CENTER FOR RESPONSE TO INTERVENTION IN EARLY CHILDHOOD

Seminar in RTI Research

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Utah Conference on Effective Practices for Teachers and Human Service Professionals:
Interventions Across the Lifespan
Utah State University, Logan UT, June 23, 2011

Guiding Issue for Today's Talk

- The RTI approach to education and human services is increasingly prevalent
- However, RTI presents unique challenges to efficacy study designs
- This presentation introduces some of these challenges encountered in the authors' research and discusses potential solutions
- Implications for RTI intervention development and efficacy research are discussed

Briefly, What is RTI?

- An early intervening approach using evidence-based practice to prevent the need for special education services
- Using universal screening of all children (students)
- Children at risk and not expected to reach future performance benchmarks, are provided additional, more intensive interventions.
- Based on child progress, decisions to keep or change a child's intervention are made within a school year as needed
- Much more!

Some RTI Efficacy Research Goals and Study Designs

- New technique development
- Refine and replicate a promising intervention
- Evaluate the efficacy of a developed and feasible intervention (e.g., Tier 1 or Tier 3 intervention)
- Evaluate the efficacy of an RTI model using Multiple Tiers of Support (MTS)

Challenges and Potential Threats (Confounds) to Internal Validity Linked to RTI Study Designs

- How does the nature of the “intervention” define cluster units in the proposed study?
- How do we handle the fact that in some studies, RTI interventions will be dynamic, children may change intervention at any time during a year based on progress?
- How should we handle repeatedly measured progress monitoring data – growth trajectories?
- How do we handle multiple layers of covarying measures (e.g., mastery, fluency, fidelity)

How does the nature of the "intervention" define cluster units in the proposed study?

- Statistical analyses of experimental RTI data lead to incorrect inferences about treatment effects (Hedges, 2007) when clustering is not considered in sampling and randomization
  - Tier 3 intervention provided to students by parents at home (Randomize children)
  - Tier 2 intervention provided children by a home visitor (Randomize home visitors)
  - A full RTI model serving all children in a school (Randomize schools)

How do we handle dynamic RTI interventions where children may change intervention at any time during a year based on progress?

- By definition, RTI services are intentionally dynamic, school teams or teachers make intervention change decisions
  - This may violate the assumptions in some quasi-experimental designs, for example the Regression Discontinuity Design)
  - Presents challenges to attribution of causal effects that include variable intervention changes and different exposures (dosage)

How should we handle repeatedly measured progress monitoring data – growth trajectories?

- Time series, repeatedly measured progress data are typical in RTI research and present some challenges to assumptions and interpretation
  - Single case designs are highly appropriate when the unit of study is the individual child's progress repeatedly measured (AB being the simplest)
  - Growth curve analyses are appropriate when the unit of analysis is multiple children repeatedly measured

How do we handle multiple layers of covarying measures (e.g., mastery, fluency, fidelity)

- RTI research typically involves multiple collection of multiple measures (e.g., dependent measures, and covariates like fidelity of implementation, time in treatment, etc.)
  - Research questions typically focus on how do covariates affect change in the dependent measure
  - SCD – graphing the data in the same figure to display covaration
  - GCA – testing whether or not covariates significantly affect the observed trajectories

Case in Point

- Buzhardt, J., Greenwood, C. R., Walker, D., Anderson, R., Howard, W. J., & Carta, J. J. (in press). Effects of web-based support on Early Head Start home visitors' use of evidence-based intervention decision making and growth in children's expressive communication. *NHSA Dialog: A Research-to-Practice Journal for the Early Childhood Field.*
- Buzhardt, J., Greenwood, C. R., Walker, D., Carta, J. J., Terry, B., & Garrett, M. (2010). Web-based tools to support the use of data-based early intervention decision making. *Topics in Early Childhood Special Education, 29(4), 201-214.*

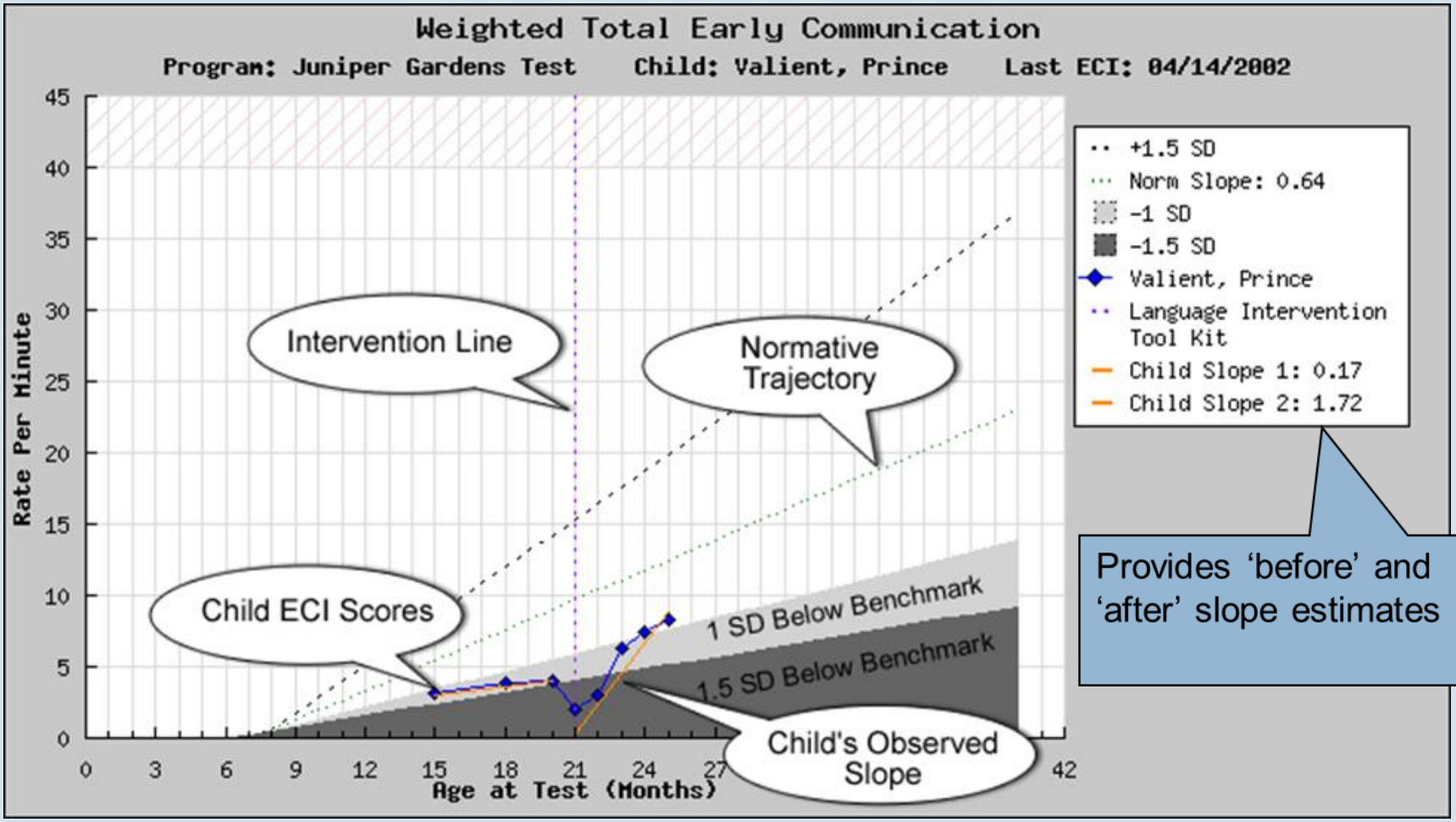
Study Highlights

- Purpose – To assess the efficacy of a Tier 2 naturalistic language intervention
  - Delivered in the home to children by parents
  - Parents coached and monitored by Early Head Start home visitors
- Experimental Conditions – with and without web-based decision making support for home visitors
- Participants – Early Head Start programs in KS, Home Visitors, and Children performing below screening benchmark's in early communication skills
- Design – Longitudinal randomized trial comparing 2 conditions: (A) home visitors with materials and basic training versus (B) condition 1 plus web-based decision support

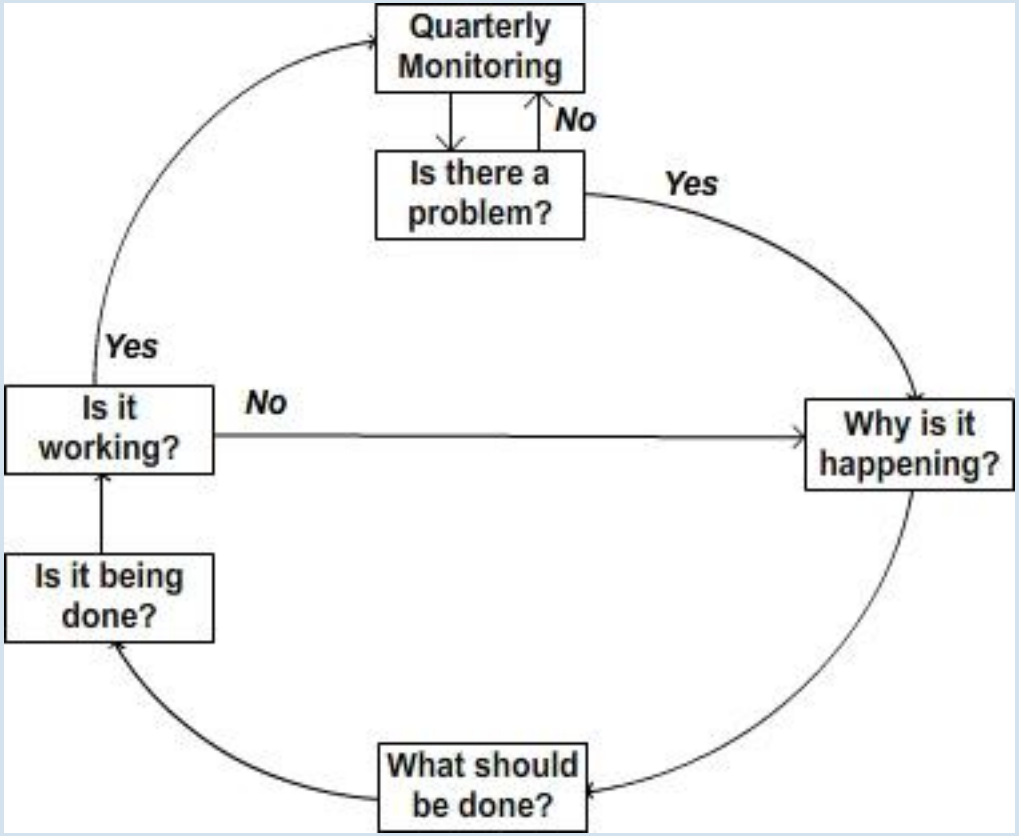
Study Highlights

- Unit of Treatment – because treatment was guided by home visitors, they were randomized to the two conditions, not children
- Measures
  - Repeatedly measured Early Communication skills allowing examination of children's growth over time
  - Fidelity of implementation for home visitors and parents

Use of Progress Monitoring in Intervention Decision Making



Use of data-based, decision making model



Web-based Support for Intervention Decision Making

- To ensure children at risk of a language delay are identified quickly
- To facilitate early intervention
- To assess the degree that interventions are implemented
- To encourage intervention changes when progress is not being made

Analytic Strategy

- Because this was a randomized design and the dependent variable was children's language growth trajectories we, used univariate CGA
  - Individual children's growth is considered in terms of slope and intercept
  - It handles missing data
  - It supports the use of independent variables and covariates (IFSP status, Age at Eligibility)

Analytic Strategy

- Because children were screened into the study at different times, each child's language data was converted to a time scale in terms of months before and after onset of the Tier 2 intervention.
- This enabled use of a twice-piece CGA with the intercept centered at the last time point prior to start of the intervention (time = 0)

Level 1 CGA Findings

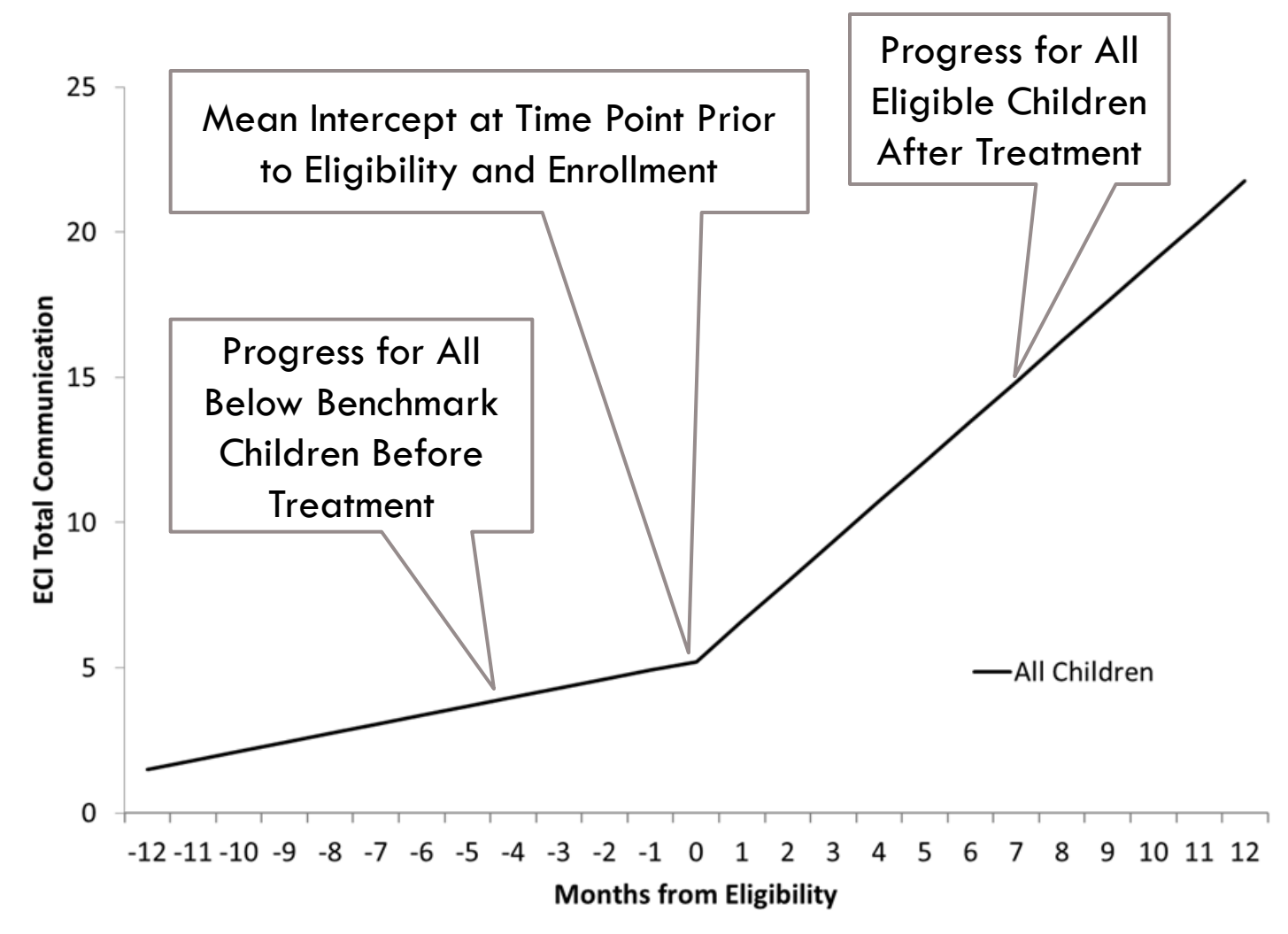


Table 1. *Descriptive Statistics*

Level-1 Descriptive Statistics					
Variable	*N*	Mean	*SD*	Minimum	Maximum
ECI Total Communication	770	7.66	6.18	0	36.2
Before Eligibility	770	-0.8	2.02	-12	0
After Eligibility	770	1.92	2.19	0	12
Level-2 Descriptive Statistics					
Variable	*N*	Mean	*SD*	Minimum	Maximum
Experimental Groups	124	0.51	0.5	0	1
IFSP Status	124	0.28	0.45	0	1
Age at Eligibility (Months)	124	16.81	9.16	4	38
Age x IFSP Status	124	5.33	9.66	0	38
Groups x IFSP status	124	0.14	0.35	0	1
Groups x Age at Eligibility	124	8.15	10.26	0	38

Note. IFSP = Individual Family Service Plan (IFSP: 0 = None, 1 = IFSP),

Experimental Groups: 0 = NonMOD, 1 = MOD

Level 2 CGA Findings

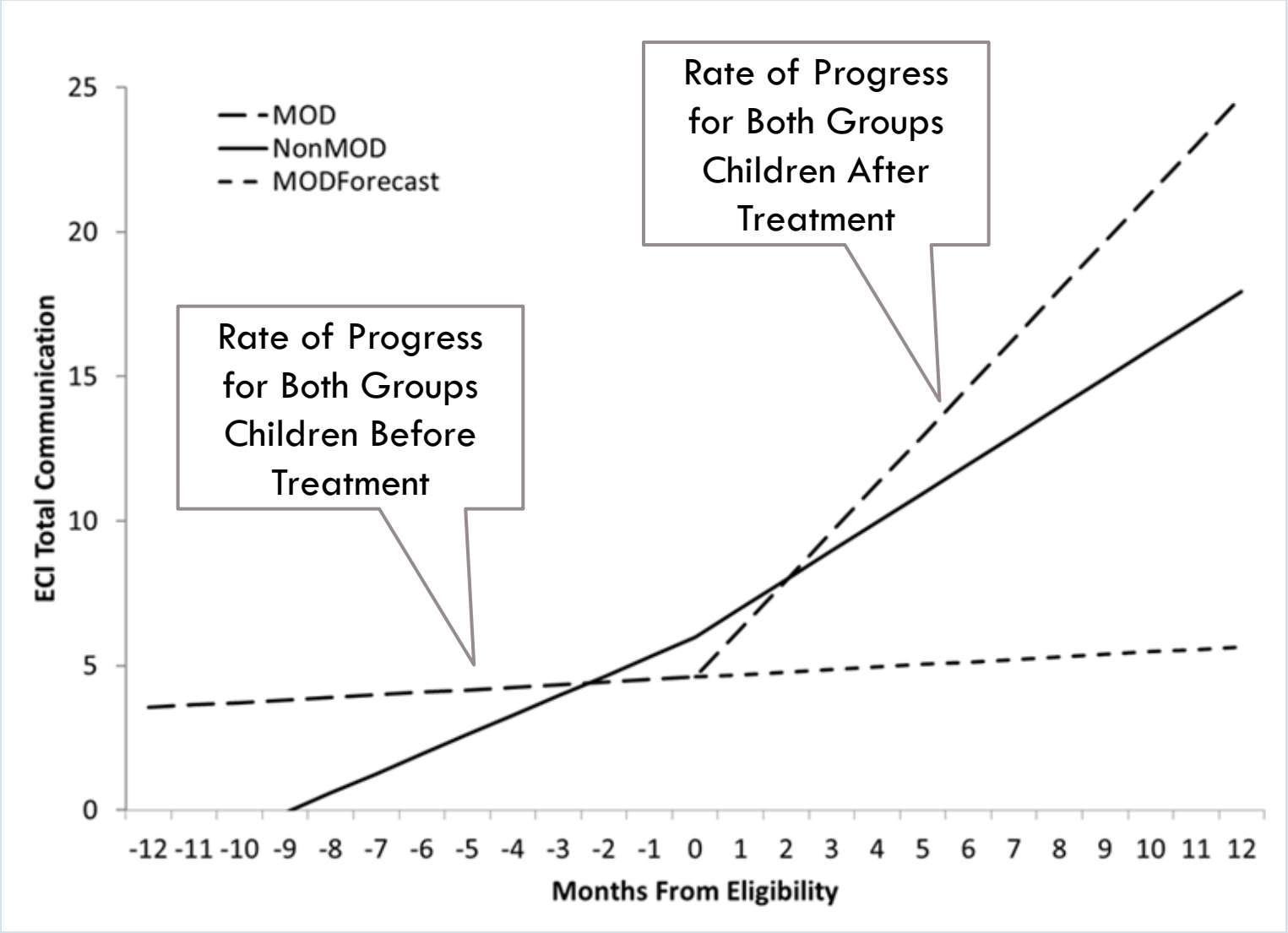


Table 2. *Two-Piece Growth Curve Models*.

	Fixed	Unconditional Model					MOD Groups Model				
	Effects	*Coefficient*	*SE*	*t*	*df*	*p*	*Coefficient*	*SE*	*t*	*df*	*p*
Level-1	Intercept	5.21	0.40	12.892	123	0.001	5.97	0.67	8.918	122	0.001
	$Slope_{Before}$	0.31	0.10	3.046	123	0.003	0.67	0.22	3.085	122	0.003
	$Slope_{After}$	1.38	0.15	8.797	123	0.001	1.00	0.22	4.572	122	0.001
Level-2	Intercept						-1.38	0.82	1.668	122	0.097
	$Slope_{Before}$						-0.59	0.24	2.452	122	0.016
	$Slope_{After}$						0.68	0.30	2.237	122	0.027
Final Estimation of Variance Components: (Based on units that had sufficient data for computation).											
	Random Effects	*SD*	*Variance*	*df*	X^2	*p*	*SD*	*Variance*	*df*	X^2	*p*
	Intercept	3.63	13.19	44	237.77	0.001	3.65	13.31	43	242.94	0.001
	$Slope_{Before}$	0.43	0.19	44	85.806	0.001	0.43	0.19	43	91.07	0.001
	$Slope_{After}$	1.15	1.33	44	99.674	0.001	1.11	1.23	43	103.71	0.001
	Level-1	3.92	15.34				3.90	15.23			
	Deviance	4589.90					4581.07				
	Parameters	10					13				

Note. Unconditional versus conditional model test, change in deviance = 7.83, $X^2(3) = 8.83$, p = .03.

Table 3. *Best Fitting Two-Piece ECI Total Communication Growth Model.*

Models	Deviance Statistic	Number of Parameters	Decrease In Deviance	X^2	*df*	*p*
Level 1	4589.898403	10				
Level 2-Age at Eligibility	4498.382414	13	91.515989	94.66	6	0.0001
Level 2-Age at Eligibility + IFSP	4491.090308	16	7.292106	7.29	3	0.062
Level 2-Age at Eligibility + IFSP + Comparison Groups	4481.568057	19	9.522251	9.52	3	0.023

Note. Age and IFSP Interaction effects were not significant

Effects of Treatment with Covariates Included Earlier in the Growth Model

Summary/Conclusion

- RTI represents a new generation of research seeking reach a greater level of effectiveness
- It also creates challenges to experimental study designs as discussed
- Solutions to some of these issues (not all!) were illustrated