

# Ch. 10: Within-Subject Experimental Designs

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## 1 Main Takeaways

### 1.1 Additional Assumptions from Within-Subjects Design

1. (A10.1, Balanced Panel): For all  $(i, t) \in \mathcal{J} \times \mathcal{T}$ , we have  $\mathbb{P}[R_{it} = 1] = 1$ , and for all  $(i, t) \in \mathcal{J} \times \mathcal{T}$  with  $\mathbb{P}[R_{it} = 1] = 1$  the researcher observes  $(Y_{it}, D_{it}, Z_{it}, \mathbf{X}_{it})$ .
2. (A10.2, Temporal Stability): For all  $t \in \mathcal{T}$ ,  $Y_{it}(D_{it}, \mathbf{D}_{i,-t}, t) = Y_{it}(D_{it}, \mathbf{D}_{i,-t})$ .
  - This rules out time-varying effects in the potential outcomes, such as respondent fatigue.
3. (A10.3, Causal Transience): For all  $\mathbf{D}_i$ ,  $Y_{it}(D_{it}, \mathbf{D}_i, T) = Y_{it}(D_{it}, T)$ .
  - This implies that the treatment effect does not persist over time when we change the treatment status; the treatment effects do not depend on the order in which they are implemented.

### 1.2 Highlighting 3 Threats to Temporal Stability

“The literature has enumerated various threats to temporal stability and here we focus on three key threats:

1. time-specific shocks to the outcome,
2. time trends such as learning or regression to the mean, and
3. the measurement outcome might change over time.”

Examples: The Hawthorne effect being just a day-of-the-week effect.

### 1.3 Randomize Treatment Order

One way to control for time effects is to “generate different random orders of the treatment conditions.”

### 1.4 Threats to Causal Transience

“The main threats to causal transience are anticipation and carry-over effects. Anticipation effects occur when subjects change their behavior because of treatments that will happen in the future... Carry-over effects occur when the impact of treatment persists through the measurement.”

“Researchers may detect carry-over effects if they counterbalance treatment regimes and compare the effects of a given treatment by position. If effects are asymmetric, carry-over effects may be confounding the results.”

### 1.5 Key Advantages of Within-Subject Design

We can retrieve:

$$\tau_i \equiv Y_{it}(1) - Y_{it}(0)$$

They offer increased power.

Exhibit 10.4: Statistical Power for Within- and Between-Subject Designs

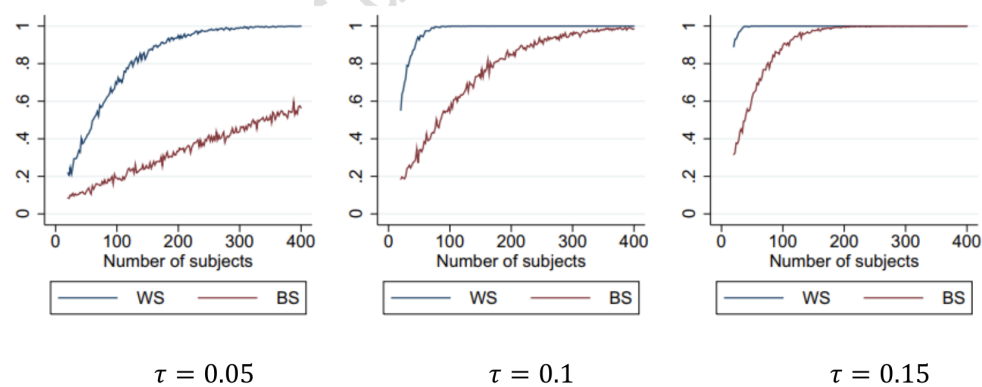


Figure 1: Figure Capturing Power for Between versus Within-Subject Designs