Methods for testing for threshold in associations between child care quality and child outcomes

Q–DOT Team
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Background

- Some evidence that the association between classroom quality and child outcomes may not be linear for early care and education
  - Burchinal, Kainz, & Cai, 2010:
    - Secondary data analysis of Head Start and Pre–K data:
    - Quadratic models for ECERS total and factor scores
  - Vandell et al, 2010:
    - Analysis of 15 year outcomes in NICHD SECCYD.
    - Quadratic models – ORCE Teacher Sensitivity
  - Burchinal et al, 2009
    - Analysis of NCEDL pre–K data.
    - Piecewise models – CLASS Instructional and Emotional Support
Background

- Hypothesized
  - Stronger associations between more specific quality measures and aligned child outcomes

- Important implications for quality improvement efforts
Two examples of “Thresholds”
Q–DOT: Linear Regression Models

- Typical model used in analysis
- Spring child outcome \( \text{outcome}_{ij} = \)
  \[ B_0 + B_1 \text{Quality}_j + B_2 \text{Covariates} + e_{ij} + u_j \]
Spring child outcome $_{ij} = B_0 + B_1 \text{Quality}_j + B_2 \text{Quality}_j^2 + B_3 \text{Fall outcome score} + B_4 \text{gender}, + B_5 \text{race} + B_6 \text{time between fall and spring assessments} + B_7 \text{whether child speaks English at home} + e_{ij} + u_j$
Q–DOT: Quadratic Models

- **Full Model:** \( \text{Outcome}_{ij} = B_0 + B_1 \text{Quality}_i + B_2 \text{Quality}_i^2 + B_3 \text{Covariates}_{ij} + \zeta_i + \varepsilon_{ij} \)

- **HLM:**
  - **level 1:** \( \text{Outcome}_{ij} = \delta_{0i} + \delta_{1i} \text{Covariates}_{ij} + \varepsilon_{ij} \)
  - **level 2:** \( \delta_{0i} = B_0 + B_1 \text{Quality}_i + B_2 \text{Quality}_i^2 + \zeta_i \)
Q–DOT: Quadratic Models

- Quadratic regression models
  - $B_0$ Intercept: predicted outcome when quality and covariates are 0
  - $B_1$ Linear Slope: expected change in outcome with 1 point change in quality when quality=0
  - $B_2$ Quadratic Slope: rate of acceleration or deceleration in slope
Q–DOT: Piecewise Regression Model

Spring child outcome_{ij} =

\[ B_0 + B_1 \text{Quality}_j + B_2 \text{Quality}_j \times \text{(high quality room)}_i + B_3 \text{Fall outcome score} + B_4 \text{gender}, + B_5 \text{race} + B_6 \text{time between fall and spring assessments} + B_7 \text{whether child speaks English at home} + \zeta_i + \varepsilon_{ij} \]
Q–DOT: Piecewise Regression Model

Full Model: \( \text{Outcome}_{ij} = B_0 + B_1 \text{Quality}_i + B_2 \text{Quality}_j * (\text{high quality room})_i + B_3 \text{Covariates}_{ij} + \zeta_i + \epsilon_{ij} \)

HLM:
- level 1: \( \text{Outcome}_{ij} = \delta_{0i} + \delta_{1i} \text{Covariates}_{ij} + \epsilon_{ij} \)
- level 2: \( \delta_{0i} = B_0 + B_1 \text{Quality}_i + B_2 \text{Quality}_j * (\text{high quality room})_i + \zeta_i \)
Secondary data analysis

- Large child care studies
  - School readiness assessments
    - Preschoolers
    - Baseline and endpoint
  - Direct assessment of classroom quality
  - HLM analyses –
    - Children nested in classrooms
    - Predicting endpoint scores from classroom quality
Q–DOT: Projects

- Head Start Family and Child Experiences Survey (FACES) – 2006
  - ~3000 children in ~ 335 classrooms

- Early Head Start Follow-Up (EHS)
  - ~1500 children in ~ 1000 classrooms

- More-at-Four (MAF): evaluation of NC Pre–K
  - ~1200 children in ~ 200 classrooms

- NCEDL 11–state Pre–K study
  - ~2400 children in ~ 700 classrooms
Q–DOT: Projects

- Preschool Curriculum Evaluation Research (PCER) Study
  ~2700 children in ~ 1000 classrooms

- My Teaching Partner (MTP): Professional Development project in VA Pre–K
  ~600 children in ~ 1000 classrooms

- NICHD Study of Early Child Care (SECC)
  ~1000 children in ~ 1000 classrooms

- Miami/Dade County Literacy Intervention Studies
  ~1500 children in ~ 750 classrooms
Q–DOT: Approach

- 2-level HLM analyses of project data
  - Quadratic quality model
  - Linear quality model
  - "Piecewise quality model": allow separate linear slopes in lower and higher quality classrooms

![Diagram showing outcome vs. classroom quality]
Q–DOT: Analyses Approach

Focus on in this presentation on analyses of measures of quality of instruction
- CLASS Instruction Support and academic outcomes
- TBRS Literacy Scale and literacy outcomes

Outcomes: Spring Pre–K assessments of
- Language (PPVT, TOPEL)
- Reading (WJ LW, TOPEL)
- Math (WJ AP)
Q–DOT: Approach

- **Spline cut-points**
  - Same cut-points used with all projects
  - Chosen theoretically – “high quality” and adapted if insufficient sample size

- **Cut-points**
  - **CLASS Instructional Support**: 2.75: (range 1–7)
  - **TBRS : Literacy Scale**: (range 1–3)
Q–DOT: Approach

- Separate analyses
  - For each quality score and outcome in each project

- Effect sizes:
  - How much change in outcomes (in SD units) do we expect with a one SD increase in classroom quality
  - Gives us a statistic that means the same thing across all analyses
  - \[ d = B \frac{sd(quality)}{sd(outcome)} \]

- Meta-analysis combined results across projects
  - Separate analysis for linear models and spline models
Q–DOT: Approach

- Reminder: 3 models examined
  - Quadratic quality model,
    - if nonsignificant then fit Linear quality model
  - “Piecewise quality model”: allow separate linear slopes in lower and higher quality classrooms
Predicted FACES language scores by level of CLASS Instruction Support

- Lower Quality
- Higher Quality
Predicted NCEDL language scores by level of CLASS Instruction Support
Findings: CLASS Instructional Support and Language Skills

- FACES
- MAF
- NCEDL
- MTP
- META-AN

Lower Quality  Higher Quality
Predicted NCEDL reading scores by level of CLASS Instruction Support
Findings: CLASS Instructional Support and Reading Skills

![Graph showing quality ratings for FACES, MAF, NCEDL, and META-AN.](Image)

Legend:
- **Lower Quality**
- **Higher Quality**

Note: * indicates statistically significant differences.
T–C Interaction Specific Quality: CLASS Instructional Support

![Graph showing the interaction of T–C quality with CLASS Instructional Support for Language, Math, and Reading. The graph indicates lower quality, higher quality, and linear support with asterisks (*) denoting significant differences.]
Predicted PCER language scores by level of TBRS Literacy Quality

- Lower Quality
- Higher Quality
Predicted PCER reading scores by level of TBRS Literacy Quality

- Lower Quality
- Higher Quality
Domain Specific Quality
TBRs: PCER only

- Language
- Math
- Reading

Lower Quality
Higher Quality
Linear

* Significance Levels
Summary: Thresholds?

- Some evidence for thresholds, especially within measures of instructional quality
  - Teacher–child relationships (CLASS)
  - Domain specific quality measures (TBRS)

- NOTE: our thresholds were selected conceptually and our results do not test whether these are the best cut-points
Methods

- Quadratic approach was not useful in detecting cut-points in our analyses
- Piecewise approach provided some evidence – but we set and did not test the cut-points
  - This allowed us to easily combine data across studies and look at replication
- Further work is needed to estimate cut-points