

Supplementary File S1

Item Response Model

The model was fitted using Bayesian estimation in the STAN package for probabilistic modelling, of the form:

$$P(x_{ij} = 1 \mid \theta_i, \delta_j, \alpha_j, \varphi_i) = \frac{1}{1 + e^{-\alpha_j(\theta_i - \delta_j + f(\varphi_i))}}$$

where x_{ij} is the response from the i^{th} person on the j^{th} item (1=pass, 0=fail), θ_i is the estimated ability (child development score) of the i^{th} child assumed to be normally distributed with mean 0 and variance 1, δ_j is the estimated difficulty of the j^{th} item, α_j (>0) is the discrimination parameter for the j^{th} item, and φ_i is the age of the i^{th} child.

In addition an increasing form exponential decay function was used to map the age of the i^{th} child to the expected corresponding mean ability through $f(\varphi_i) = C(1 - e^{-\varphi_i^t})$, where, C is a parameter governing the y-axis asymptote of the inverse exponential decay function and t is a parameter governing its shape.

The above model is similar in form to a standard two parameter logistic model (2PL) with an added function governing the average ability for a given age. Note that the θ parameter represents the ability of the child relative to other children of their age while $\theta + f(\varphi)$ represents the ability of the child relative to all other children. Four chains with 2000 warm up and 1000 sample iterations were run to reach convergence.