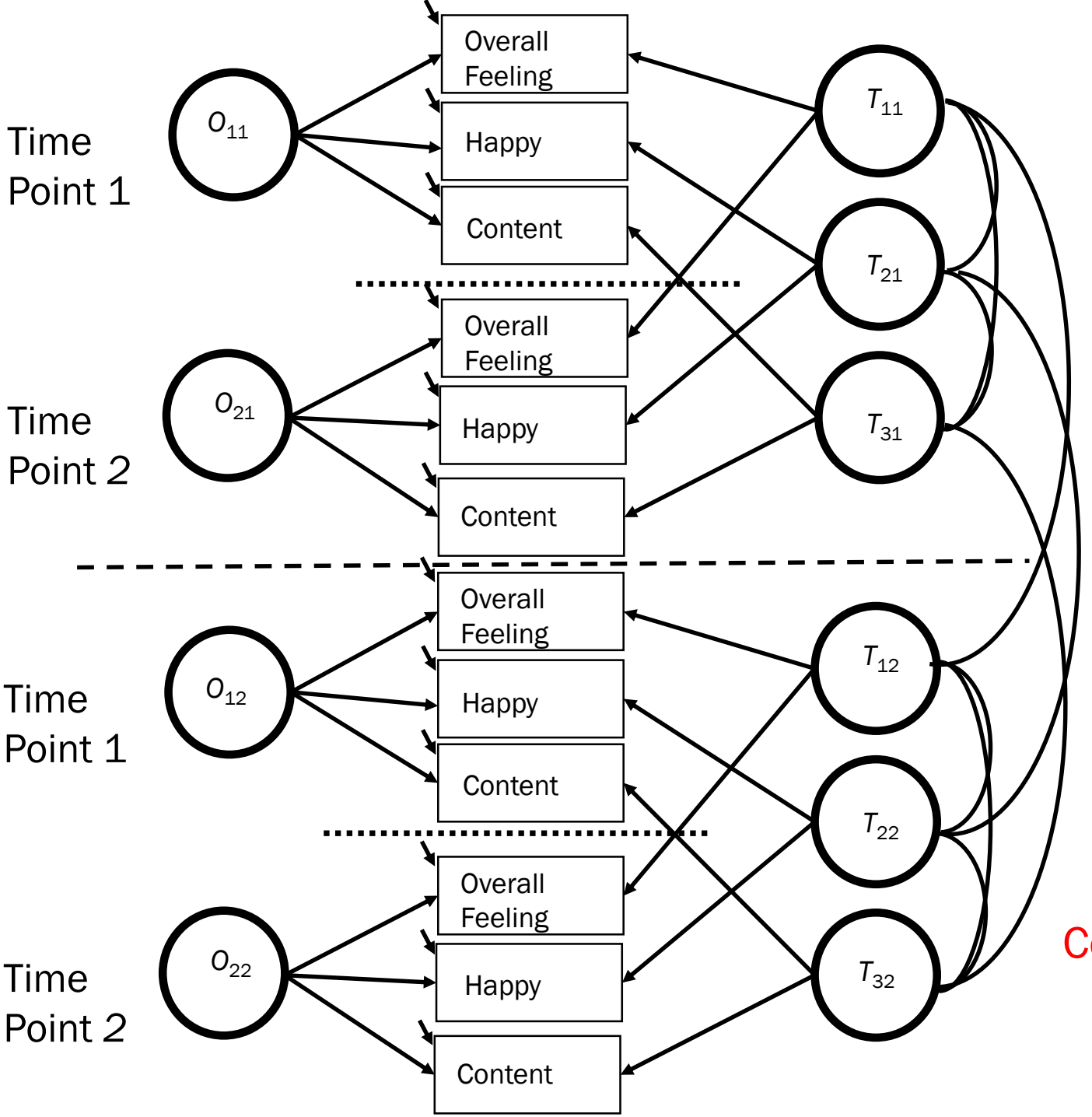
Confounding of Situation and Interaction effects

- In LST models, situations are assumed to be randomly sampled from a universe of possible situations.

- Since the situations are not identified it is impossible to separate situation effects and person-situation interaction effects.

LST-RF Models

- Person-situation interactions
  - Need to examine specific, pre-identified situations.
- Geiser et al: Latent State-Trait model for Random and Fixed effects.
- Measurements taken at
  - multiple time points
  - multiple fixed *situations*.



LST-RF Model

Reference Situation 1
Pre-quitting smoking

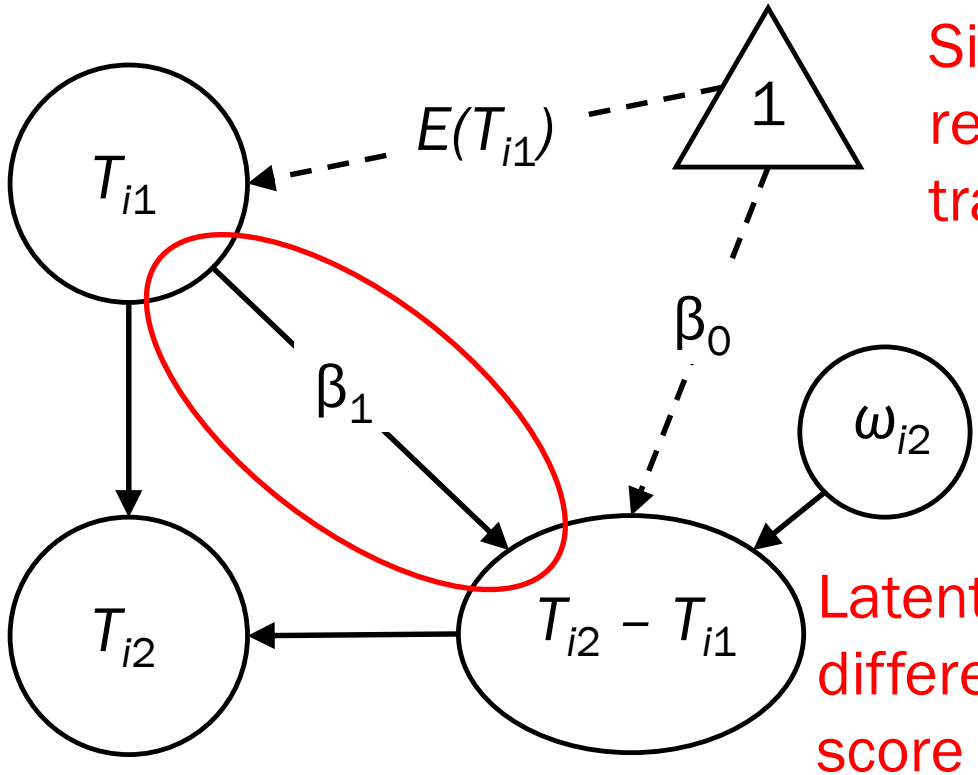
Situation 2
Post-quitting smoking

Correlations between traits across situations
=
Similarity of traits are across situations.

Difference Score Parameterization

Reference Situation 1
Pre-quitting smoking

Situation 1
Post-quitting smoking



Situational changes are regressed on pre-quitting trait values.

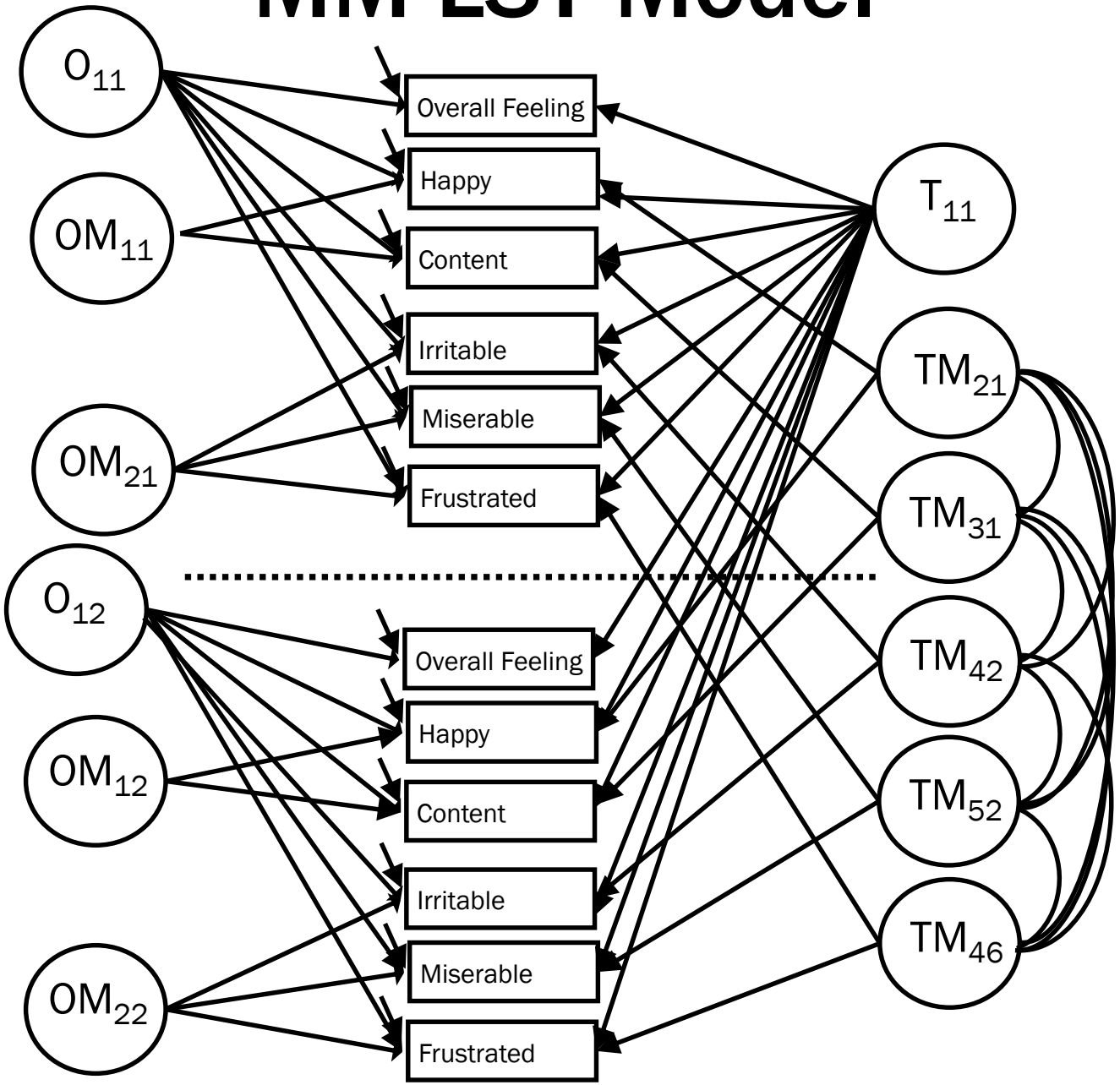
Latent difference score

Adapted from Geiser et al. (2015)

Extension to Multiple Methods

- There are many ways to model method effects using CFA (Eid, 2000; Kenny, 1975; Marsh & Hocevar, 1984; Widaman, 1985).
- We use the Correlated Traits Correlated Methods (minus 1) model [CTC(M-1)] model (Eid, 2000)
- Requires choosing a reference method
- MM-LST Models (Courvoisier et al., 2008)

MM-LST Model



Method 1

Method 2

Method 1

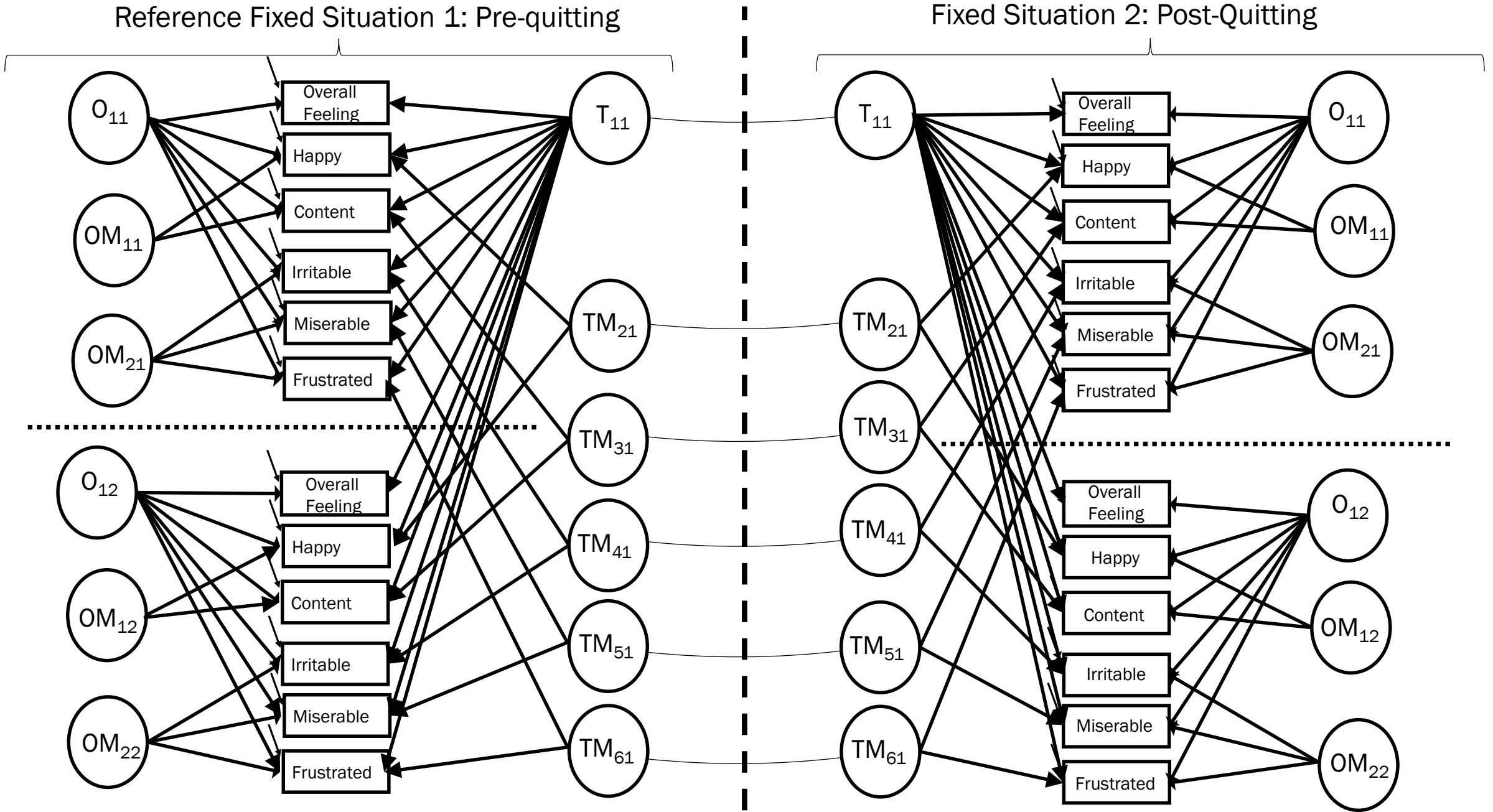
Method 2

Time pt 1

Time pt 2

Modified from Courvoisier et al. (2008)

MM-LST-RF Model



How Method-Specific Are The Trait and State Portions In Each Situation?

Within-Fixed Situations Coefficients

- Shared and unique consistency

$$SCon(\tau_{imts}) = \frac{\lambda_{ims}{}^2 Var(T_{11s})}{Var(\tau_{imts})} \qquad UCon(\tau_{imts}) = \frac{Var(TM_{ims})}{Var(\tau_{imts})}$$

- Shared and unique occasion-specificity

$$SOSpe(\tau_{imts}) = \frac{\delta_{ims}{}^2 Var(O_{11ts})}{Var(\tau_{imts})} \qquad UOSpe(\tau_{imts}) = \frac{\gamma_{ims}{}^2 Var(OM_{mts})}{Var(\tau_{imts})}$$

Adapted from Courvoisier et al. (2008)

Effects We Want To Study

- Are situation effects simply methodological artifacts?
- Are method effects constant across situations?
- Do method effects interact with situations?

Are situation effects method-specific?
Across Fixed Situations Coefficients

- Situation-specificity of traits

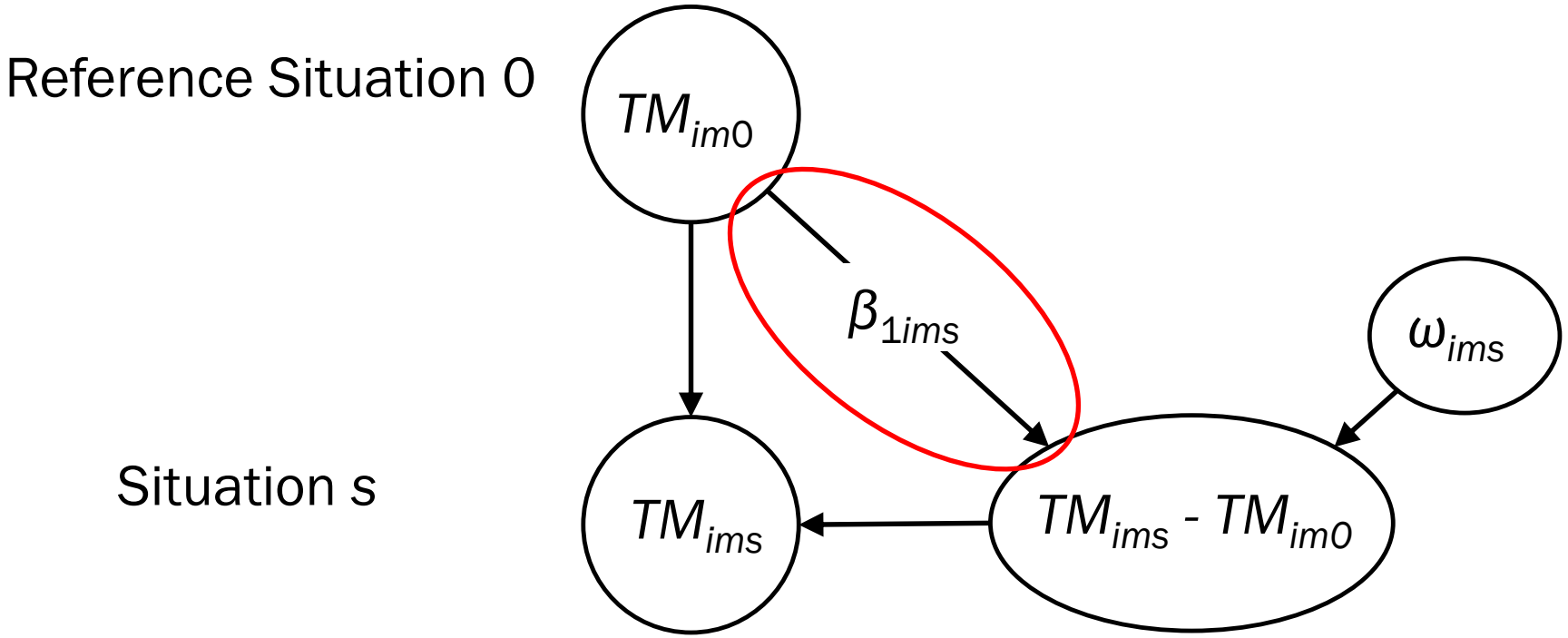
$$SitSpe(T_{i1}) = 1 - [Corr(T_{i1r}, T_{i1s})]^2$$

- Method-specificity of situation effect

$$MS(T_{ims} - T_{imr}) = \frac{Var(TM_{ims} - TM_{imr})}{Var(T_{ims} - T_{imr})}$$

MM-LST-RF Model

- We can look at method effect x situation interactions using a similar parameterization as the LST-RF model



Are P x S Interactions Method-Specific?
Across Fixed Situations Coefficients

- Person x situation interaction coefficient

$$(P \times S)_{11s} = \frac{\beta_{111s}{}^{2} Var(T_{11r})}{Var(T_{11s} - T_{11r})}$$

- Method-specificity of person x situation interaction

$$MS(PxS_{ims}) = \frac{\beta_{1ims}{}^{2} Var(TM_{imr})}{\lambda_{im}{}^{2} \beta_{11rs}{}^{2} Var(T_{11r}) + \beta_{1ims}{}^{2} Var(TM_{imr})}$$

Are Method Effects Constant Across Situations?
Across Fixed Situations Coefficients

- Situation-specificity of method effects

$$SitSpe(TM_{im}) = 1 - [Corr(TM_{imr}, TM_{ims})]^2$$

How much of the change in method effects is due to ME x S interactions?

Across Fixed Situations Coefficients

- Method x situation interaction coefficient

$$(M \times S)_{ims} = \frac{\beta_{1ims}{}^{2} Var(TM_{imr})}{Var(TM_{ims} - TM_{imr})}$$

Empirical Application

- EMA study of smokers' affect (N=235) (Shiffman et al., 2002)
- Affect recorded prior to quitting and post quitting
- 6 affect indicators:
  - *Overall Feeling*
  - *Happy*
  - *Content*
  - *Irritable*
  - *Miserable*
  - *Frustrated*

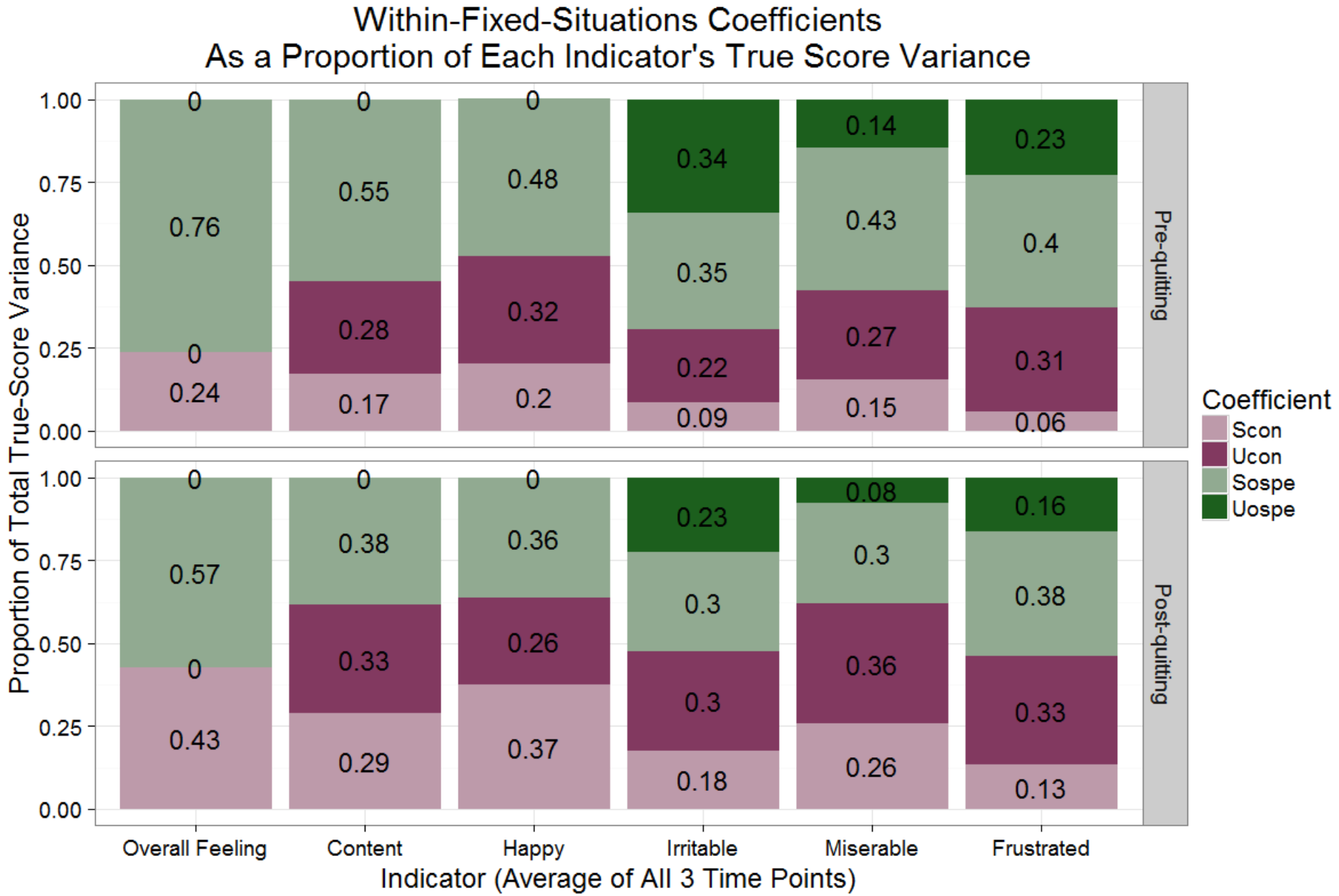
5-point Likert-style Scale:
Very Bad, Bad, Neutral, Good, Very Good

4-point Likert-style Scale:
NO!!!, no?, yes?, YES!!!

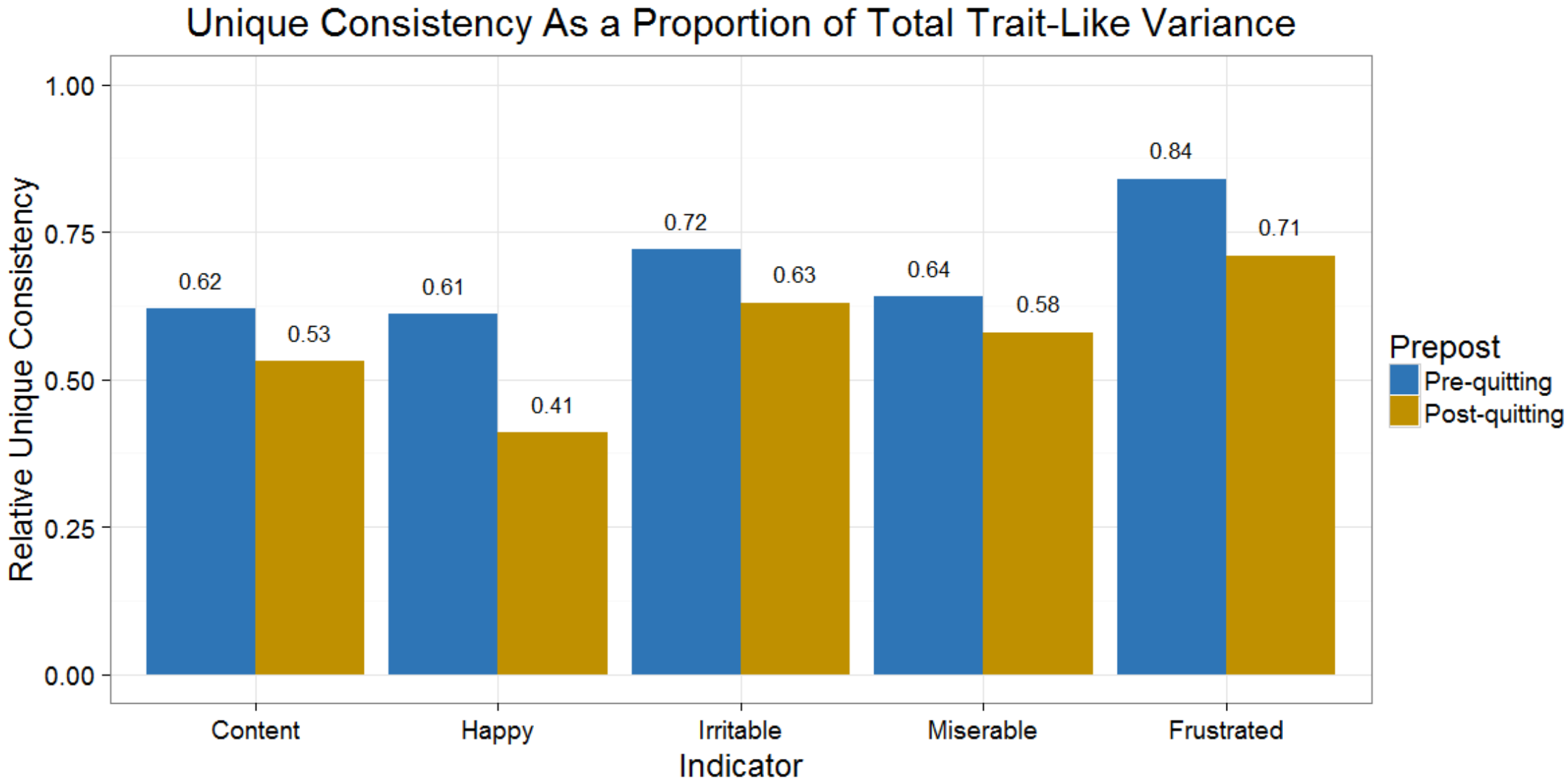
Goodness of Fit Tests

- Found that we did not need method-specific occasion-residual factors for positively keyed items
- Final model fit after invariance constraints:
- $\chi^2(590)=755.60$, $p<.001$; RMSEA=.035; CFI=.96

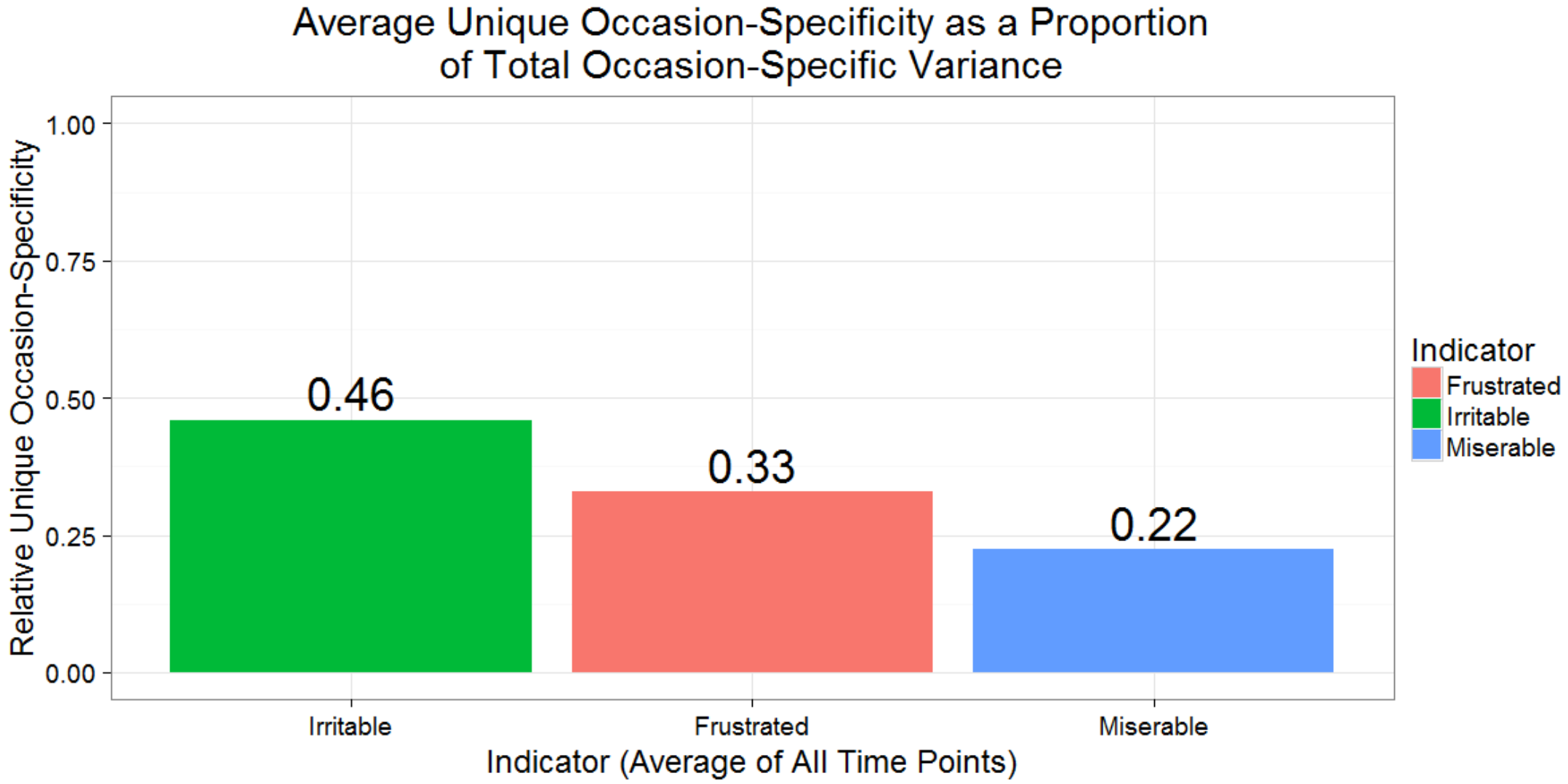
Within-Fixed Situations Coefficients



Within-Fixed Situations Coefficients

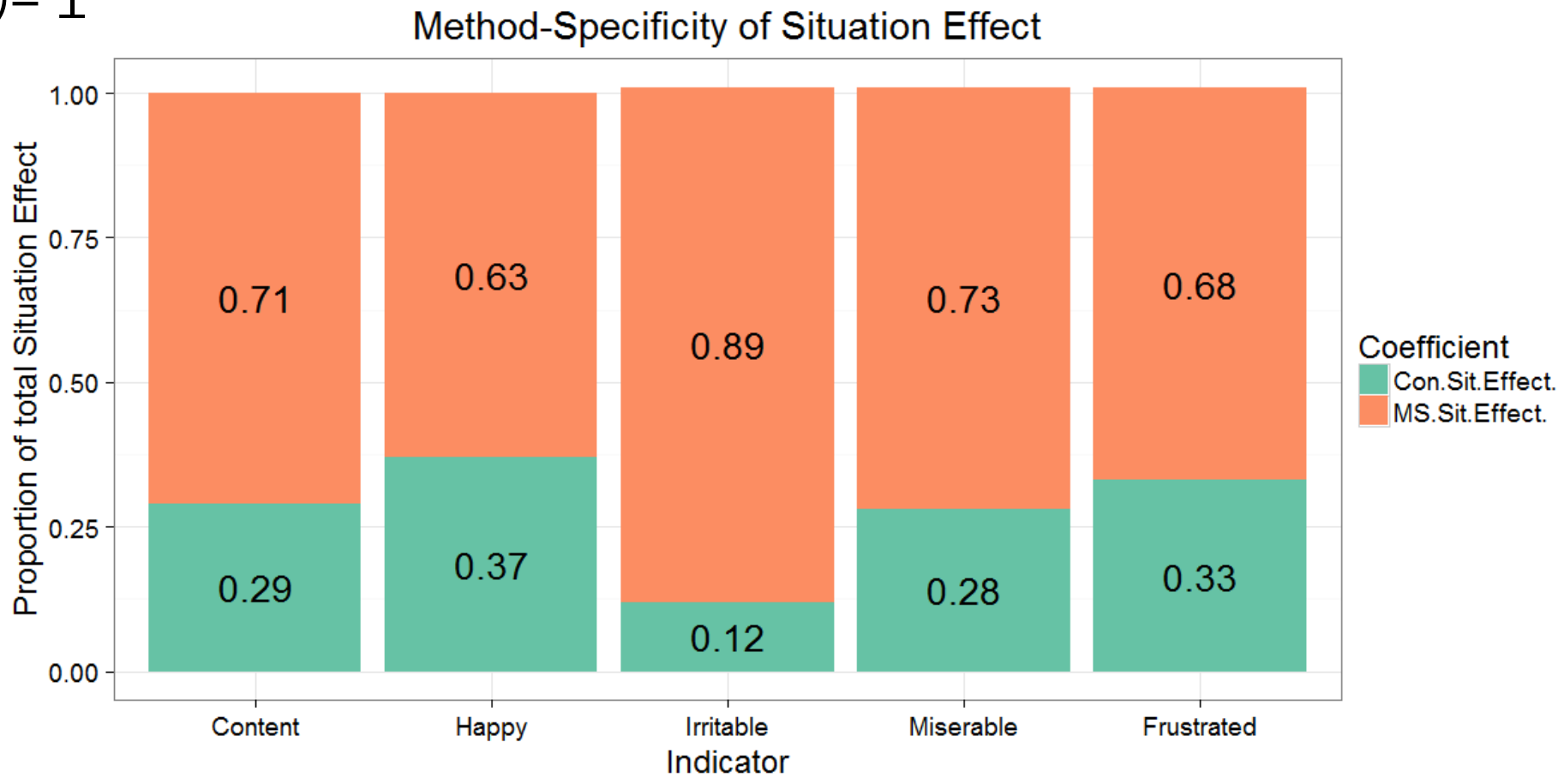


Shared and Method-specific Occasion-residual Variance



Situation Specificity, P x S of Reference Trait Method specificity of Situation Effect

- *SitSpe(Overall Feeling$_1$)*= 0
- *P x S(Overall Feeling$_1$)*= 1



Person x Situation Interaction

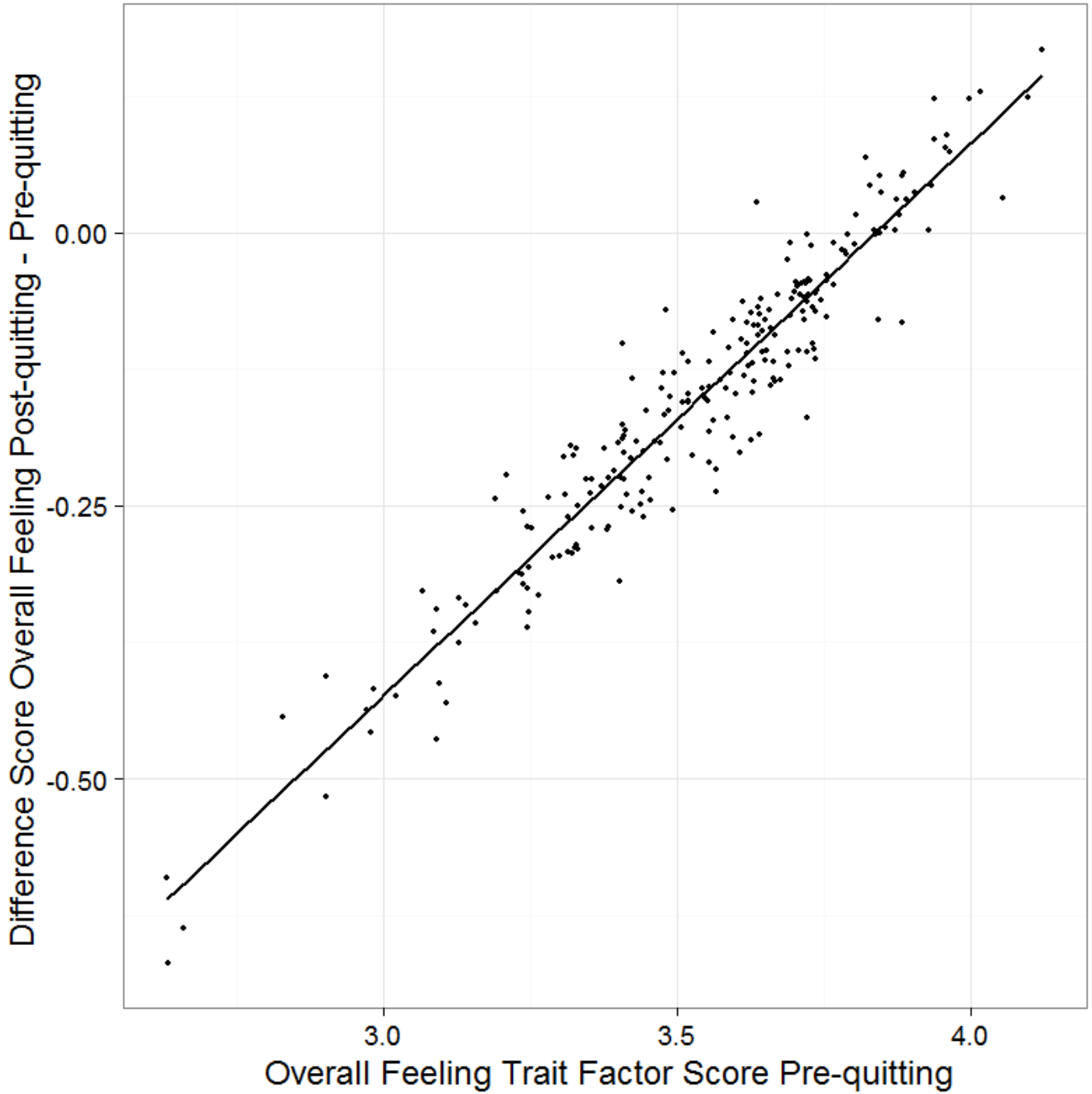
Regression of Overall Feeling Post Minus Pre Difference Score on Pre-quitting Overall Feeling Trait score:

β_0=-2.41
β_1=.641 (*p*=.04)

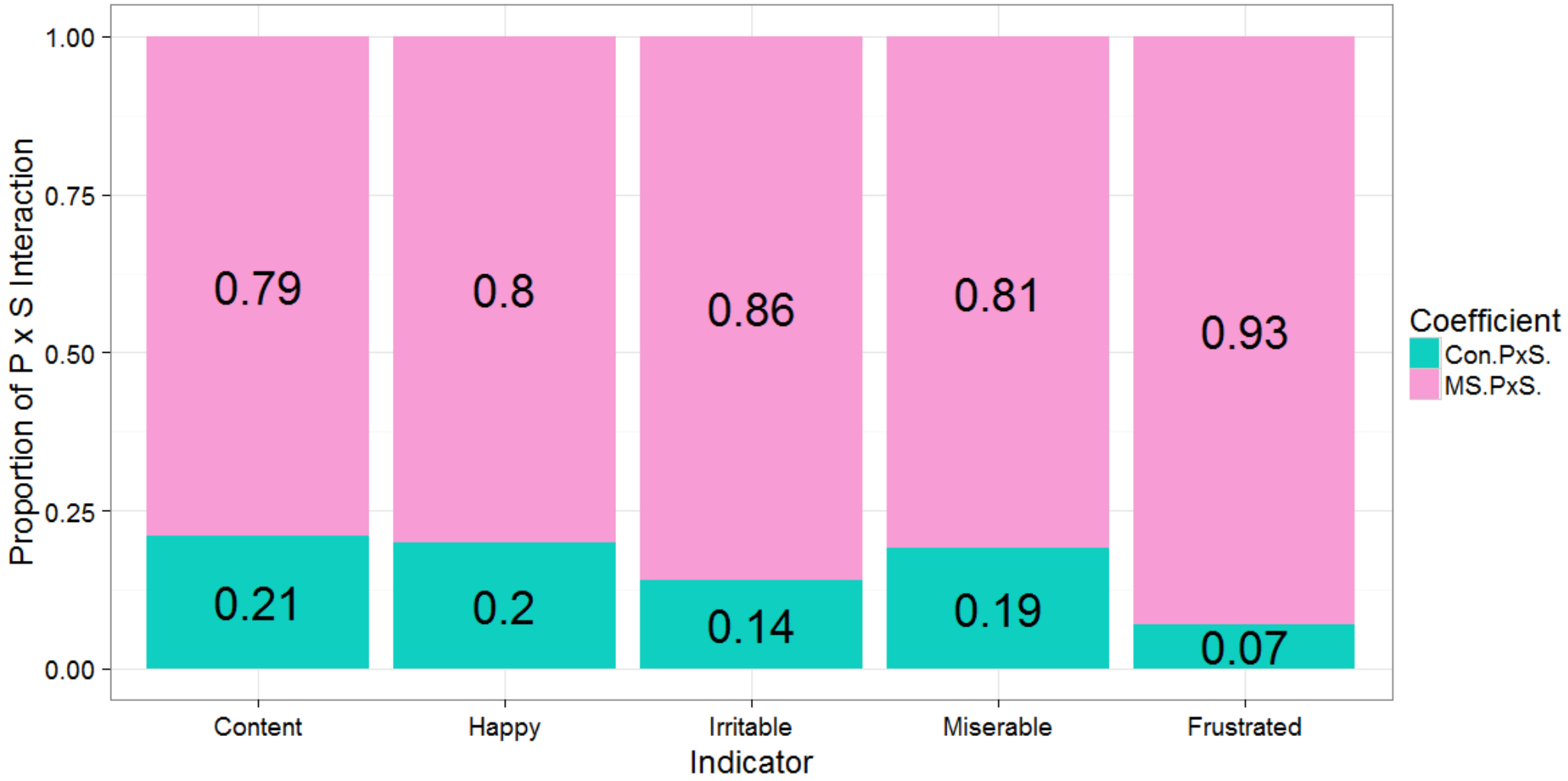
Average Difference Score: $\beta_0 + \beta_1 E(T_{11r})$

$$= -2.41 + (.641)(3.54)$$

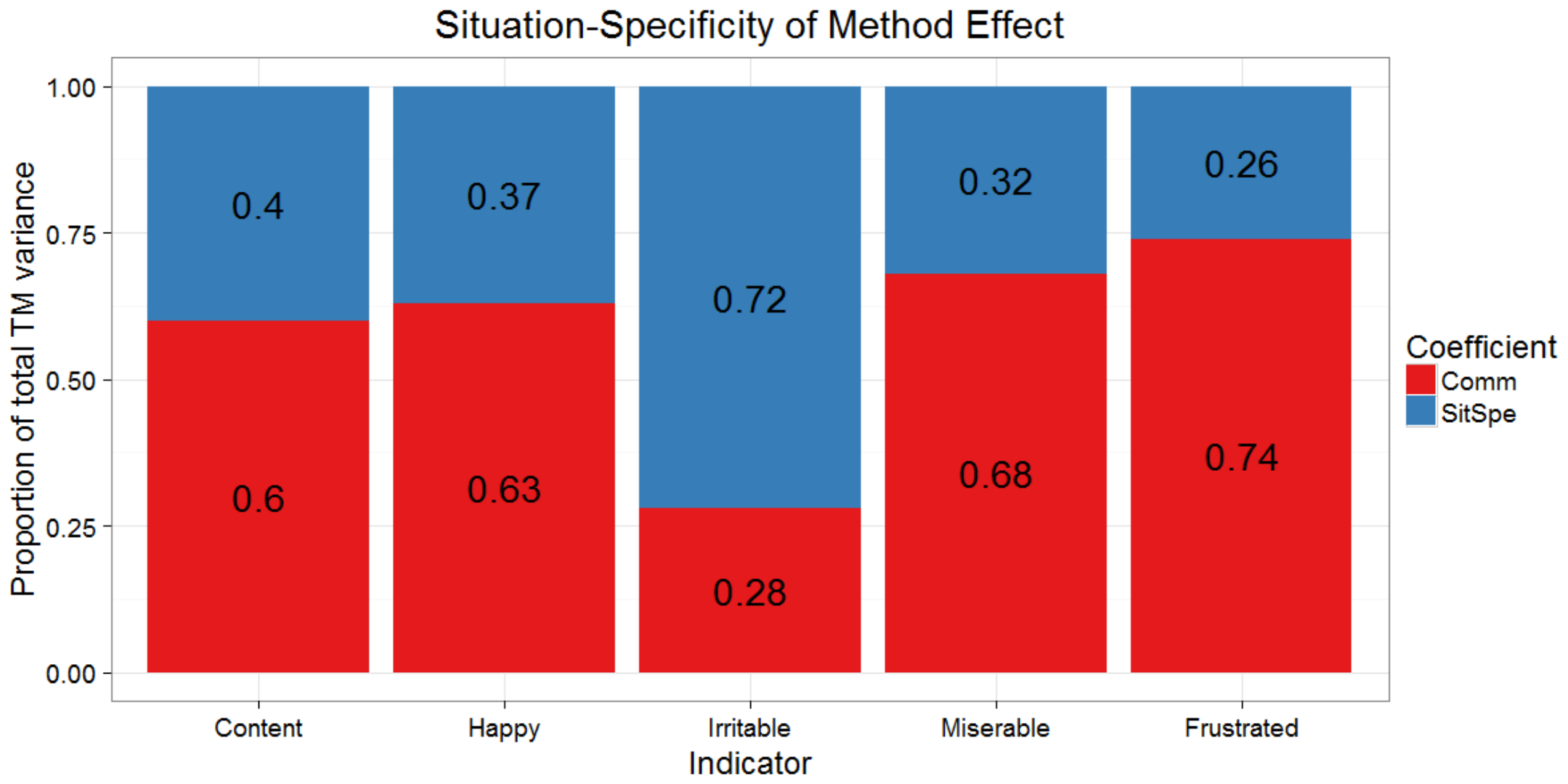
$$= -.14$$


Difference Score Overall Feeling Post-quitting - Pre-quitting
0.00
-0.25
-0.50
3.0
3.5
4.0
Overall Feeling Trait Factor Score Pre-quitting

Method-specificity of P x S interaction



Situation-Specificity of Method Effect

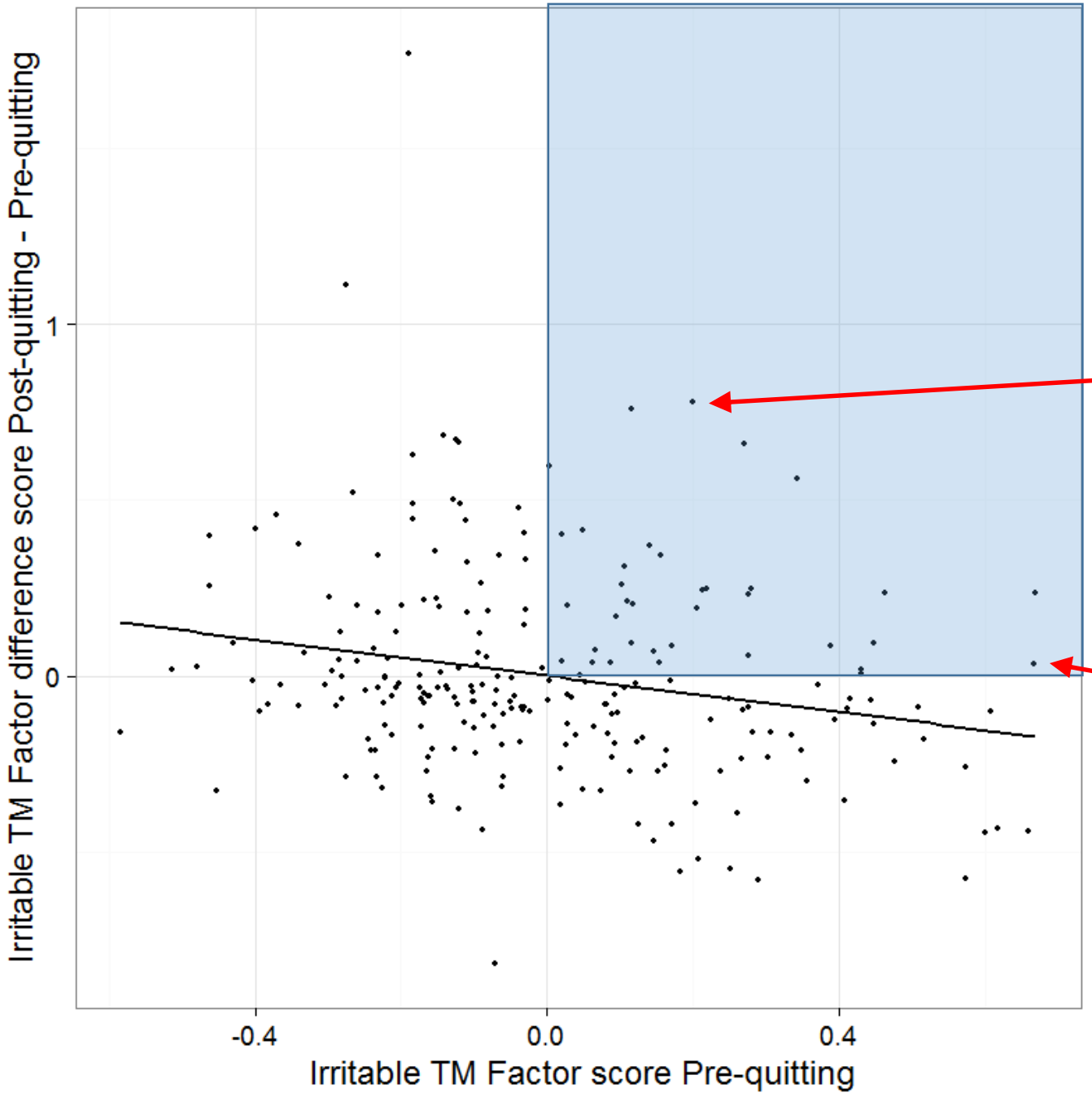


Method x Situation Interactions

Table. *Difference regression coefficients for assessing method x situation interaction*

Indicator	b_{0im}	b_{1im}	p value (b_{1im})
Content	–	.004	.98
Happy	–	-.175	.23
Irritable	–	-.331	.09
Miserable	–	.132	.59
Frustrated	–	-.092	.57

Note. *$p<.05$ **$p<.01$ ***$p<.001$



Example
Pre-quitting TM score
(overestimation): 0.2
TM Difference score: 0.7

Example
Pre-quitting TM score
(overestimation): 0.7
TM Difference score: 0.05

Advantages

- The MM-LST-RF model allows researchers to examine a large number of effects previously not considered by other approaches.
- The MM-LST-RF model is highly flexible

Limitations

- Large amount of within-subjects measurements.
- Requires selection of a reference method.

Thank you!

Questions?

Table 4. *Model Goodness-of-Fit Measures for different MM-LST-RF models fit to Smoker's Affect Data*

Model	$\chi2$	*df*	*p*	RMSEA	CFI	AIC	Comp. Model	$\chi2$ Δ	*df* Δ	*p* ($\chi2$ Δ)	ΔCFI
1. Baseline LST Model	720.68	560	<.001	.035	.961	16315					
2. $'\lambda_{imr}='\lambda_{ims}$ $\delta_{imr}=\delta_{ims}$	736.01	572	<.001	.035	.960	16307	1	15.33	12	.224	-.001
3. $\alpha_{imr} = \alpha_{ims}$	747.52	577	<.001	.035	.958	16308	2	11.50	5	.042*	-.002
4. $\alpha_{imr} = \alpha_{ims}$; *Happy* item intercept freely estimated	737.34	576	<.001	.035	.961	16300	3	1.32	4	.857	.003
5. $E(T_{11r})=E(T_{11s})$	752.06	577	<.001	.036	.957	16313	4	14.73	1	<.001***	-.004
6. $Var(T_{11r}) = Var(T_{11s})$	751.45	577	<.001	.036	.958	16312	4	14.12	1	<.001***	-.003
7.$Var (O_{1tr}) = Var(O_{1ts})$	740.28	581	<.001	.034	.961	16293	4	2.94	1	.086	.000
8. $Var(OM_{m1r}) = Var(OM_{m2r})$ $Var(OM_{m1s}) = Var(OM_{m2s})$	753.23	585	<.001	.035	.959	16298	7	12.95	4	.01*	-.002
9. $Var(OM_{mtr}) = Var(OM_{mtr})$ $Var(OM_{mts}) = Var(OM_{mts})$ excluding t=1r	742.71	584	<.001	.034	.961	16290	7	2.43	3	.489	.000
10. $Var(OM_{mtr})=Var(OM_{mts})$ excluding t =1r	744.52	585	<.001	.034	.961	16289	9	1.81	1	.178	.000
11. $Var(TM_{imr})=Var(TM_{ims})$	755.60	590	<.001	.035	.960	16290	10	12.89	5	.024*	-.001

Note. Comp. Model = Comparison Model. RMSEA= Root Mean Square Error of Approximation. CFI = Comparative Fit Index. AIC=Akaike's information criterion. *$p<.05$ **$p<.01$ ***$p<.001$