Multilevel Modeling: A Primer

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Question

Does frequency of feedback from managers predict employee engagement?

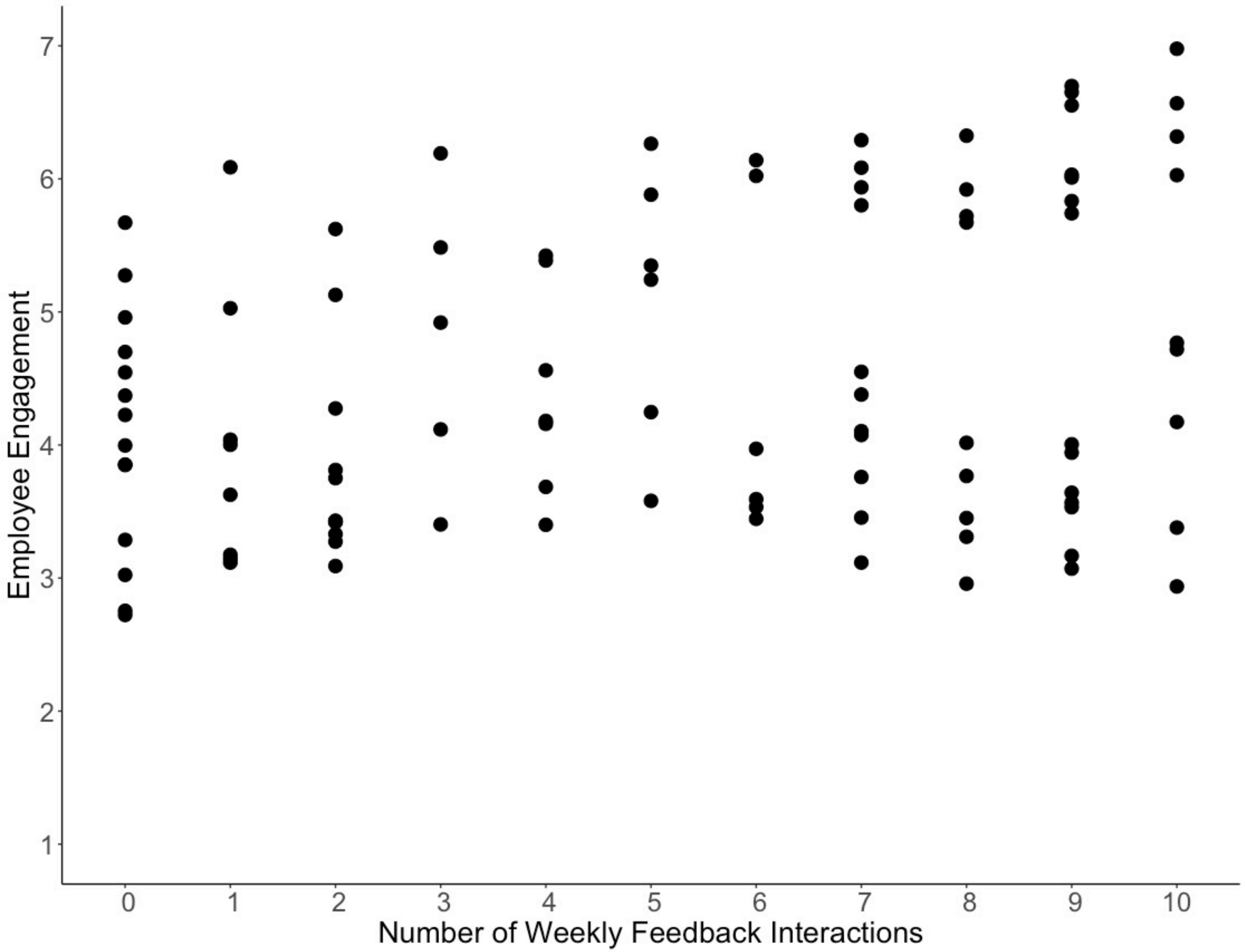
FF & Engagement

Does frequency of feedback from managers predict employee engagement?

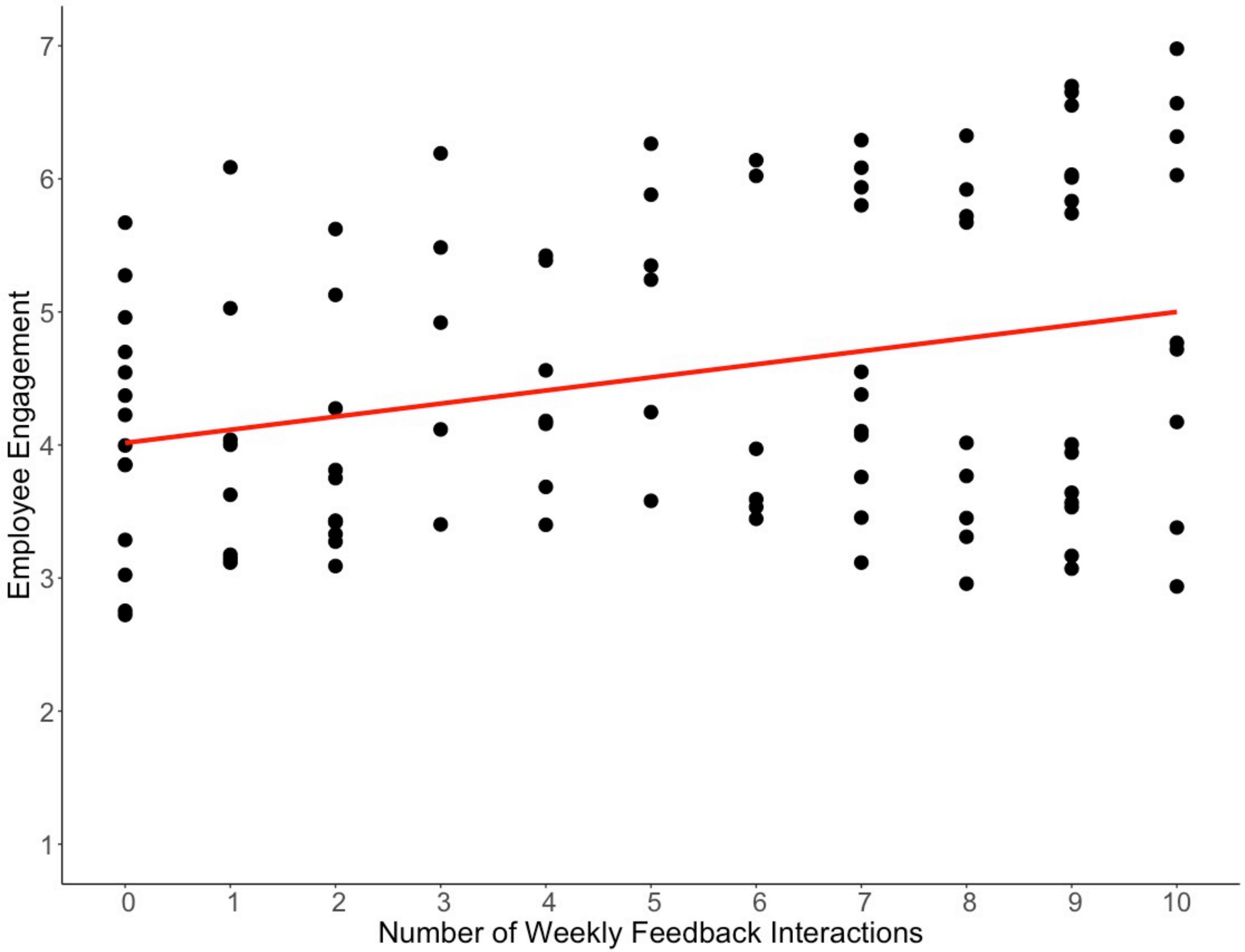
N = 100 employees in org unit

Employee	Number of Weekly FB Ints	Engagement
1	4	4.67
2	1	3.54
3	9	6.12
4	6	3.31
5	3	3.27

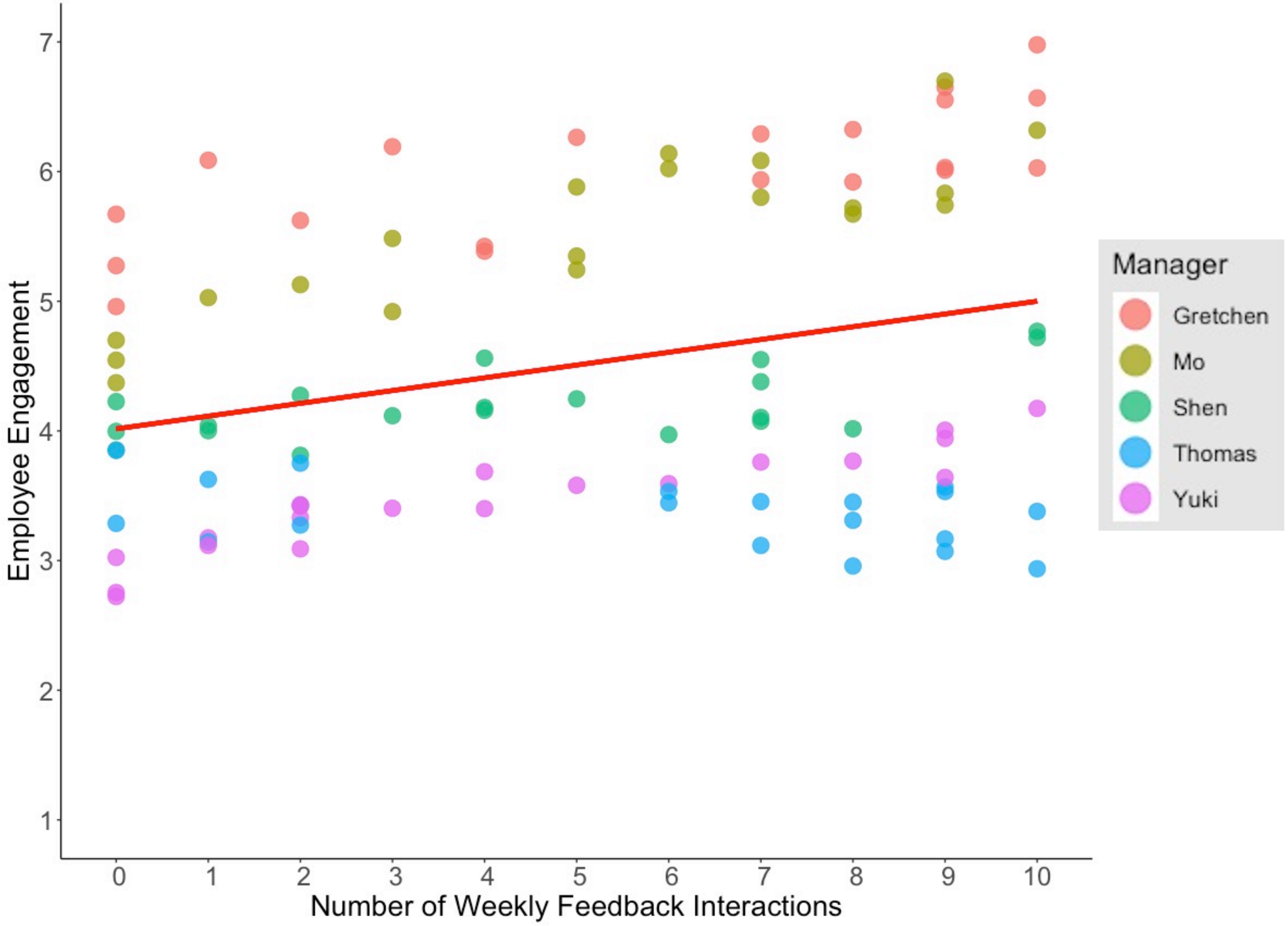
FF & Engagement



FF & Engagement: OLS Line



Problem



Employee Engagement
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
8
9
10
Number of Weekly Feedback Interactions
Manager
Gretchen
Mo
Shen
Thomas
Yuki

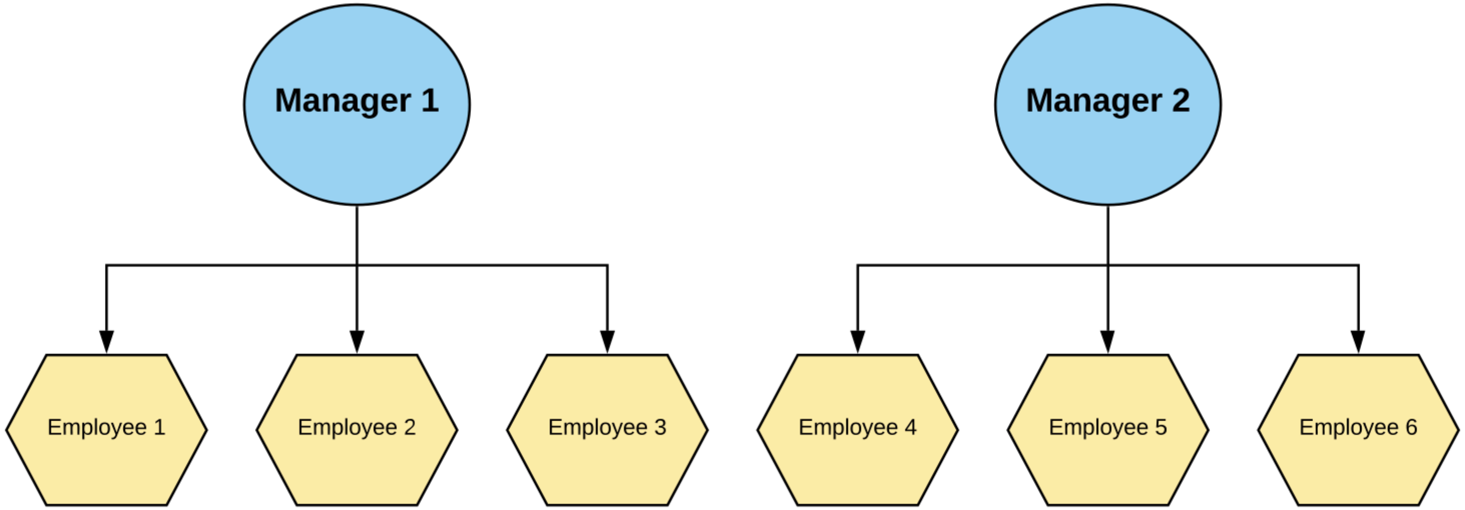
Problem

- Org unit is <u>hierarchically</u> structured
  - Employees *nested* under managers

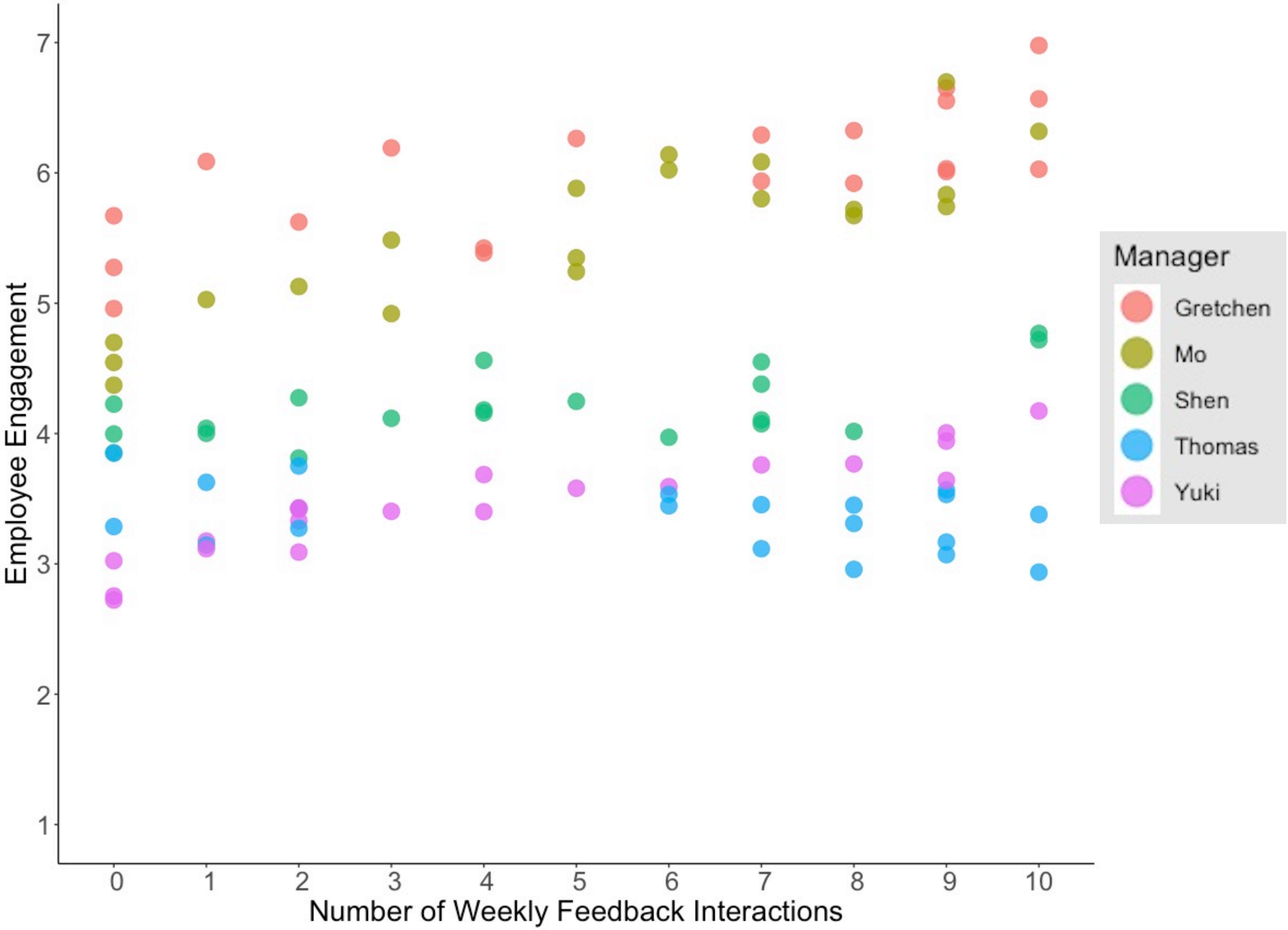
Employee	**Manager**	# Weekly FB	Engagement
1	Mo	4	5.18
2	Yuki	1	3.04
3	Gretchen	9	6.12
4	Thomas	6	3.31
5	Yuki	3	3.27
6	Mo	2	4.89
7	Thomas	5	3.42

Problem

- Org unit is <u>hierarchically</u> structured
  - Employees *nested* under managers



Problem



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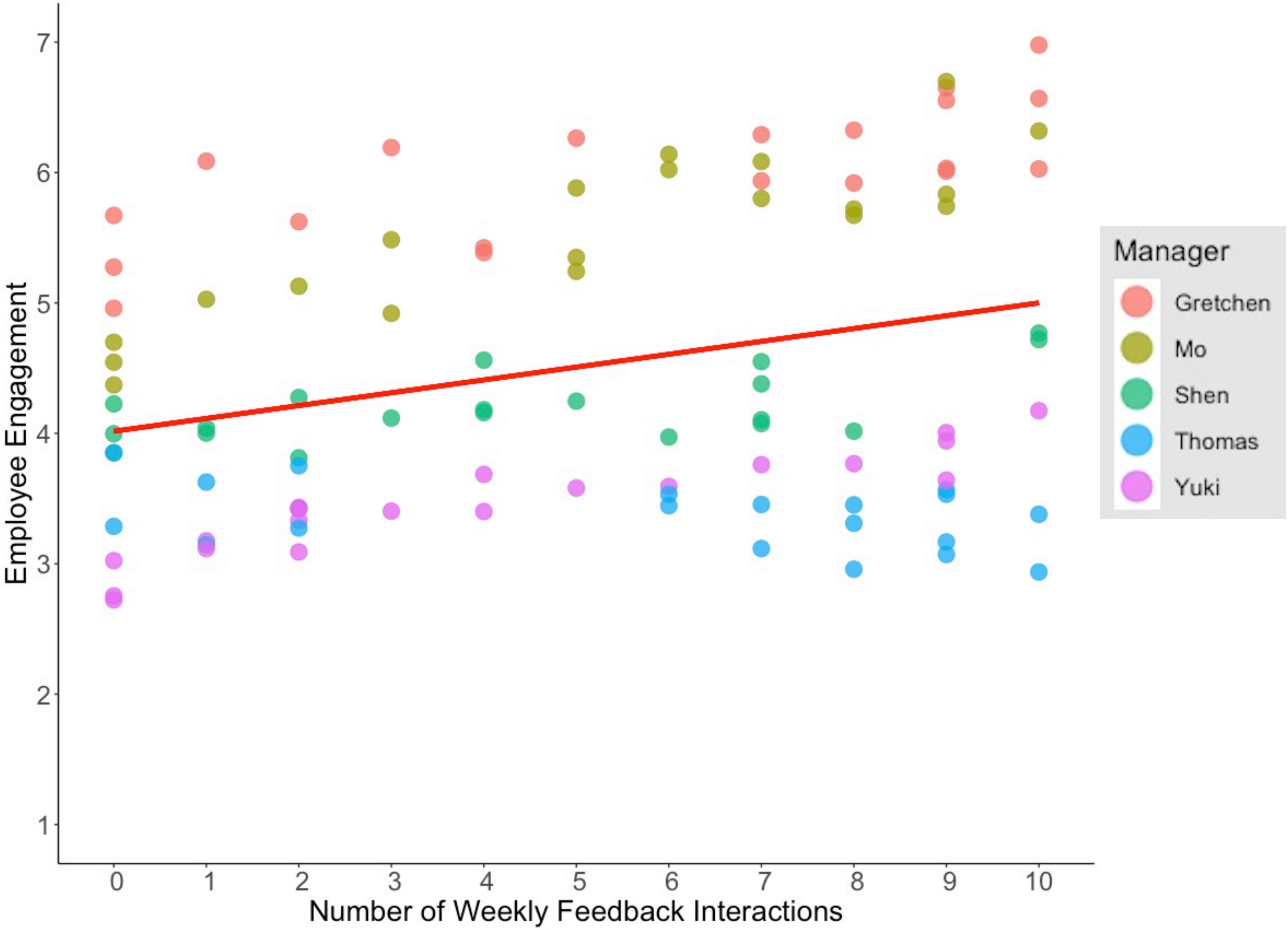
Problem



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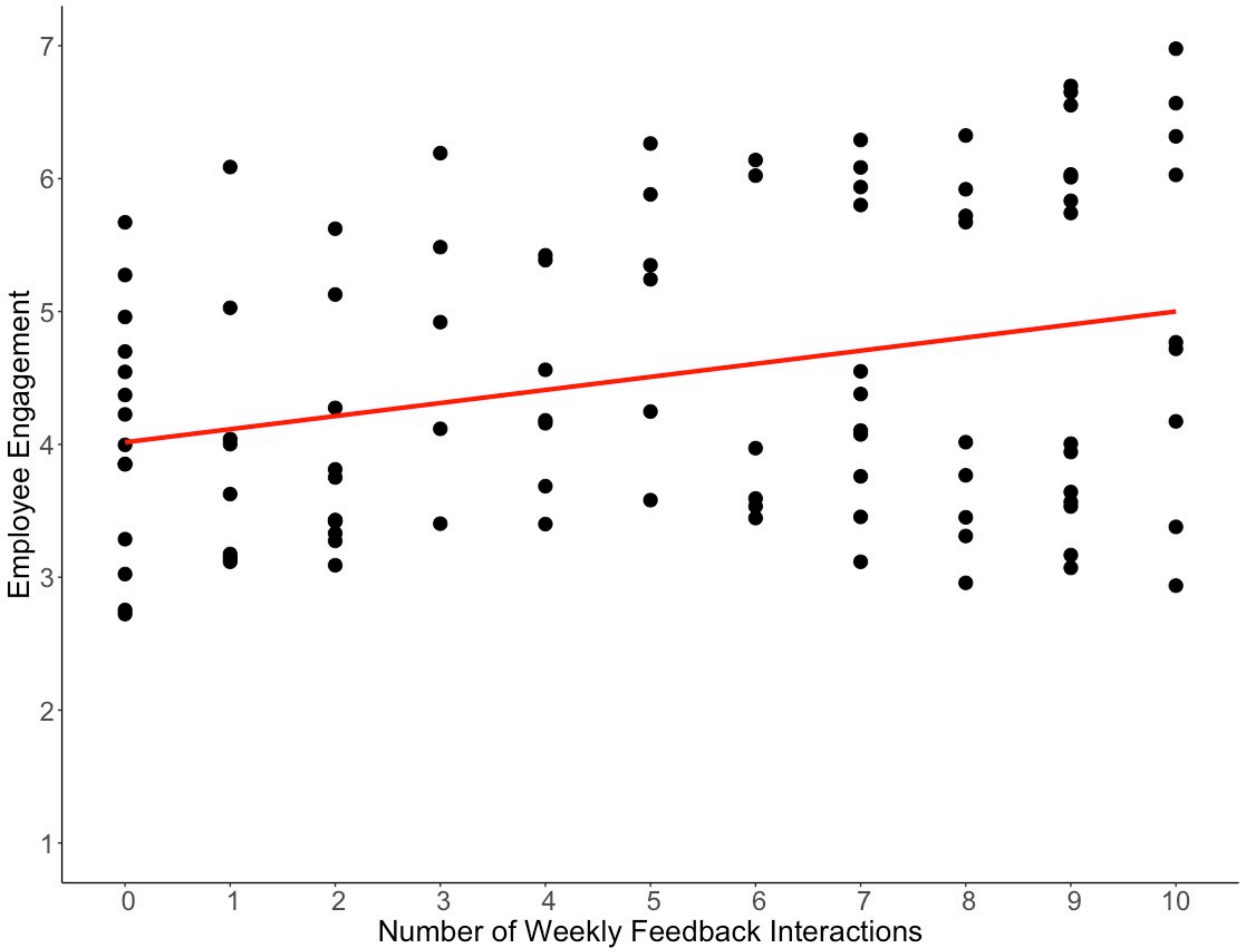
OLS



Employee Engagement
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Number of Weekly Feedback Interactions

OLS

Does frequency of feedback from managers predict employee engagement?

$$y = engagement$$
$$x = \#\ of\ weekly\ feedback\ interactions$$

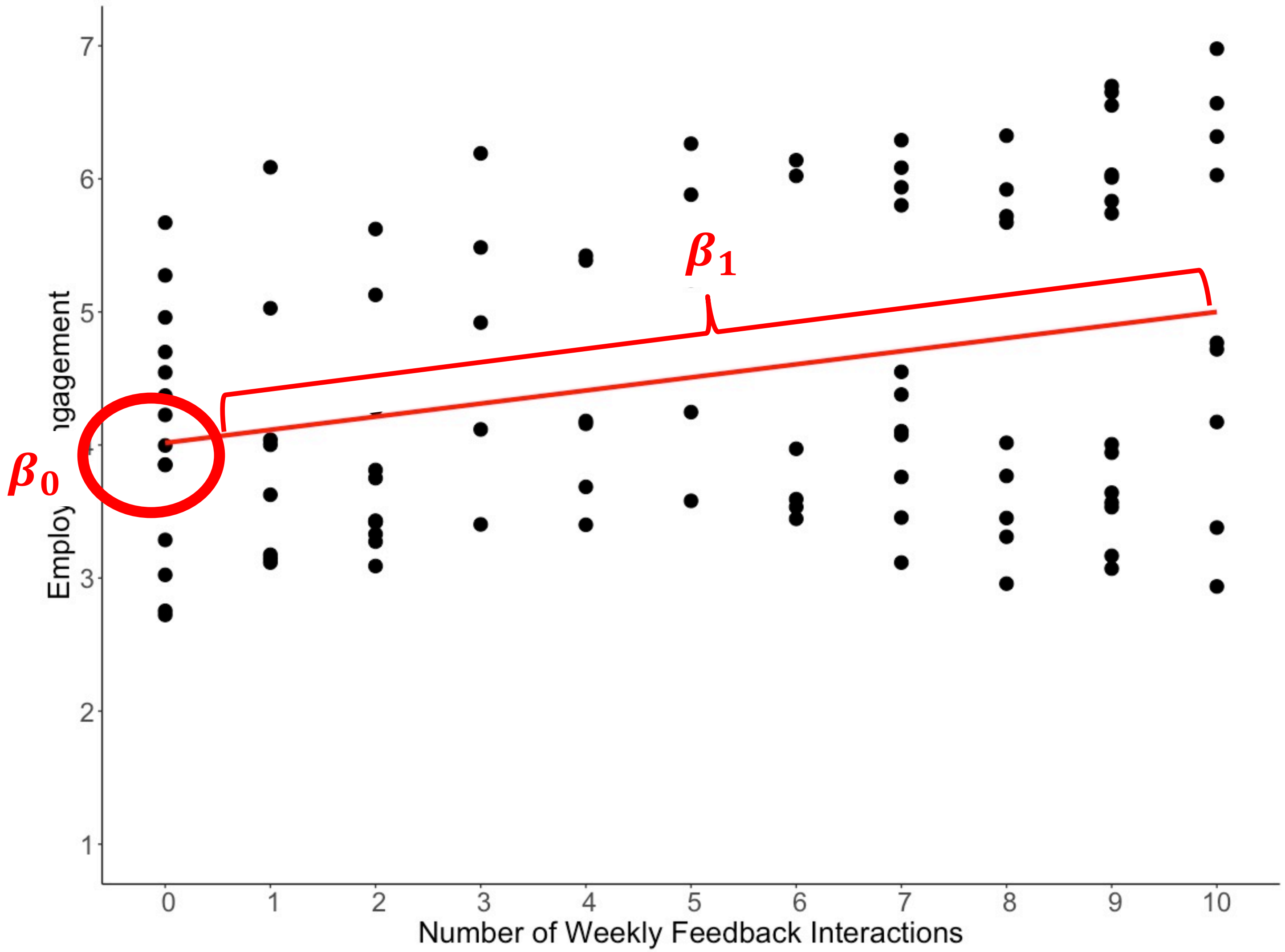
<u>OLS Regression</u>

$$\hat{y}_i = \beta_0 + \ \beta_1 x_i$$

$$\widehat{engagement}_i = \beta_0 + \ \beta_1 feedback_i$$

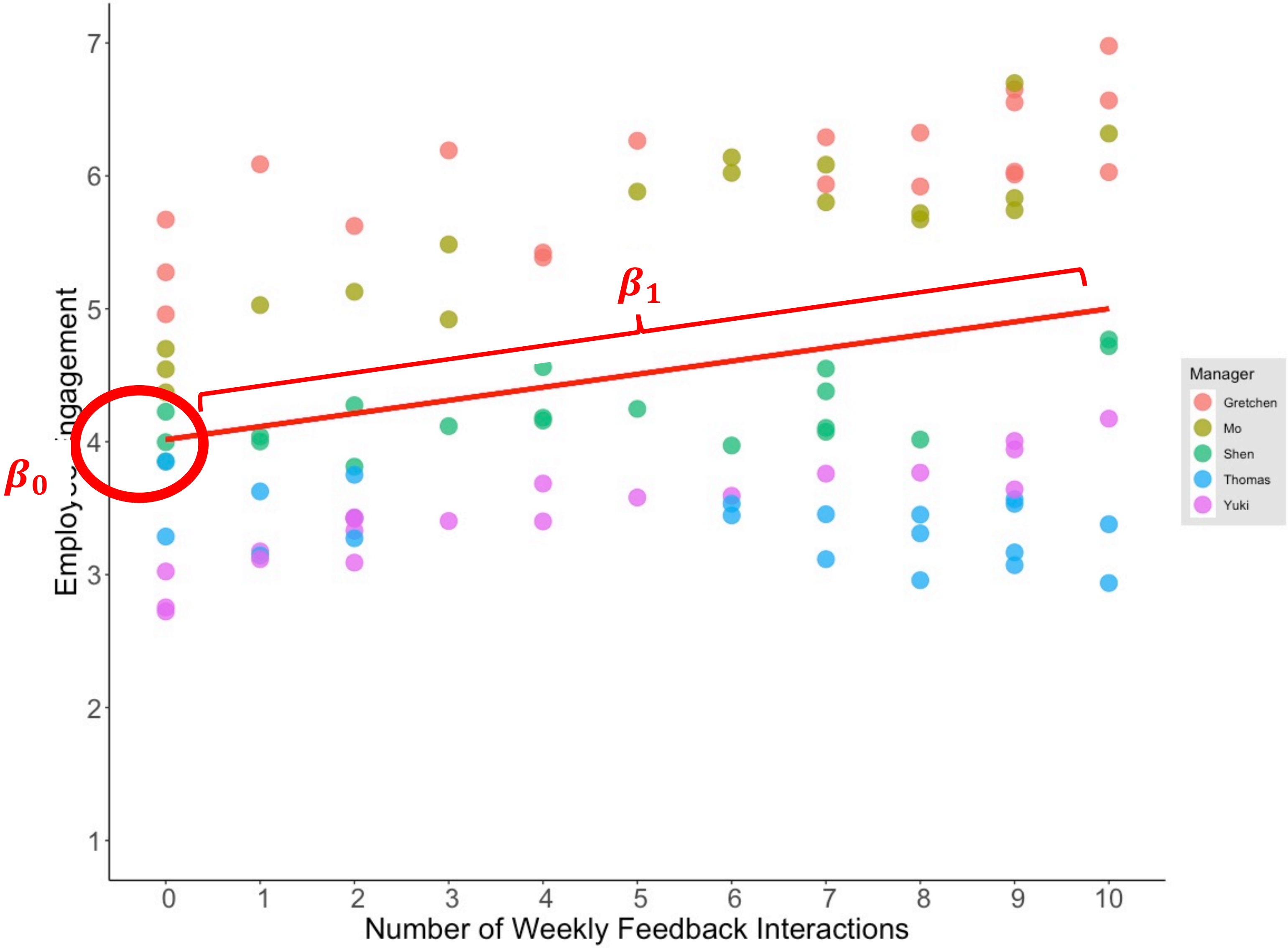
$$\widehat{engagement}_i = \beta_0 + \beta_1 feedback_i$$

OLS

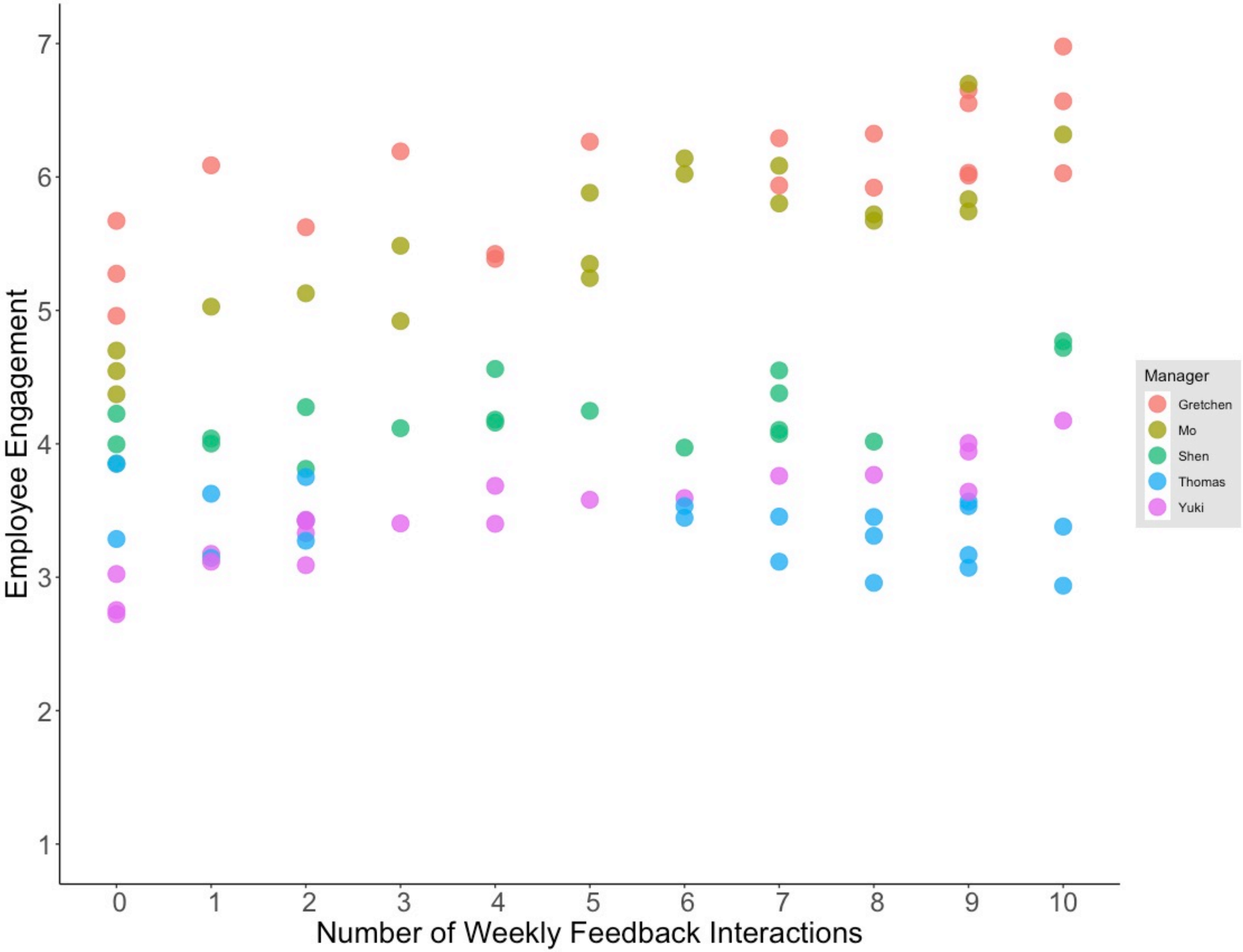


OLS

$$\widehat{engagement}_i = \beta_0 + \beta_1 feedback_i$$



OLS



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MLM Basics: What is MLM?

- Generalization of linear model
- Parameters allowed to vary by group
  - Regression coefficients
    - β_0
    - β_1

Changes depending on group!

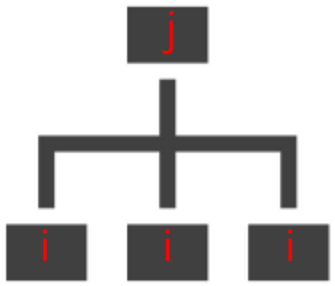
MLM Basics: What is MLM?

- OLS Regression model

$$\hat{y}_i = \beta_0 + \beta_1 x_i$$

- Multilevel model
  - Introduce grouping indicator *j*

$$j = group\ (e.g., manager)$$



$$\hat{y}_{j[i]} = \beta_{0j} + \beta_{1j} x_{[i]}$$

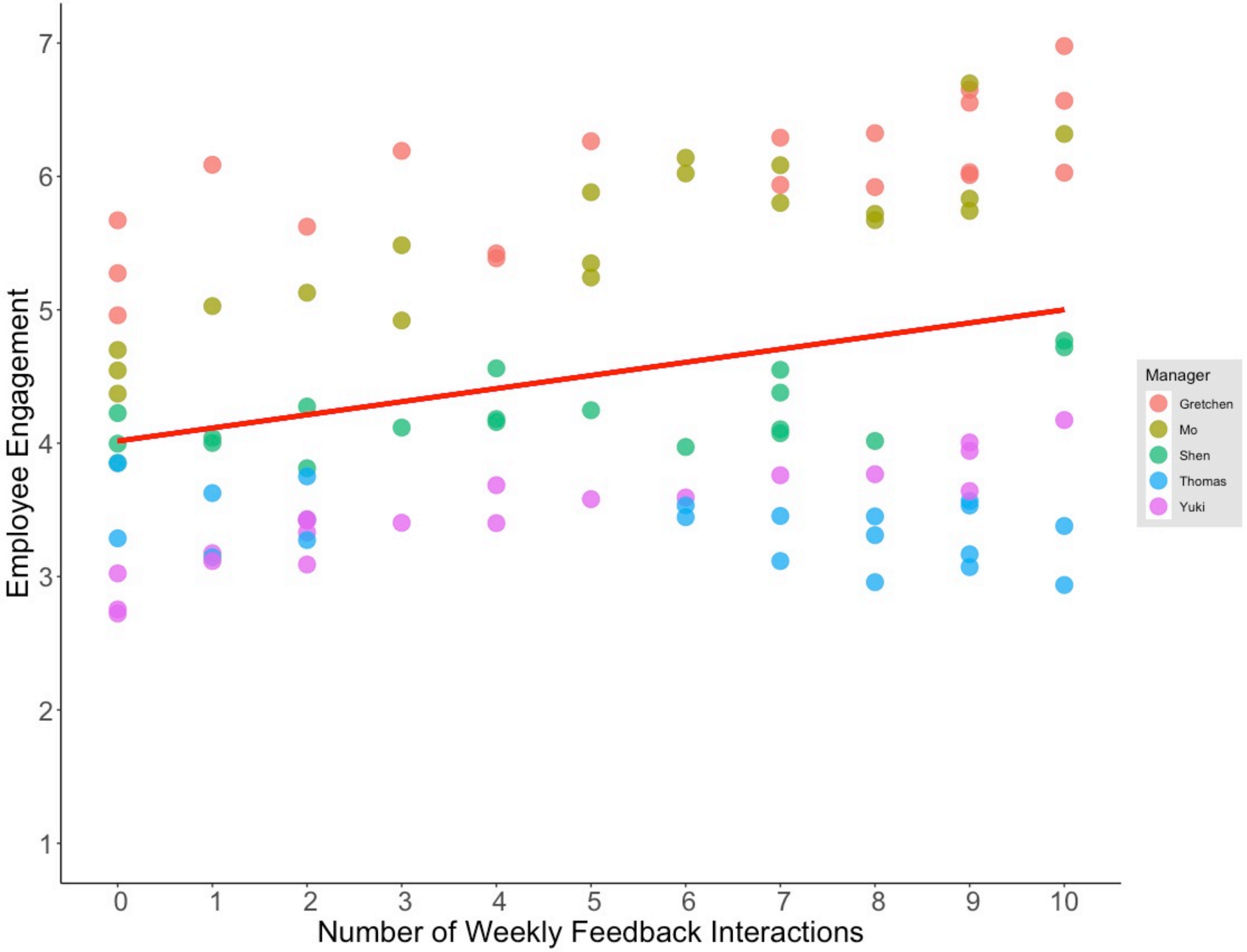
Intercept for group *j*

Slope for group *j*

MLM Basics

Back to our example:

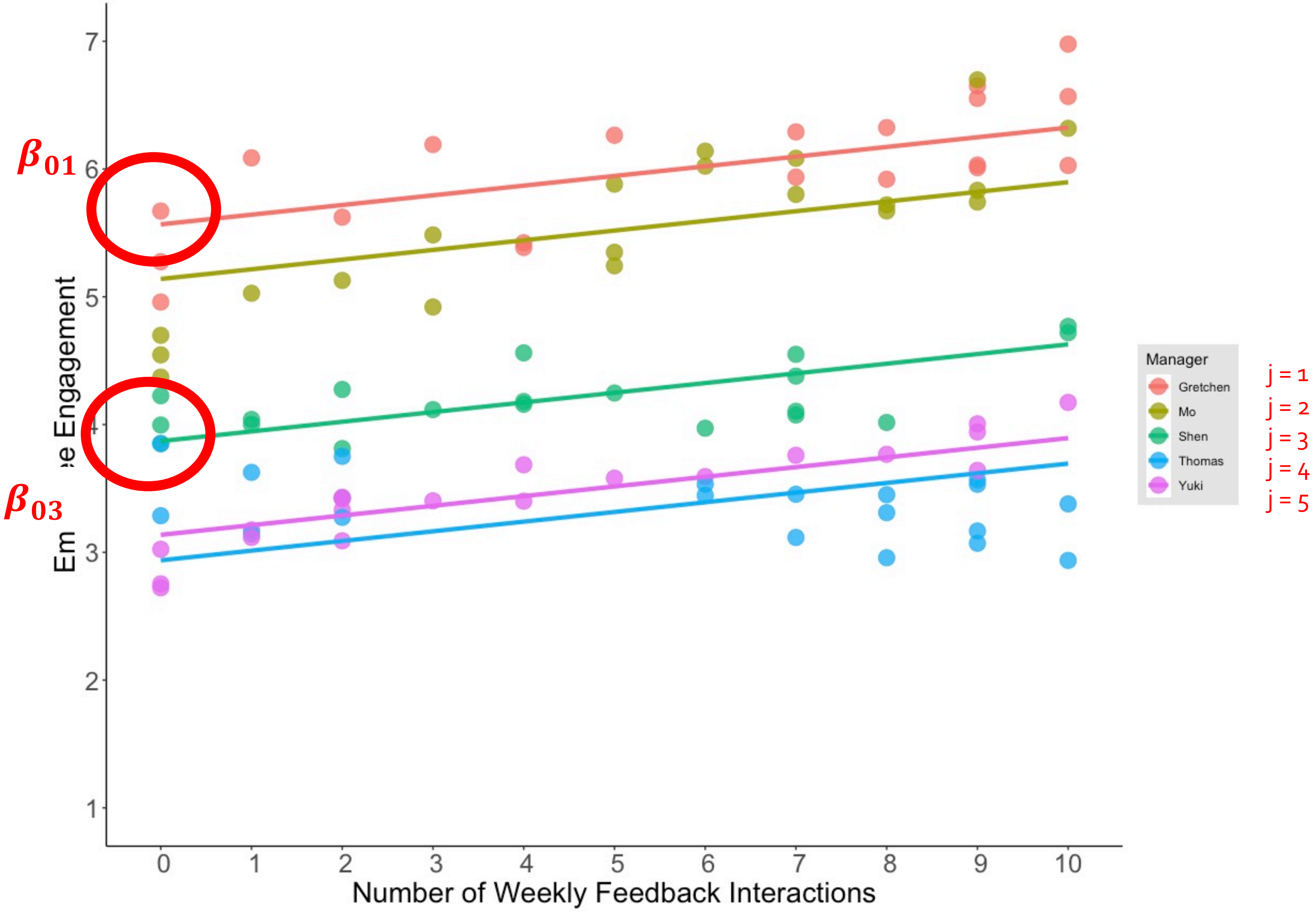
$$\widehat{engagement_i} = \beta_0 + \ \beta_1 feedback_i$$



MLM Basics

Random intercept:

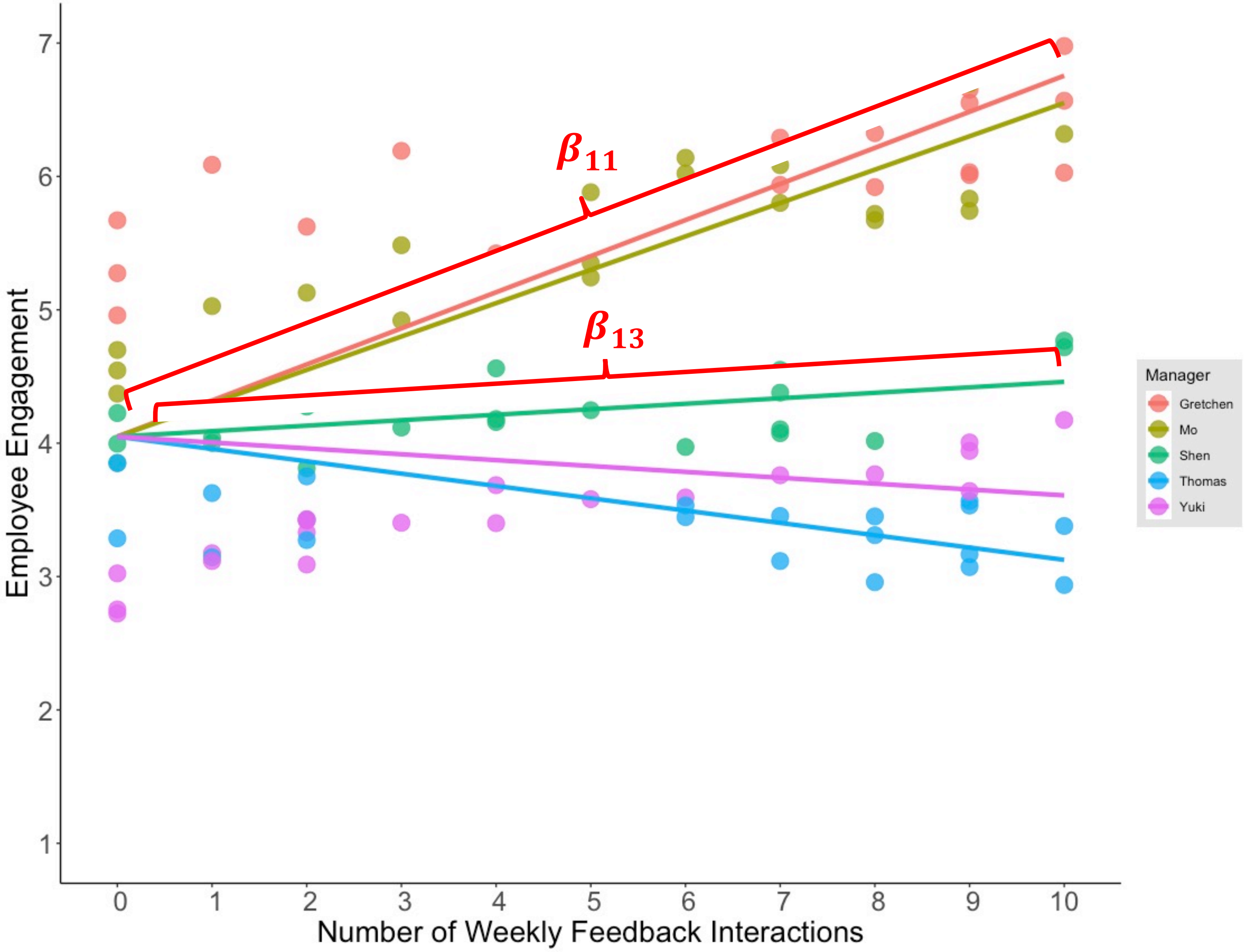
$$\widehat{engagement}_{j[i]} = \beta_{0j} + \beta_1 feedback_i$$



MLM Basics

Random slope:

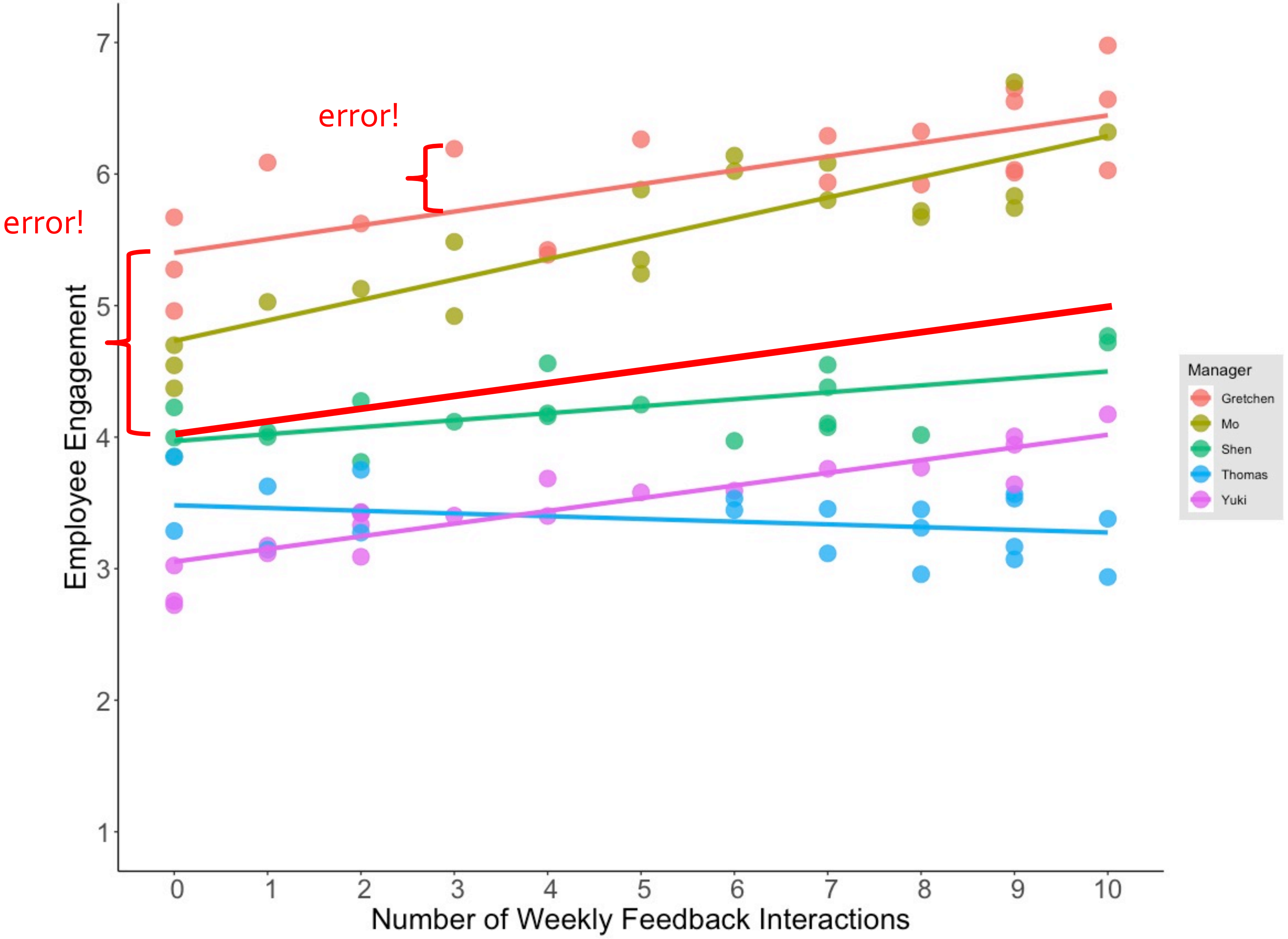
$$\widehat{engagement}_{j[i]} = \beta_0 + \beta_{1j} feedback_i$$



MLM Basics

Random intercept and slope:

$$\widehat{engagement}_{j[i]} = \beta_{0j} + \beta_{1j} feedback_i$$



MLM Mechanics

OLS

$$y_i = \beta_0 + \beta_1 x_i + \epsilon_i$$

Individual-level error

MLM

Level 1 $$y_{j[i]} = \beta_{0j} + \beta_{1j} x_{j[i]} + \epsilon_{[i]}$$

Level 2

$$\beta_{0j} = \gamma_{00} + \mu_{0j}$$
$$\beta_{1j} = \gamma_{10} + \mu_{1j}$$

Group-level error in intercept

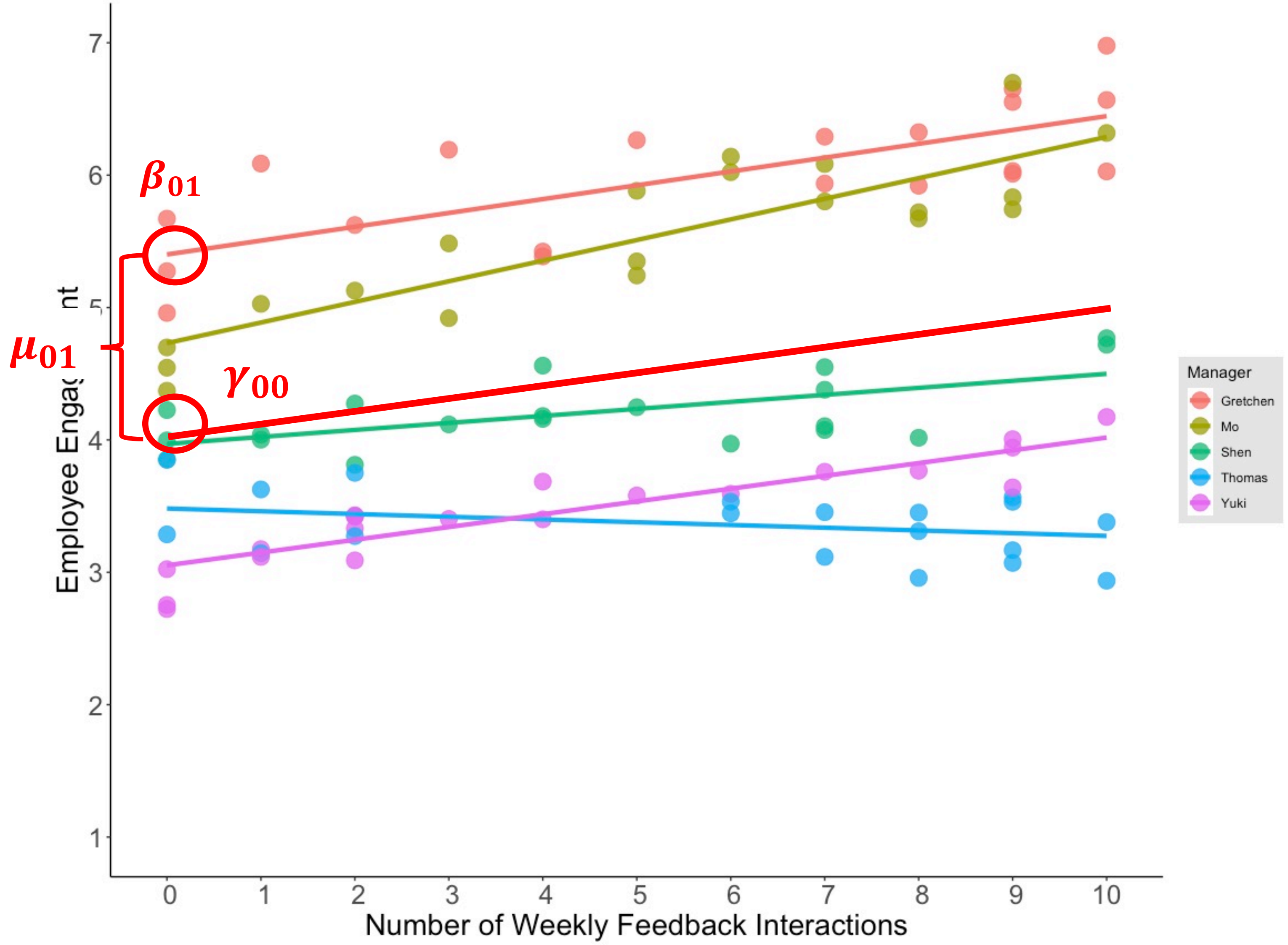
Group-level error in slope

Average intercept and slope *across* all groups

MLM Basics

Random intercept and slope:

$$\widehat{engagement}_{j[i]} = \beta_{0j} + \beta_{1j} feedback_i$$



MLM Mechanics

OLS

Individual-level error

$$y_i = \beta_0 + \beta_1 x_i + \epsilon_i$$

MLM

Level 1 $$y_{j[i]} = \beta_{0j} + \beta_{1j} x_{j[i]} + \epsilon_{[i]}$$

Group-level error in intercept

Level 2

$$\beta_{0j} = \gamma_{00} + \mu_{0j}$$
$$\beta_{1j} = \gamma_{10} + \mu_{1j}$$

Group-level error in slope

Average intercept and slope *across* all groups

MLM Mechanics

- Add predictors at different levels
  - Individual-level
  - Group-level

Level 1

$$engagement_{j[i]} = \beta_{0j} + \beta_{1j} feedback_i + \epsilon_i$$

Level 2

Group-level predictor of intercepts

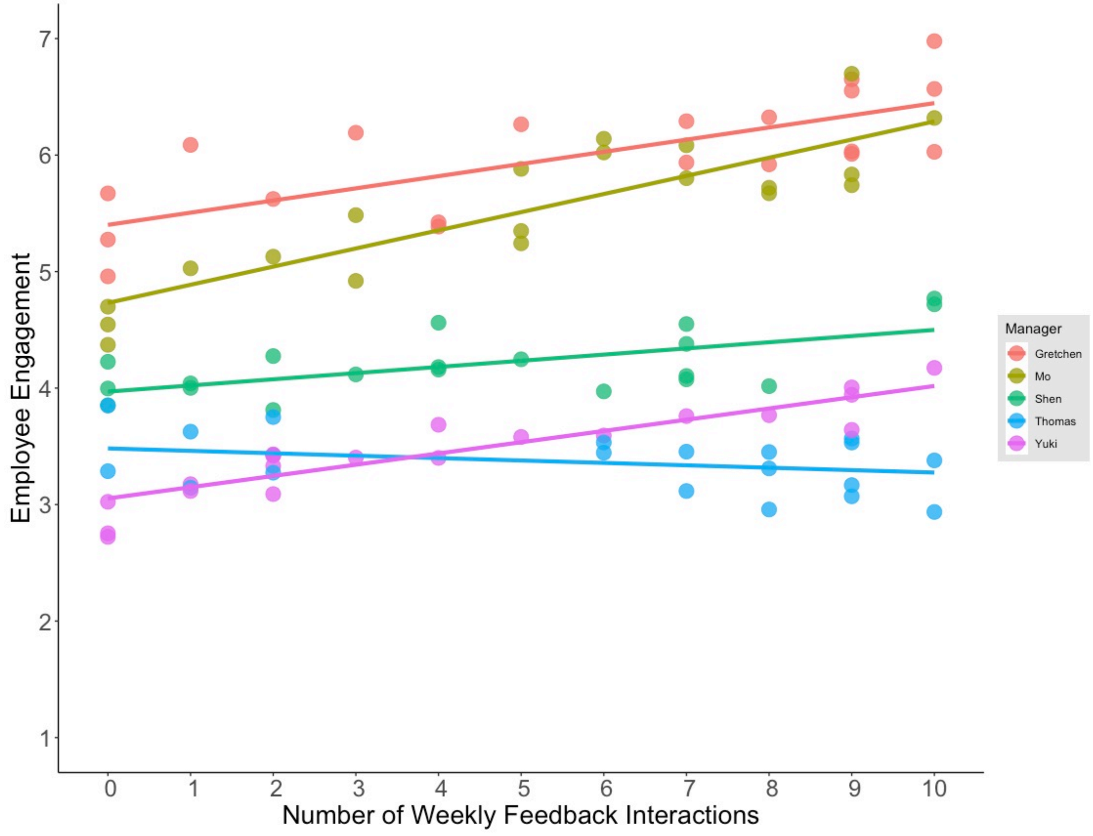
$$\beta_{0j} = \gamma_{00} + \gamma_{01} leadership_j + \mu_{0j}$$
$$\beta_{1j} = \gamma_{10} + \gamma_{11} leadership_j + \mu_{1j}$$

Group-level predictor of slopes

MLM Mechanics

$$engagement_{j[i]} = \beta_{0j} + \beta_{1j} feedback_i + \epsilon_i$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01} leadership_j + \mu_{0j}$$
$$\beta_{1j} = \gamma_{10} + \gamma_{11} leadership_j + \mu_{1j}$$



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