Responsiveness to Intervention (RTI): A Conceptually and Statistically Superior Approach to LD Identification

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The National Research Center on Learning Disabilities, a collaborative project of staff at Vanderbilt University and the University of Kansas, sponsored this two-day symposium focusing on responsiveness-to-intervention (RTI) issues.

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Main Points

- LD: Latent Construct NOT Manifest Variable
- Low Achievement, IQ-Discrepancy, Processing Profiles, and RTI are best understood as alternatives to measuring the LD construct
- RTI has conceptual, statistical, and practical advantages over univariate (e.g., Low Achievement), bivariate (e.g., IQ-Discrepancy), and static multi-variate (e.g., processing profiles) alternatives to measuring LD
- Validity of the concept of LD does NOT hinge on the validity of any particular approach to measuring LD, but educational outcomes for individual children do

LD: Latent Construct NOT Manifest Variable

- Like most important concepts in behavioral science, LD is a latent contruct
  - LD is not directly observable
  - Rather, LD must be inferred from patterns of test performance and other directly, but also imperfectly, measured criteria (e.g., lack of exclusionary factors such as economic disadvantage and limited English proficiency)
  - Thus, LD is not "latent" in the individual, but latent in the observable patterns of test performance and behavioral characteristics of individual students

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LD: Latent Construct NOT Manifest Variable

- The concept of LD implies one or more unique classes of learners that differ from the classes of individuals without LD
- The validity of the concept of LD hinges on the existence of these unique classes, whereas the utility of the concept of LD and its relevance for improving educational outcomes for individual children hinges on our ability to identify individuals with LD and provide them with effective interventions

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Utility in Measurement Depends on Reliability and Validity

- For measurement to be useful, scores must be reliable and inferences based on those scores must be valid
- Reliability limits validity. If scores are not reliable, inferences cannot be valid.
- The reliability of a score is a function of the number of items going into the score and their respective validities.
- In latent variable contexts, we can also discuss the reliability the construct (Fornell & Larcker, 1982).
- The reliability of a construct is a function of the number of tests used to assess the construct and their respective validities.

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Utility depends on reliability …

- Low Achievement offers a univariate approach to measurement of LD;
  - Y is used as a proxy for Y_T
    - Values of $Y_T <$ "?" indicate LD ;
    - Values of $Y_T >$ "?" do not
- Reliability is a question of how well Y measures Y_T

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Utility depends on reliability…

- Discrepancy offers a bivariate approach:
  - Y_i measures Y_{Ti}
  - IQ_i measures IQ_{Ti}
  - $D_i = Y_i - b*IQ_i$ measures $\_i = Y_{Ti} - \_*IQ_{Ti}$
  - Values of $\_i <$ "?" indicate LD
- That is, we use the observed discrepancy (D_i) to measure the true discrepancy ($\_i$)
- Reliability is a question of how well Y measures Y_T, how well IQ measures IQ_T, and how well b estimates _

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Utility Also Depends on Validity

- These univariate and bivariate approaches to measurement of LD demonstrate the weakest form of validity _ face validity _ in so far as they capture the notion of ***unexpected underachievement***
- For Low Achievement definitions,
  - ***unexpected underachievement*** simply reflects the rareness of scores below the cut-off
- For IQ-discrepancy definitions,
  - ***unexpected underachievement*** is captured by $\_*IQ_{Ti}$, which is a form of expectation about achievement
  - Specifically, $\_*IQ_{Ti}$ is an expectation about achievement based on intelligence
  - $b*IQ_i$ is an estimate of that expectation

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Utility depends on validity…

- Face validity alone is insufficient to justify the use of a measurement system, whether we are measuring LD, intelligence, achievement, comprehension, motivation, etc.
- A valid system for identifying LD must go beyond face validity
- Specifically, a valid system for identifying LD will yield classifications of individuals who differ qualitatively in one or more ways

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Utility depends on validity…

- The validity of any approach to measuring the latent construct of LD hinges on its ability to identify individuals with LD, that is, to identify unique classes of individuals
- Unfortunately, univariate (e.g., Low-Achievement) and bivariate (e.g., IQ-Discrepancy) approaches to measuring the LD construct carry insufficient information about the latent construct
- They cannot identify unique classes of individuals because these measurement systems are underidentified

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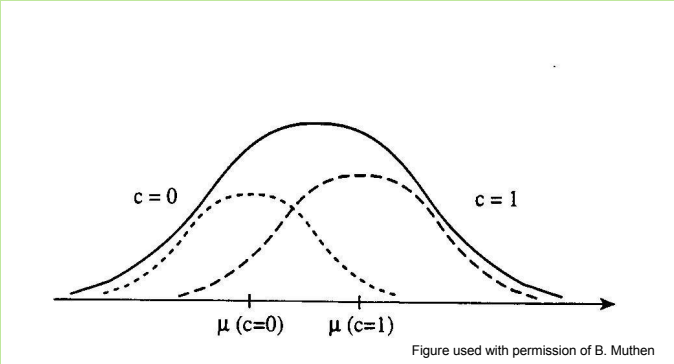
Hypothetical Probability Distribution (Mixture) Involving 2 Latent Classes

solid line - observed distribution
dashed lines - unobserved distributions



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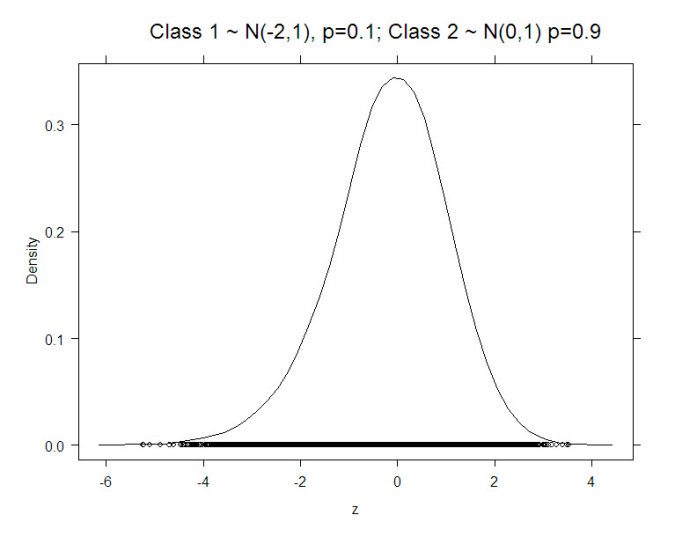
Simulated Probability Distribution (Mixture) Involving Two Latent Classes



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Types of Validity Evidence

- Incidence of specific characteristics _ gender, presence of neurological signs, genetic markers, etc.
- Qualitatively Distinct Cognitive Profiles, i.e., profiles that differ in shape and not just elevation
- Differential Prognosis
- Differential Response to Intervention

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Responsiveness to Intervention (RTI)

- The problems alluded to thus far stem largely from the reliance on assessments from a single point in time and in one or two dimensions
- However, even if we got around these shortcomings, the limited conceptualization of ***unexpected underachievement*** is unsatisfying
- In contrast, RTI begins from the standpoint of measuring the same behavior over multiple time points.

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RTI: Focus on Learning

- Collecting multiple measures over time has the potential to reduce the difficulties encountered with reliance on a single assessment at a single time point because more information means more reliable decisions
- Focusing on multiple measurements over time has the effect of moving the identification process from "ability-ability" comparisons (two different abilities compared at one point in time) to "ability change" models (same ability over time)

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Conceptual Advantages of RTI

- Focuses the definition of LD on a failure to learn, where learning can be measured more directly,
- RTI controls the circumstances of instruction, thereby providing a clearer basis for the expectation of learning and the unexpectedness of any failure to learn.
- Models based on RTI are informative about educational status at any point in time and about educational attainment at future points in time
- Learning can be measured at all levels of ability and at all levels of achievement. That is, it is possible to consider the ***expected*** learning rate conditional on ability (as in discrepancy) or on status (as in low achievement).
- Learning can also be conditioned on the basis of other factors.

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Statistical advantages of RTI

- Because the precision in estimating slopes improves as the number of time points increases (Rogosa, 1995), focusing on the measurement of change can lead to more precise estimates of individual learning and status than models which emphasize single time point assessments
- When more than two assessments are collected, the reliability of estimated change can also be estimated directly from the data
- Imprecision in individual estimates can be reduced by combining information across individuals resulting in improved estimates of growth parameters for individual students as well as for groups of students.

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Statistical advantages of RTI

- For those who favor status models over learning models (i.e., models that emphasize the level of attainment over the rate or process of attainment), the intercept term can be used as an estimate of status.
- Moreover, this intercept will provide a more precise estimate of true status at any single point in time than would a single assessment at that same point in time.
- In addition, the growth model carries the advantage that true status can be estimated at any point along the time line, including extrapolations beyond the observed time line

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Statistical advantages of RTI

- The collection of multiple time points of data allows for the introduction of latent classes and the possibility of statistically separating individuals into unique classes of learners based on their estimated growth trajectories.
- Such general growth mixture modeling carries the promise of being able to empirically address the question of dimensional vs. categorical conceptions of LD (Muth_n, Khoo, Francis, & Boscardin, 2003).

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General Growth Mixture Modeling

- GGMM goes beyond conventional random coefficient growth modeling by using latent trajectory classes which allow for
  - heterogeneity with respect to 1) growth functions, 2) antecedents, and 3) consequences
  - prediction of trajectory class membership
  - confirmatory clustering with respect to parameters or typical individuals
  - classification of individuals
  - enhanced prevention through matching of classes to optimal intervention strategies

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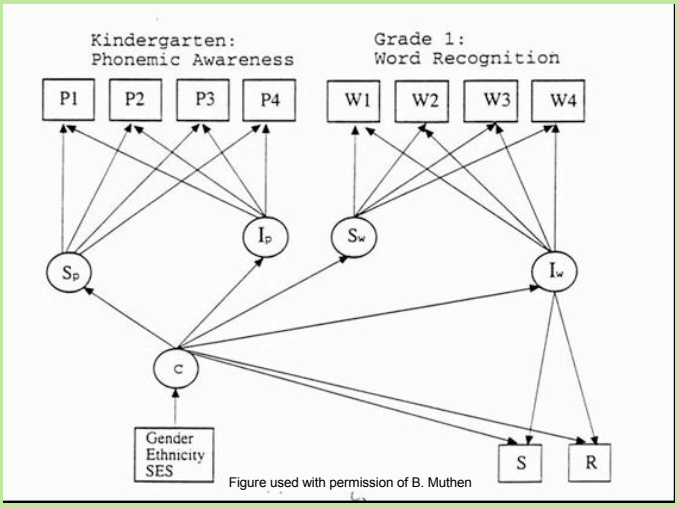
Conceptual Diagram for a Latent Growth Mixture Model of Early Reading



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Recap - Main Points

- Validity of the concept of LD does NOT hinge on the validity of any particular approach to the identifcation of individuals with LD
- Current univariate and bivariate approaches to identification are incapable of identifying unique classes of individuals with LD
- RTI provides considerable conceptual advantages by shifting the emphasis back onto learning and away from status, but at the same time provides more information about status than current approaches
- RTI also brings considerable statistical advantages that result from the increased number of assessments available on individual children, and the ability to borrow precision across different levels of the model

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