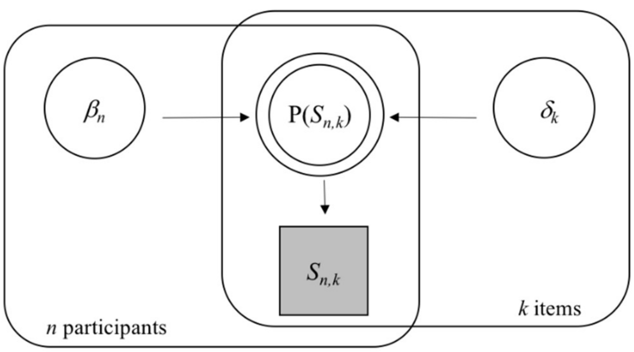
Supplemental material, Walker et al., "Beyond Percent Correct: Measuring Change in Individual Picture Naming Ability," *JSLHR*,
https://doi.org/10.1044/2021_JSLHR-20-00205

Supplemental Material S2. Directed acyclic graphs of the variables, dependencies, and prior assumptions for the cross-sectional and longitudinal Bayesian IRT models.

A) Directed acyclic graph depicting variables and dependencies in the cross-sectional item response theory model of naming accuracy (IRT-P(S)), used to estimate the unidimensional item difficulty values δ from an independent data set. B) Directed acyclic graph depicting variables and dependencies in the longitudinal model of IRT-P(S). The ability of a participant β combines with the previously observed difficulty of an item δ to determine the probability of a correct response P(S) via a logistic equation. The parameters of the prior distribution on β are intended to be minimally informative about the probability of success on a test item of average difficulty. The binary outcome S of each naming trial is modeled as a Bernoulli trial with probability of success P(S). The change in a participant's ability during an interval of time between tests Δ is modeled as a standard normal Gaussian, with a prior belief centered on zero change. circle/square = continuous/discrete variable, shaded/unshaded = observed/unobserved variable, single/double border = stochastic/deterministic variable, arrow = dependency, rounded square = set. The ~ symbol means "is distributed as".

A)



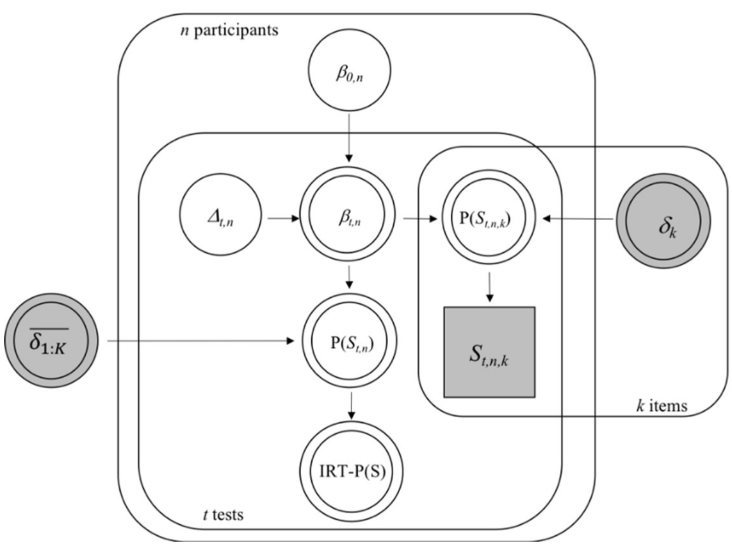
$\beta_n \sim \text{Gaussian}(0, 1)$

$\delta_k \sim \text{Gaussian}(0, 1)$

$$\mathrm{P}(S_{n,k}) = \frac{e^{\beta_n - \delta_k}}{1 + e^{\beta_n - \delta_k}}$$

$S_{n,k} \sim \text{Bernoulli}(\mathrm{P}(S_{n,k}))$

B)



$\beta_{0,n} \sim \text{Gaussian}(-0.2, 1.7)$

$\Delta_{1,n} = 0$

$\Delta_{t>1,n} \sim \text{Gaussian}(0, 1)$

$\beta_{t,n} = \beta_{0,n} + \sum_{tt=1}^{t} (\Delta_{tt,n})$

$$\mathrm{P}(S_{t,n,k}) = \frac{e^{\beta_{t,n} - \delta_k}}{1 + e^{\beta_{t,n} - \delta_k}}$$

$S_{t,n,k} \sim \text{Bernoulli}(\mathrm{P}(S_{t,n,k}))$

$$\overline{\delta_{1:K}} = \frac{\sum_{k=1}^{K} (\delta_k)}{K}$$

$$\mathrm{P}(S_{t,n}) = \frac{e^{\beta_{t,n} - \overline{\delta_{1:K}}}}{1 + e^{\beta_{t,n} - \overline{\delta_{1:K}}}} = \text{IRT-P(S)}$$