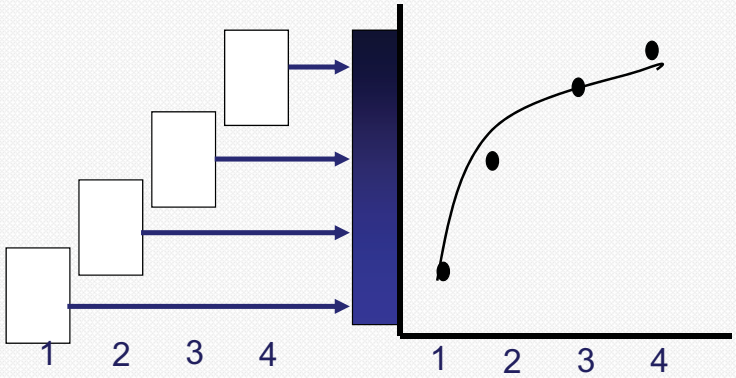
The Discrimination-Censoring Paradox in Item Response Growth Models



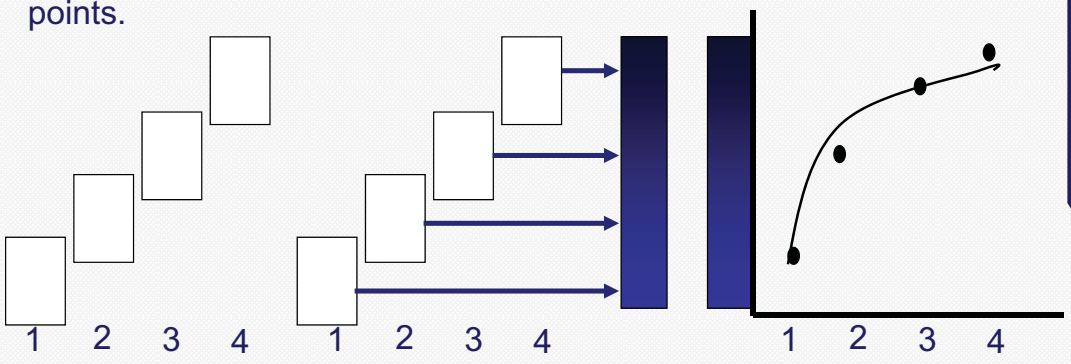
Jennifer Koran
Southern Illinois University Carbondale

Presently, there are three steps for modeling growth in educational achievement.

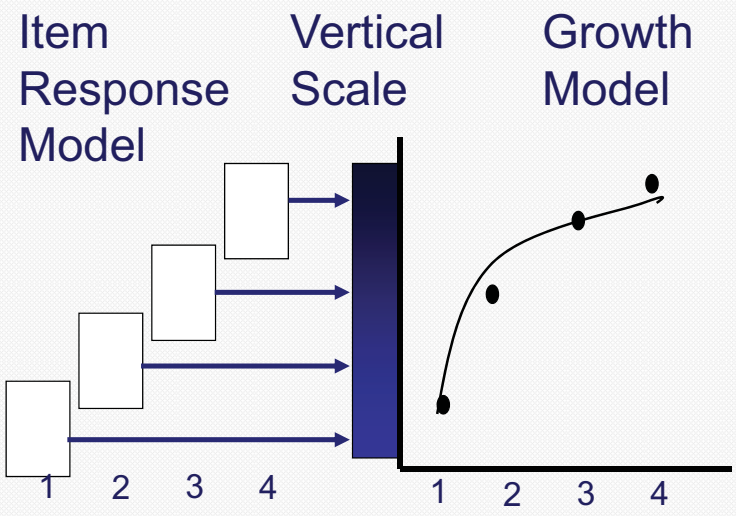
1. Tests of increasing difficulty are scored over multiple time points.

2. Scores are transformed to a vertical scale.

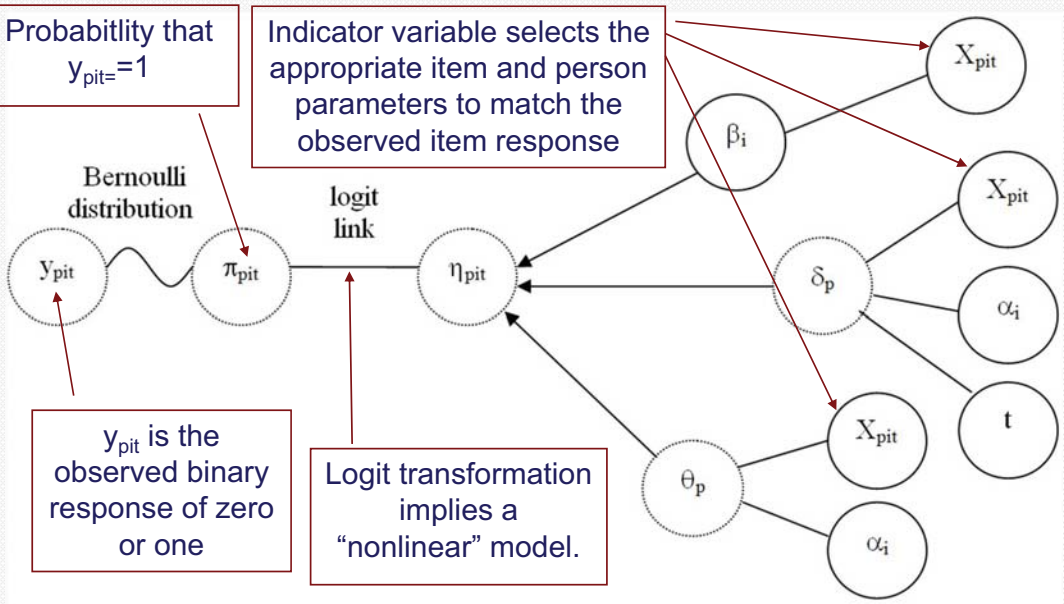
3. A growth model is fit to the scaled scores.



An item response growth model conducts all three steps simultaneously.

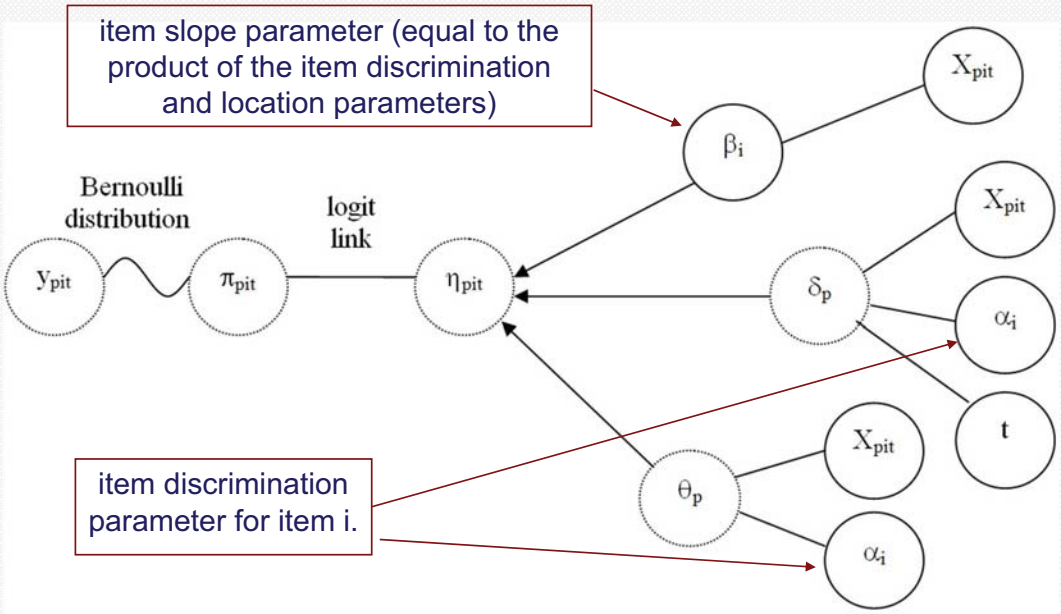


The model takes the form of a nonlinear mixed effects model.



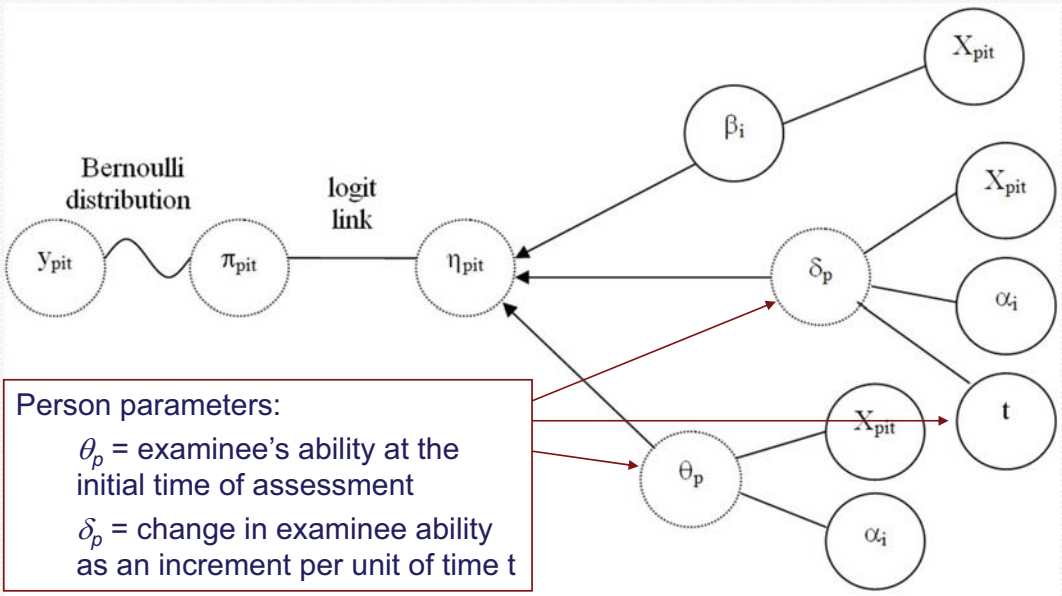
Note: The convention used in this diagram closely follows that used in De Boeck and Wilson (2004).

The model is an extension of the two-parameter logistic item response model.



Note: The convention used in this diagram closely follows that used in De Boeck and Wilson (2004).

Person parameters are included in the functional form for growth.



Note: The convention used in this diagram closely follows that used in De Boeck and Wilson (2004).

The model with a linear trajectory for growth takes the form of this equation.

Initial level of ability

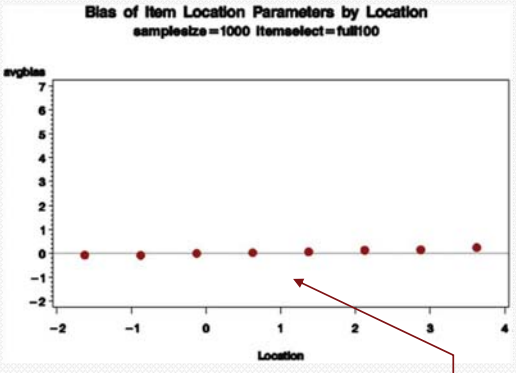
Rate * time

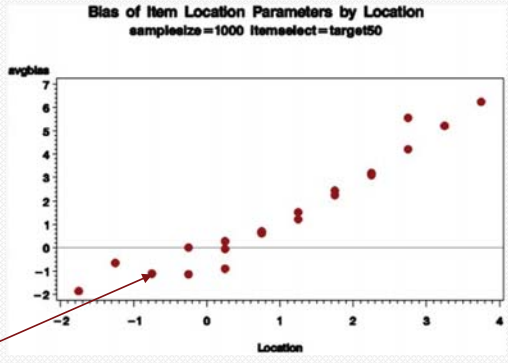
$$logit(y_{pit}) = \sum_{i=1}^{I} a_i \theta_p X_{pit} + t \sum_{i=1}^{I} a_i \delta_p X_{pit} - \sum_{i=1}^{I} \beta_i X_{pit}$$

- person parameters θ and δ are normally distributed random variables
- mean vector [0, μ_δ]'
- variance/covariance matrix T = $\begin{bmatrix} 1 & \\ \tau_{10} & \tau_{11} \end{bmatrix}$
- residuals are assumed to be normally distributed with mean zero and variance one

The complexity of the item selection design affected the bias in the parameter estimates.

Item Location Parameter

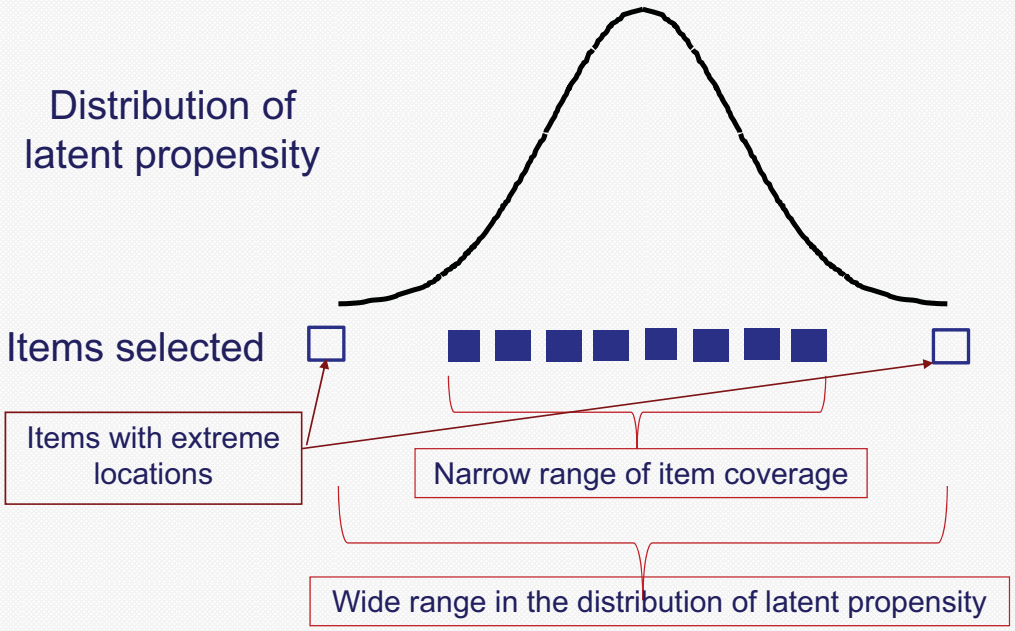




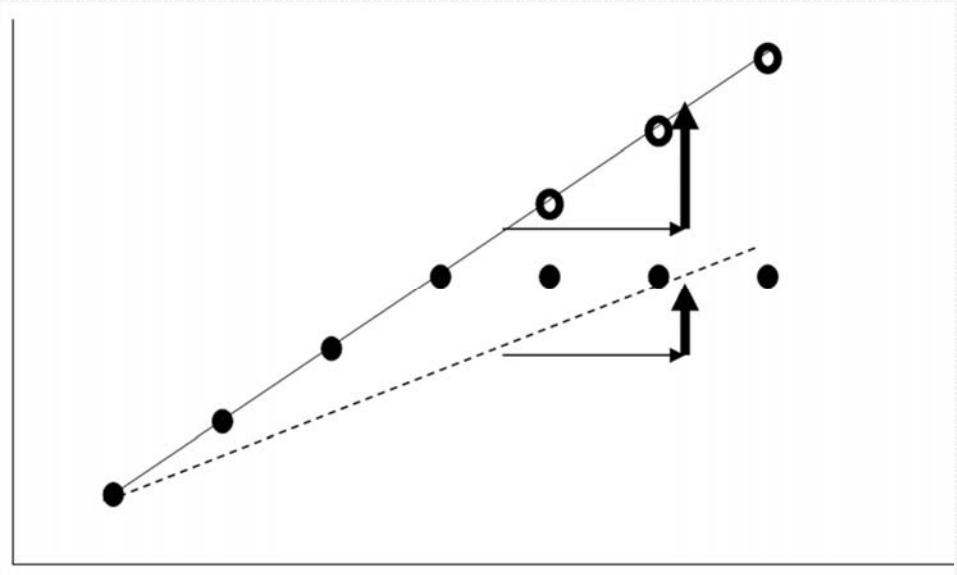
100% common items design

50% common items design

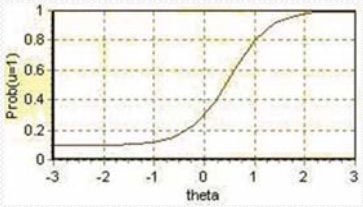
Incompatibility in the design leads to conflict within the integrated model.



In the presence of censoring, growth is underestimated.

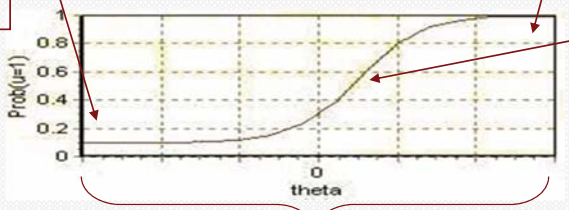


When item discrimination estimation is challenged, the latent scale stretches.



Easy items appear to be easier.

Difficult items appear to be more difficult.

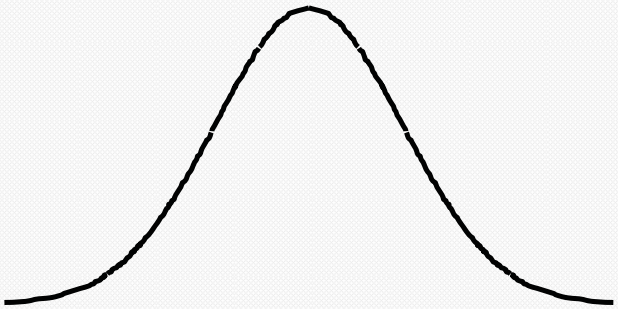


Item discrimination slope is more gradual.

Greater average growth rate.

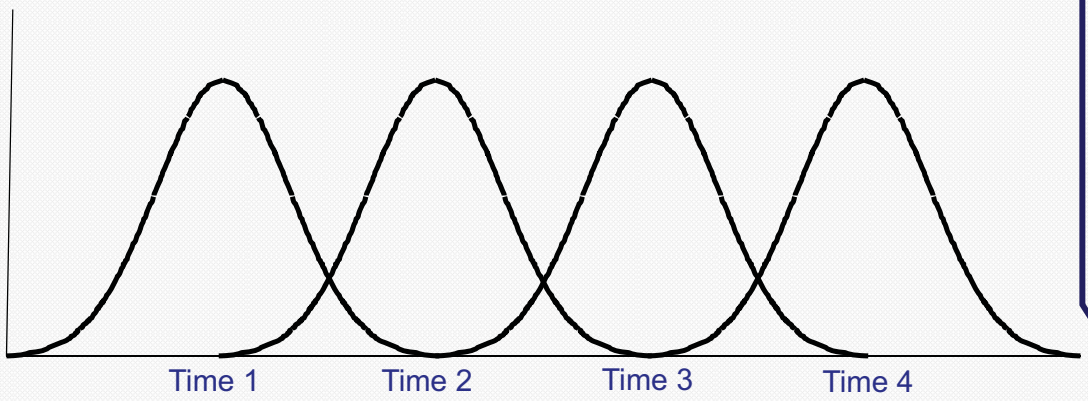
What are some options for addressing the Discrimination-Censoring Paradox?

Distribution of latent propensity



Items selected

The mixture of latent distributions from several time points may not be normal.



The integrated model reveals the nuances of longitudinal design quality.