2x2x2 Design Simulation

Context (Business vs Nursing) × Pool Composition × Gender Feedback

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Contents

Study Design Overview

Design Structure

1. **Context**
    - Business context (women historically underrepresented)
    - Nursing context (women historically overrepresented)
2. **Pool Composition**
    - Women underrepresented in candidate pool
    - Women overrepresented in candidate pool
3. **Feedback**
    - Gender feedback provided
    - No gender feedback (control)

Predicted Patterns

Pool Composition	Context	Expected Treatment Effect
Women Underrepresented in Pool		
	Business (historically underrepresented)	+20%
	Nursing (historically overrepresented)	+45%
Women Overrepresented in Pool		
	Business (historically underrepresented)	-11%
	Nursing (historically overrepresented)	0%

Key predictions:

- **Business context effects** based on actual Study 3 data (+20% / -11%)
- **Nursing context** hypothesized to show amplified positive effect when women underrepresented (+45%), but no correction when overrepresented (0%)
- N~2500 used in simulation

Table 1: Proportion Selecting Women by Condition

Context	Pool Composition	Control	Treatment	Effect
Business	Women_Under	0.336	0.538	0.202
Business	Women_Over	0.729	0.618	-0.111
Nursing	Women_Under	0.336	0.786	0.450
Nursing	Women_Over	0.729	0.729	0.000

Simulated Cell Means

Statistical Models

Three-Way Interaction Model

Model specification:

$$\begin{aligned}\text{female\_pick} = \beta_0 + \beta_1 \text{gender\_feedback} + \beta_2 \text{overrepresented} + \beta_3 \text{nursing\_context} \\ + \beta_4 (\text{gender\_feedback} \times \text{overrepresented}) \\ + \beta_5 (\text{gender\_feedback} \times \text{nursing\_context}) \\ + \beta_6 (\text{overrepresented} \times \text{nursing\_context}) \\ + \beta_7 (\text{gender\_feedback} \times \text{overrepresented} \times \text{nursing\_context}) + \epsilon\end{aligned}$$

```
##
## Call:
## lm(formula = female_pick ~ gender_feedback * overrepresented *
##     nursing_context, data = sim_data)
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -4.044e-13 -1.900e-16 -6.000e-17  2.500e-16  1.269e-13
##
## Coefficients:
##                                                    Estimate Std. Error
## (Intercept)                                       3.360e-01  4.987e-16
## gender_feedback                                   2.020e-01  7.053e-16
## overrepresented                                   3.930e-01  7.053e-16
## nursing_context                                   1.529e-15  7.053e-16
## gender_feedback:overrepresented                  -3.130e-01  9.974e-16
## gender_feedback:nursing_context                   2.480e-01  9.974e-16
## overrepresented:nursing_context                  -2.751e-15  9.974e-16
## gender_feedback:overrepresented:nursing_context -1.370e-01  1.411e-15
##                                                    t value Pr(>|t|)
## (Intercept)                                       6.737e+14  < 2e-16 ***
## gender_feedback                                   2.864e+14  < 2e-16 ***
## overrepresented                                   5.572e+14  < 2e-16 ***
## nursing_context                                   2.168e+00  0.03025 *
## gender_feedback:overrepresented                  -3.138e+14  < 2e-16 ***
## gender_feedback:nursing_context                   2.486e+14  < 2e-16 ***
## overrepresented:nursing_context                  -2.758e+00  0.00585 **
## gender_feedback:overrepresented:nursing_context -9.712e+13  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.823e-15 on 2496 degrees of freedom
## Multiple R-squared:      1,  Adjusted R-squared:      1
## F-statistic: 1.31e+29 on 7 and 2496 DF,  p-value: < 2.2e-16
```

Alternative Model: Separate Models by Context

We can also estimate the effect separately within each context and then compare the interaction terms.

Business context model:

$$\text{female\_pick} = \beta_0 + \beta_1 \text{gender\_feedback} + \beta_2 \text{overrepresented} + \beta_3 (\text{gender\_feedback} \times \text{overrepresented}) + \epsilon$$

Nursing context model:

$$\text{female\_pick} = \gamma_0 + \gamma_1 \text{gender\_feedback} + \gamma_2 \text{overrepresented} + \gamma_3 (\text{gender\_feedback} \times \text{overrepresented}) + \epsilon$$

```
## === BUSINESS CONTEXT ===

##
## Call:
## lm(formula = female_pick ~ gender_feedback * overrepresented,
##     data = sim_data %>% filter(context == "Business"))
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -9.606e-14 -5.570e-16  1.400e-17  3.080e-16  1.736e-13
##
## Coefficients:
##                                  Estimate Std. Error    t value Pr(>|t|)
## (Intercept)                     3.360e-01  3.219e-16  1.044e+15   <2e-16 ***
## gender_feedback                 2.020e-01  4.552e-16  4.437e+14   <2e-16 ***
## overrepresented                 3.930e-01  4.552e-16  8.633e+14   <2e-16 ***
## gender_feedback:overrepresented -3.130e-01  6.438e-16 -4.862e+14   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.695e-15 on 1248 degrees of freedom
## Multiple R-squared:      1,  Adjusted R-squared:      1
## F-statistic: 2.654e+29 on 3 and 1248 DF,  p-value: < 2.2e-16

##
## === NURSING CONTEXT ===

##
## Call:
## lm(formula = female_pick ~ gender_feedback * overrepresented,
##     data = sim_data %>% filter(context == "Nursing"))
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -5.959e-14 -1.170e-15 -1.900e-16  1.900e-16  3.660e-13
##
## Coefficients:
##                                  Estimate Std. Error    t value Pr(>|t|)
## (Intercept)                     3.360e-01  6.442e-16  5.216e+14   <2e-16 ***
```

```
## gender_feedback                  4.500e-01  9.110e-16  4.940e+14   <2e-16 ***
## overrepresented                  3.930e-01  9.110e-16  4.314e+14   <2e-16 ***
## gender_feedback:overrepresented -4.500e-01  1.288e-15 -3.493e+14   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.14e-14 on 1248 degrees of freedom
## Multiple R-squared:      1,  Adjusted R-squared:      1
## F-statistic: 1.04e+29 on 3 and 1248 DF,  p-value: < 2.2e-16
```

Wald Test: Comparing Interaction Coefficients

The key test is whether β_3 (Business interaction) differs significantly from γ_3 (Nursing interaction).

```
## WALD TEST

## ================================

## Business context interaction (b3): -31.3 pp (SE = 0 )

## Nursing context interaction (g3):  -45 pp (SE = 0 )

## Difference (g3 - b3):              -13.7 pp

## P-value:                           0
```

Visualizations

Figure 1: Women Underrepresented in Pool

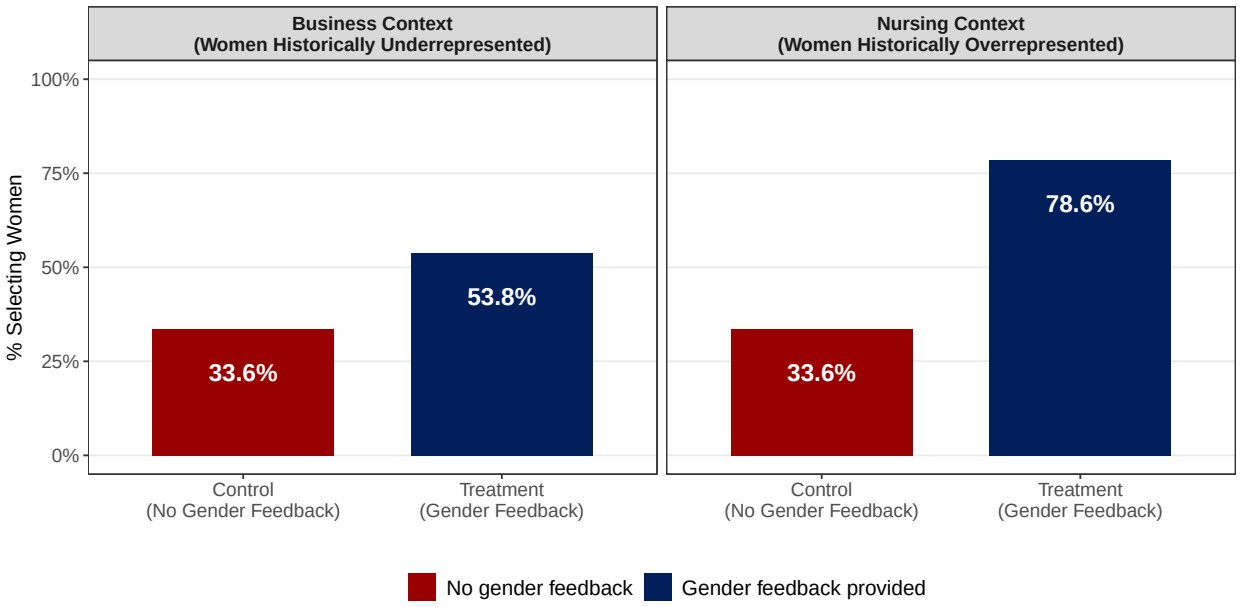

Figure 1: Women Underrepresented in Candidate Pool

Figure 2: Women Overrepresented in Pool

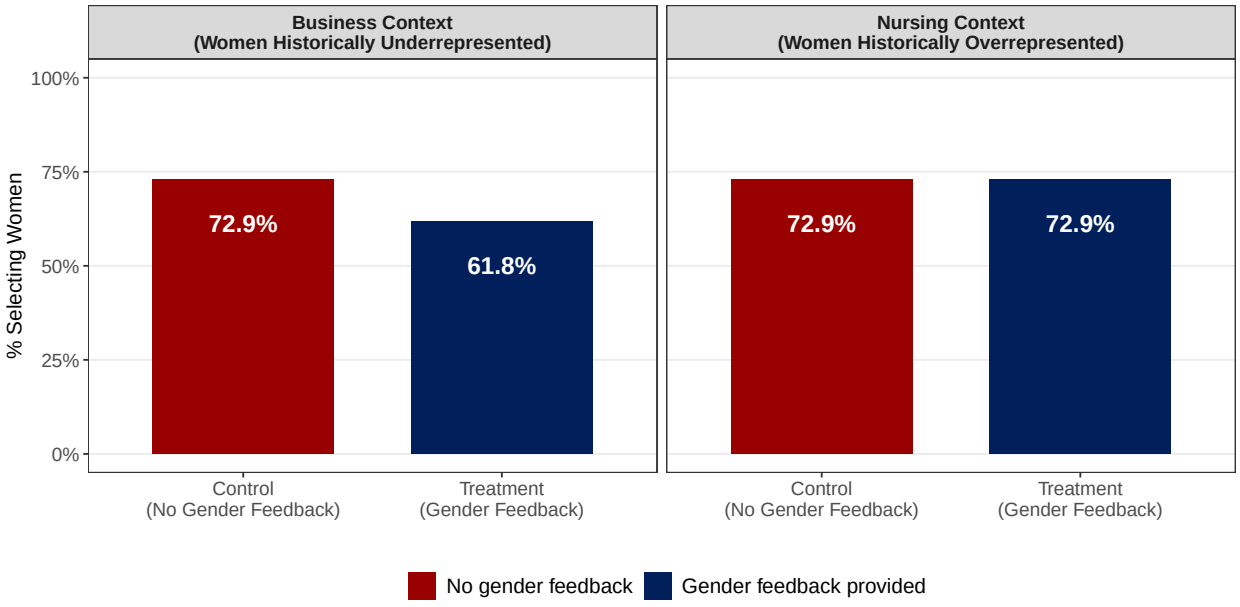

Figure 2: Women Overrepresented in Candidate Pool