Examining Thresholds of Child Care Quality in Two Multi-Site Data Sets: Preliminary Analyses Using Generalized Additive Model (GAM) and Confirmatory Factor Analyses of Quality Measures

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Investigating Thresholds of Child Care Quality Predicting Children's Development

Background

- Several studies have provided compelling evidence that better quality generally predicts more optimal child outcomes.
- Studies examining associations between quality of child care and children's developmental outcomes have typically tested linear models to determine whether higher levels of quality predict better developmental outcomes.
- It is possible that the strength of association between predictors and outcomes varies across the measurement scale such that particular levels of quality are significantly more strongly associated with children's development. A more fine-grained analysis can help to answer the question of whether a particular threshold of quality that best predicts children's development can be identified.

Purpose

- The current study aims to test whether associations between quality and children's outcomes are best represented by traditional linear models or by a function that is allowed to vary, and also to examine these associations across infancy and preschool using well established measures of quality (ECERS-R, FDCRS, ITERS, Caregiver Interaction Scale)

Method

- To investigate the nonlinearity of outcome on each predictor (measures of quality), multiple tests of the generalized additive model (GAM; Hastie & Tibshirani, 1986) were applied. This investigation provides us evidence for determining the thresholds if they exist. Based on the thresholds, we examine the change of associations between outcome and each predictor by using parametric piecewise model or we fit the fractional polynomial model (Royston and Altman, 1994) to data.

Sample

- Two data sets: Early Head Start (EHS) National Evaluation
  Quality Improvements in Early Childhood Education (QUINCE)
- EHS: children ranging from infancy to 60 months of age *n*=3001
  QUINCE: preschool aged children *n*=718

Key Findings

- The result of fitting GAM that examines if there is nonlinear relation between outcome and quality of care offers evidence of nonlinear trends for association between some quality and children's outcome variables at all time points (14, 24, 36 and 60 months) in EHS.
- There is also a linear trend between some child outcomes and program quality variables.

Future Study

- The next step of our study is to examine the association between quality and children's outcomes for the QUINCE study.
- We will also explore the 'threshold of quality' of those quality variables which showed a nonlinear relation with child outcomes based on current findings.

Example

Table 1. *Results of Linearity and Nonlinearity Tests on Quality for EHS 14 Month Data*

Outcomes	Quality		
	CIS	C (ITERS)	F (FDCRS)
Engagement of Parent			(L;**)
Sustained Attention with Objects		(**)	(L;**)
Negativity toward Parent	(**)		
Bayley: BSID-II Mental Development Index Score	(L; **)		
BBRS: Orientation/Engagement Scale			
BBRS: Emotional Regulation	(*)		
Macarthur CDI Vocabulary Comprehensive		(L;**)	
Macarthur CDI Vocabulary Product			(**)
EASI: Emotionality Scale	(**)		(**)
EASI: Sociability Scale	(*)	(**)	

Note: (*) p-value for nonlinearity is between 0.05 and 0.10.
(**) p-value for nonlinearity is less than 0.05.
(L) significant linear relationship with outcome.

- Table 1 shows the relation between program quality and child outcomes variables at 14 months (EHS).
- Some variables show a non-linear relationship (marked in red).
- Some variables are best represented by linear relation.
- The rest do not show a special trend (nonlinear or linear).

Figure 1. Nonlinear Relation Between ITERS Score and Children's Sustained Attention with Objects at 14 Months

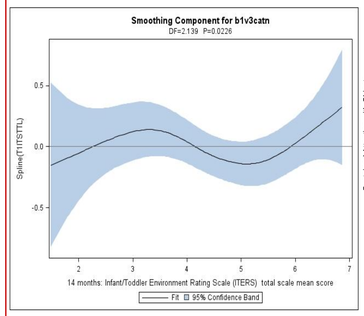
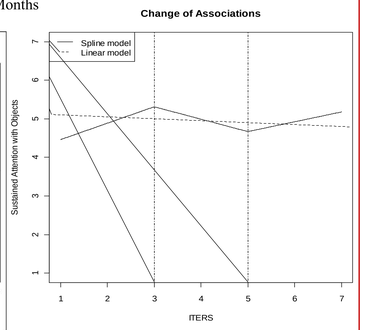


Figure 2. Change of Associations Between ITERS Score and Children's Sustained Attention with Objects at 14 Months.



- Figure 1 shows the nonlinear relation between ITERS total score and children's sustained attention with objects at 14 months.
- Further study would examine the cutoff points based on the graph and related theories.
- The result of model comparison between spline model and linear model in Figure 2 indicates that the spline model is a significantly better fitted model than the linear model (p-value of likelihood ratio test is 0.0196).

A Confirmatory Factor Analysis of the Early Childhood Environment Rating Scale-Revised and Family Day Care

Background

- Studies have documented modest relations between global child care ratings on observational child care measures and children's development. However, newer studies have examined relations between factors created within the global measures and more targeted outcomes in children's development.
- Assessing the structure of global quality measures can help researchers, educators and policy makers determine which aspects of early childhood environments that matter for children's development should be targeted for quality improvement.

Purpose

- To determine if factor structures identified in ECERS-R and FDCRS in QUINCE (two-factor for ECERS-R and three-factor for FDCRS) study hold true for QUINCE Time 2(after intervention) data and the same measures used in EHS sample when children were age 14, 24, 36 and 60 months.

Method

- SAS 9.2 Proc Calis

Sample

Program	Measure	Time 2
QUINCE	ECERS	74
	FDCRS	200

Program	Measure	14M	24M	36M	60M
EHS	ECERS			455	859
	FDCRS	79	87	63	40

Result

- **QUINCE**

Fit functions for **ECERS-R**:
Time 2: CFI=.92 not bad; SRMR=.0748, good; RMSEA=.066, not bad; chi-square=254.24, *df*=186, chi-square/*df*<2, good;
Fit functions for **FDCRS**:
Time 2: CFI=.85, not good; SRMR=..0705, good; RMSEA=.065, not bad; chi-square=580.16, *df*=316, chi-square/*df*<2, good;

- **EHS**

Fit functions for **ECERS-R**:
36 month: CFI=.90, not bad; SRMR=.0536, good; RMSEA=.085, not bad; chi-square=799.81, *df*=186, chi-square/*df*>2, bad;
60 month: CFI=.90, not bad; SRMR=.0496, good; RMSEA=.08, not bad; chi-square=1182.00, *df*=186, chi-square/*df*>2, bad;
Fit functions for **FDCRS**:
14 month: CFI=.77, not good; SRMR=.09, not good; RMSEA=.096, not bad; chi-square=544.41, *df*=316, chi-square/*df*<2, good;
24 month: CFI=.84, not good; SRMR=.07, good; RMSEA=.10, bad; chi-square=593.66, *df*=316, chi-square/*df*<2, good;
36 month: CFI=.71, bad; SRMR=.09, not good; RMSEA=.13, bad; chi-square=672.44, *df*=316, chi-square/*df*>2, bad;
60 month: CFI=.85, not good; SRMR=.12, bad; RMSEA=.15, bad; chi-square=602.73, *df*=316, chi-square/*df*<2, good;

Conclusion

- The factor structures found in QUINCE study (two-factor structure for ECERS-R and three-factor structure for FDCRS) reach the borderline level of fitness for both QUINCE Time 2 data and EHS 14, 24, 36 and 60 month data.

References

- Hastie, T. and Tibshirani, R.J. (1986). Generalized additive models. *Statistical Science, 1(3),* 297-310.
- Royston, P. and Altman, D. G. (1994). Regression using fractional polynomials of continuous covariates: Parsimonious parametric modeling. *Applied Statistics*, 43, 429-453

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