The CANDLE Study: Aspects of Early Childhood Development in a Shelby County, TN Population

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THE URBAN CHILD INSTITUTE

Outline

- Lifecourse perspective overview
- Children in Memphis/Shelby County
- Overview of CANDLE
- Selected CANDLE data on socioemotional development – WORK IN PROGRESS
- Ancillary Investigations – Room for more
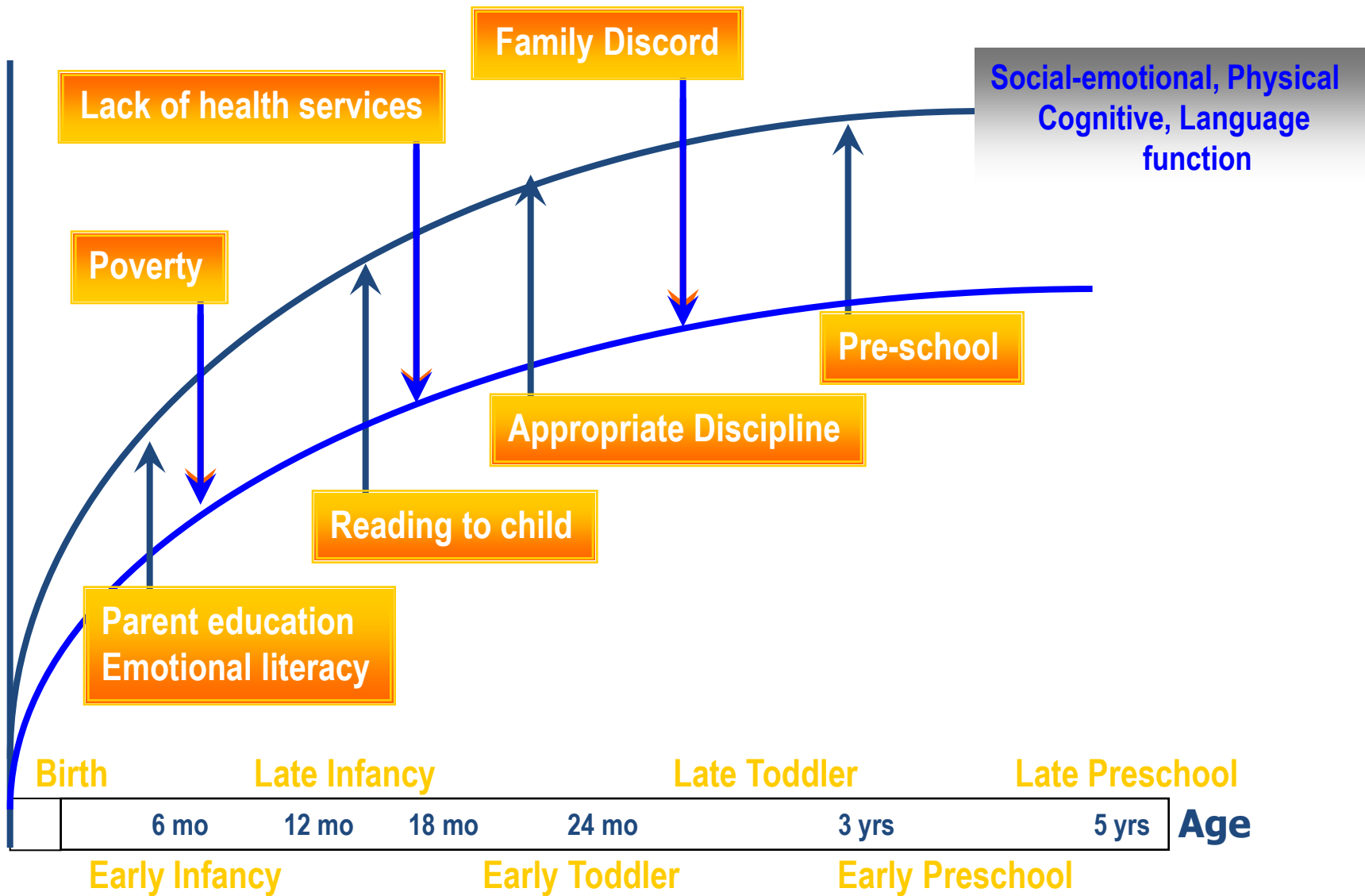- How can we change child outcomes?

Lifecourse Perspective and Disparities
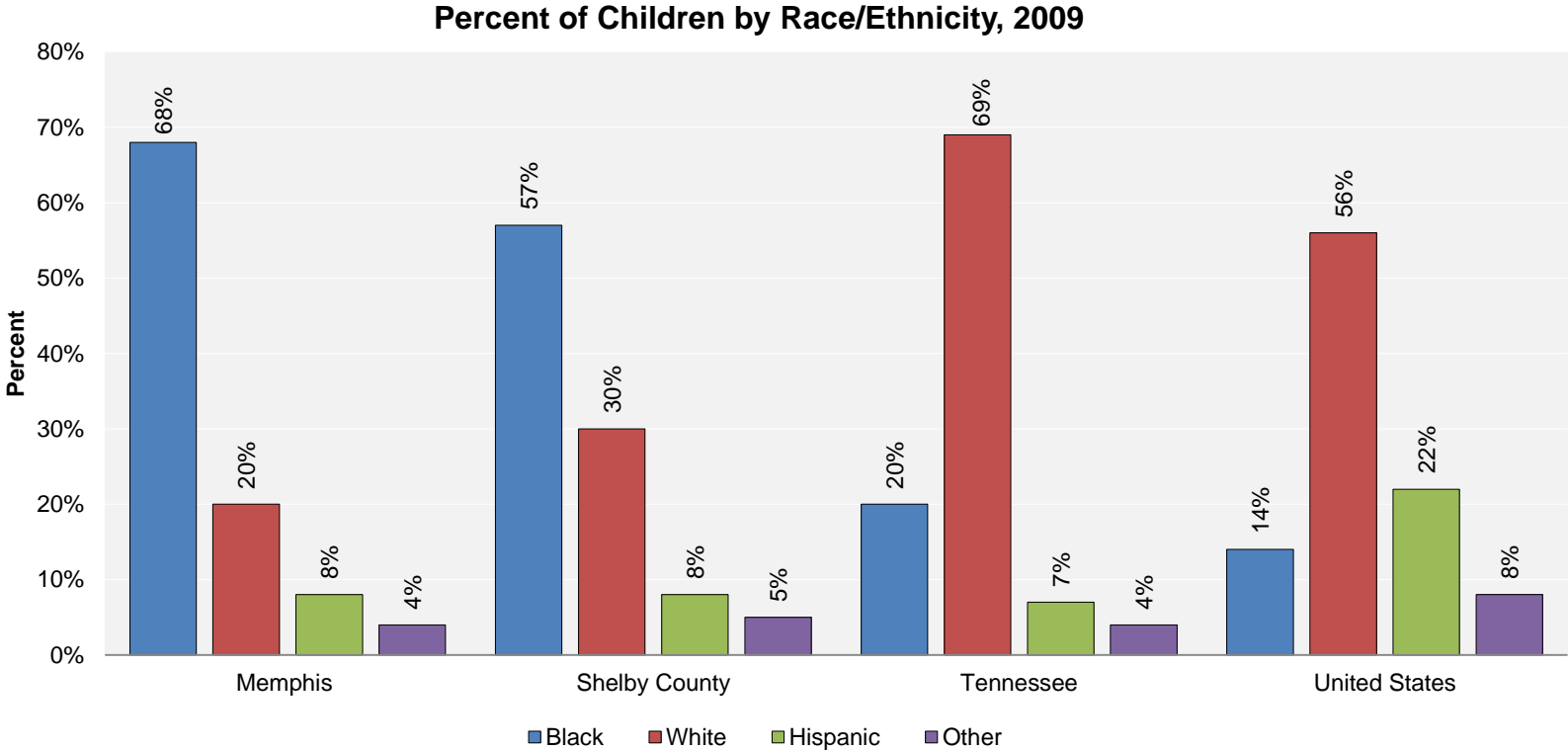

Lu MC, Halfon N, 2003
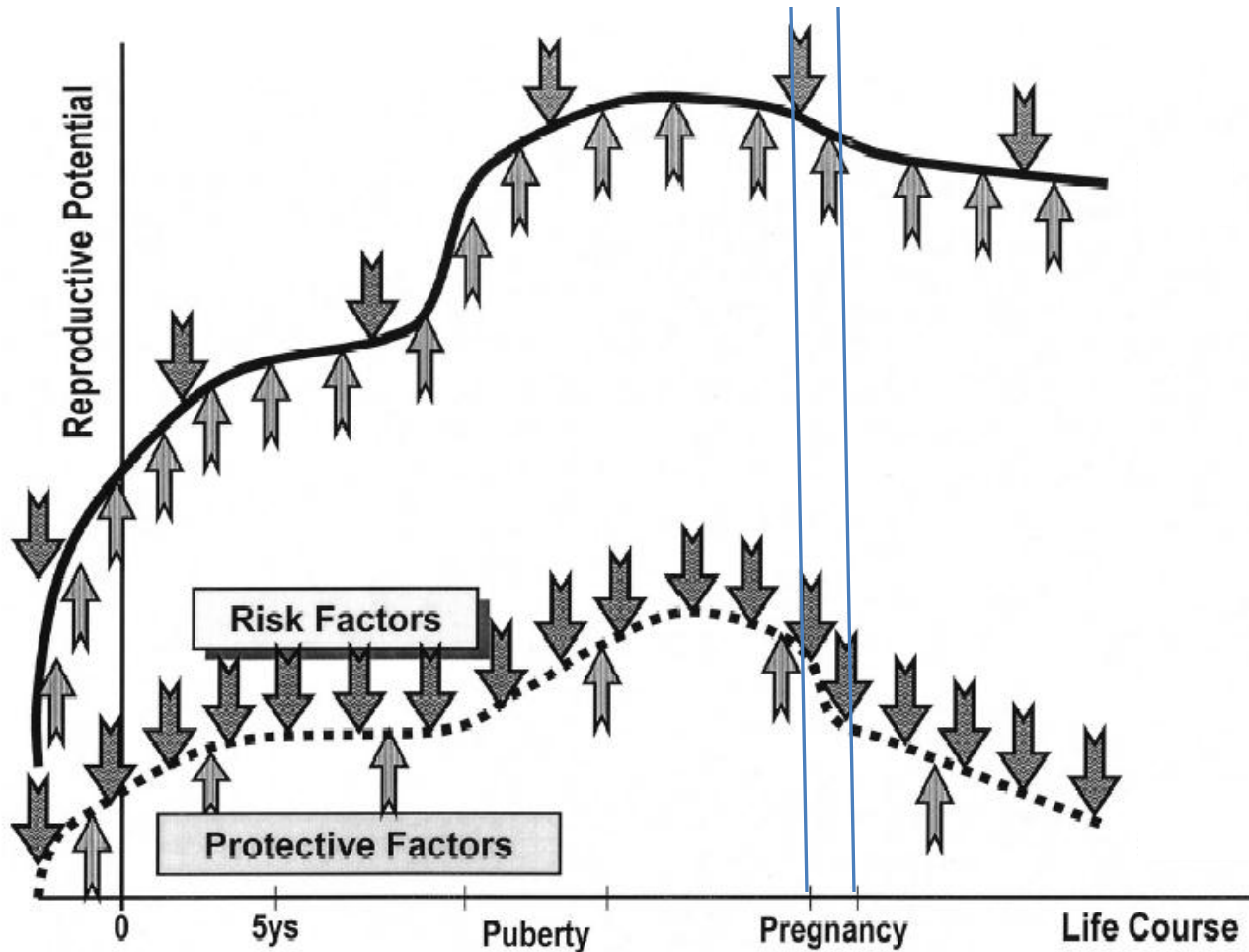
Key Lifecourse Perspective Concepts

- **Today's experiences and exposures determine tomorrow's health. Effects are cumulative.**

- **Health trajectories are particularly affected during critical or sensitive periods.**

- **Predictable pathways. The broader environment – biologic, physical, and social – strongly affects the capacity to be healthy.**

- **Inequality in health reflects more than genetics and personal choice. Equity.**

Amy Fine, Milt Kotelchuck, 2009

Developmental Health

Family Discord

Lack of health services

Social-emotional, Physical Cognitive, Language function

Poverty

Pre-school

Appropriate Discipline

Reading to child

Parent education Emotional literacy

Birth　　　　　Late Infancy　　　　　Late Toddler　　　　Late Preschool

| 6 mo | 12 mo | 18 mo | 24 mo | 3 yrs | 5 yrs | Age |

Early Infancy　　　　　　Early Toddler　　　　Early Preschool

Hertzman (2010)

Memphis/Shelby County Children

Percent of Children by Race/Ethnicity, 2009

Legend: ■ Black ■ White ■ Hispanic ■ Other

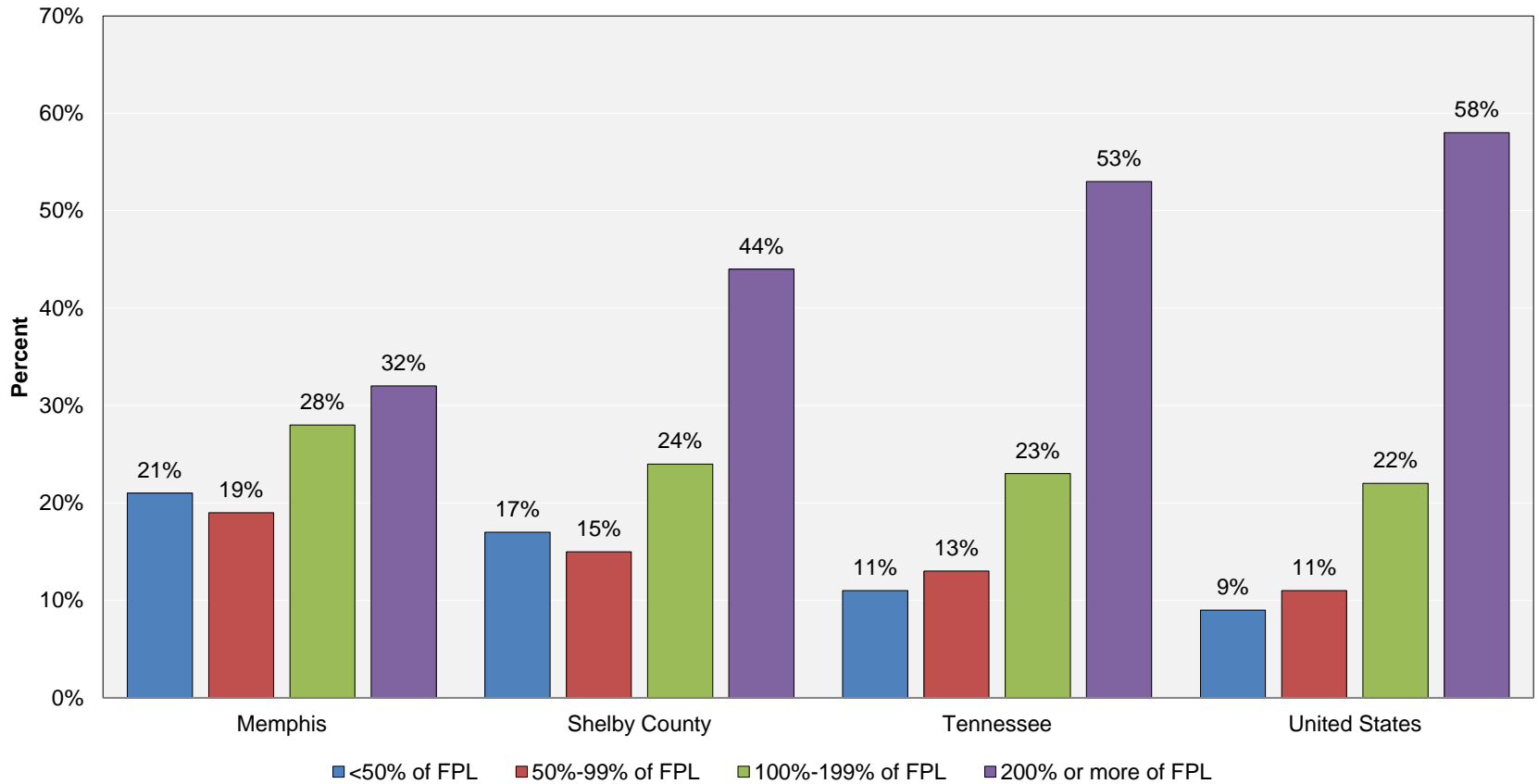|	Black	White	Hispanic	Other
Memphis	68%	20%	8%	4%
Shelby County	57%	30%	8%	5%
Tennessee	20%	69%	7%	4%
United States	14%	56%	22%	8%

Memphis/Shelby County Children

Percent of Children by Living Standard, 2009

A Public Health Problem

- Teen birth rate (40.0/K) is #7 of 95 counties in TN (27.3/K)

- Substantiated child abuse is #21 in TN

- Shelby County HS dropout rate (25.9%) is #1 in TN (10.4%)

- Only 4% of Memphis City Schools seniors are ready for college, based on scoring at least 19 on the ACT, the college entrance exam taken by district seniors. In other words, of 6,774 seniors, only 271 are college ready.

CANDLE Study

The CANDLE Study (**C**onditions **A**ffecting **N**eurocognitive **D**evelopment and **L**earning in **E**arly Childhood) is a longitudinal cohort study designed to:

- Evaluate 1,500 pregnant women and their children living in Memphis/Shelby County, TN from the second trimester into childhood.

- Investigate the wide range of genetic, epigenetic, demographic, environmental and social factors influencing child development across urban and suburban neighborhoods.

Timeline: The CANDLE Study

	Category	Enrollment Clinic Visit 16-26 wks M1	3rd trimester Clinic Visit (27-42wks) M2	Birth Hosp M3	4-Week Home Visit HV1	12 Mo. Clinic Visit CV1	24 Mo. Clinic Visit CV2	24 Mo. Home Visit HV2	36 Mo. Clinic Visit CV3	48-60 Mo. Clinic Visit CV4
Demographics Survey	Prenatal	X				X	X		X	X
Maternal Baseline Data Form	Prenatal	X								
Updates and Complications Form	Prenatal			X						
Labor & Delivery Form	Prenatal			X						
Neonatal Summary Form	Prenatal			X						
Maternal (blood, urine)	Biological Samples	X	X	X						
Child (cord blood, placental tissue, blood)	Biological Samples			X						X
Food Frequency Questionnaire	Nutrition	X			X					
Choline Inhibitor Questionnaire	Nutrition	X			X	X		X	X	
Infant/Toddler Feeding Questionnaire	Nutrition				X	X		X	X	
Food Supplement Information	Nutrition				X	X		X	X	
24-Hour Food Recall	Nutrition				X	X		X	X	
Comprehensive Feeding Practices	Nutrition									X
Lead Risk Assessment Questionnaire	Health				X	X		X	X	
Child Exam (CSHCN)	Health					X	X		X	X
Brief Infant Sleep Questionnaire	Health					X		X	X	
Family Health History	Health					X				
Child Health Update Form	Health				X	X		X	X	
Maternal Exam	Health									X
Asthma & Environment	Health									X
Atopy History	Health									X
Child Sleep Habits	Health									X
PCI Teaching Scale (NCAST)	Cognitive					X	X		X	
BSID-III (Bayley)	Cognitive					X	X		X	
Child Abuse Potential Inventory	Cognitive					X	X		X	
M-CHAT	Cognitive						X			
SIB-R Early Development Form	Cognitive					X	X		X	X
WASI-III Subscales	Cognitive					X				
CARS (subset of children)	Cognitive								X	
WIAT-III Word Reasoning	Cognitive								X	
Achenbach TOF	Cognitive									X
Bracken 3-R	Cognitive									X
BRIEF-P	Cognitive									X
Stanford-Binet 5	Cognitive									X
Conflict Tactics Scale - 2	Psychosocial		X				X			X
Traumatic Life Events Questionnaire - 2	Psychosocial		X						X	
Child Behavior Checklist - 3	Psychosocial								X	X
Social Support Questionnaire - 6	Psychosocial		X				X			
Rosenberg Self Esteem	Psychosocial		X				X			
BITSEA	Psychosocial					X	X			
Brief Symptom Inventory	Psychosocial		X			X	X		X	X
Edinburgh Post-natal Depression Scale	Psychosocial				X	X				
Knowledge of Infant Development	Psychosocial		X				X			
Household Questionnaire	Psychosocial				X			X	X	X
HOME Inventory	Psychosocial							X		
Parenting Stress Index	Psychosocial					X	X		X	X
TEMPS	Psychosocial	X					X			
Child Care Information	Psychosocial					X		X	X	
State-Trait Anxiety Inventory	Psychosocial								X	
NEO Personality Inventory	Psychosocial								X	
CAGE Substance Abuse Screening Tool	Psychosocial								X	
Center for Epidemiological Studies Depression Scale	Psychosocial									X
Parental Incarceration	Psychosocial									X
Parenting Relationship	Psychosocial									X

Phone Visits at 3, 6, 9, 15, 18, 21, 27, 30, 33, 42, 48, 56 months

CANDLE Data Collection
Current Status – 1/14/12
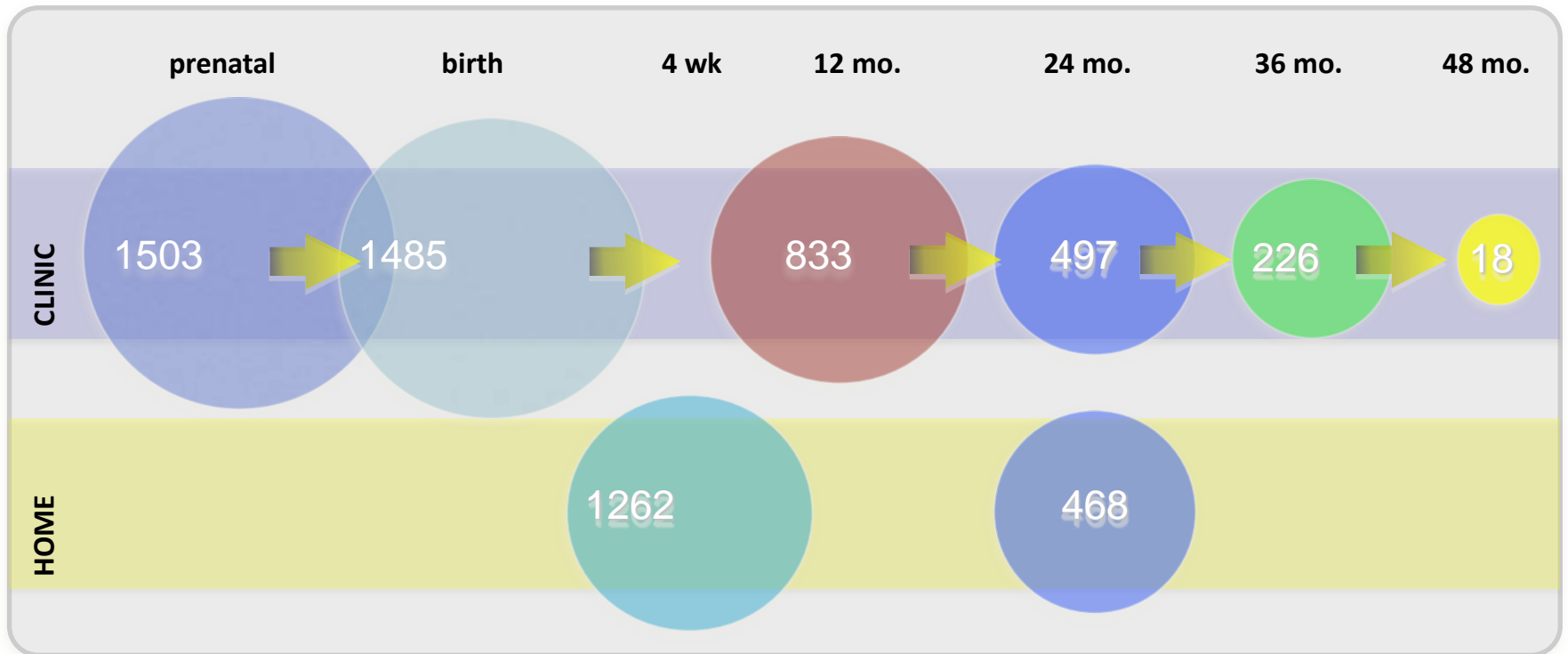
Maternal and Infant Measures by Visit

Measure	M1 16-26w	M2 27-42w	M3 Birth	HV1 4w	CV1 12m	CV2 24m	CV3 36 m
Demographics	X				X	X	X
Maternal							
Temperament	X					X	
Psychol Symptoms		X			X	X	X
Postnatal Depression				X	X		
Parenting Stress					X	X	X
Child Abuse Potential					X	X	X
Child			X		X	X	
Cognition & Lang					X	X	X
SE Development					X	X	X
Growth			X		X	X	X
Parent Child Interaction					X	X	X

Background

Child socioemotional (SE) development is a complex interaction of environmental, biological, social, cultural and community factors operating from preconception through childhood.

Poverty associated with stress, less effective parenting, decreased maternal responsiveness.
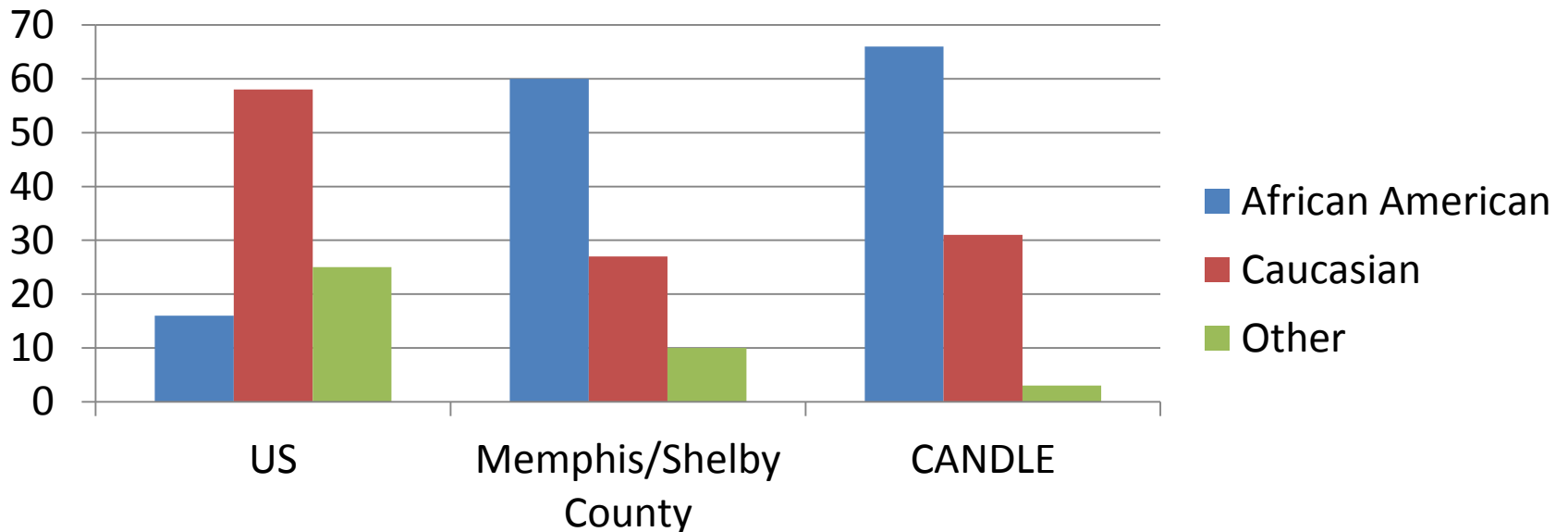
Depression associated with disengaged parenting.

SE competence is essential for a productive life as an older child and adult.

Objective

To examine maternal and child characteristics associated with maternal-reported child SE problems in 12, 24 and 36 month old African-American children living in urban-suburban areas.

Percent of Children by Race

Subjects

- 549 African American mother-infant dyads
  - 489 evaluated at 12 months of age
  - 290 evaluated at 24 months of age
  - 150 evaluated at 36 months of age

Dataset: September 30, 2011

Maternal Study Measures

- Maternal Demographics
  - Age, # of pregnancies
  - Education, marital, income, health insurance status
- Temperament Evaluation of the Memphis, Pisa, Paris, and San Diego (TEMPS) – 2nd tri, 24m
  - Temperament or personality styles
  - Cyclothymic scaled score
- Brief Symptom Index (BSI) – 3rd tri, 12m, 24m, 36m
  - Overview of psychological symptoms and their severity
  - Global symptom index

Maternal Study Measures

- Edinburgh Postnatal Depression Scale (EPDS) 4w, 12m
  - Total score
- Parenting Stress Index (PSI-SF) 12m, 24m, 36m
  - Parental Distress, Parent-Child Dysfunctional Interaction, Difficult Child, Total Score
- Child Abuse Potential Inventory (CAPI) 12m, 24m, 36m
  - CAPI abuse score

Child Study Measures

- Brief Infant Toddler Social Emotional Assessment (BITSEA)
  - Parent report
  - Possible SE Problem at 12 and 24 months (25%ile)
- Child Behavior Checklist at 36 months
  - Total Problem T-score ≥ 60 (~25%ile)
- Bayley Scales of Infant and Toddler Development - III
  - At 12 months: screener
  - At 24 and 36 months
    - Cognitive scaled score
    - Receptive, Expressive and Total Language scaled scores
- Parent Child Interaction Teaching Scale

Reported SE Problems

- BITSEA "possible problem"
  - 12 months: 36% (176/489)
  - 24 months: 33% (95/290)
- CBCL Total Problem T-score ≥ 60
  - 36 months: 21% (31/150)

Maternal Demographics Predicting Child SE Problems

- At 12 and 24 months:
  - Younger moms: 23y vs 25y
  - Lower income (<$5K): 27-31% vs 15-23%
  - Not graduating HS: 19-27% vs 11%
- At 36 months:
  - Lower income (<$5K): 45% vs 30%
  - No age or education effect

Maternal Behavioral Health

BSI Global Symptom Index at:	12m BITSEA Possible Problem Median (25%-75%)		p
	Yes	No	
Gestation	54 (47-59)	48.5 (42-55)	<.0001
12 months	51 (44-60)	45 (36-52)	<.0001

BSI Global Symptom Index at:	24m BITSEA Possible Problem Median (25%-75%)		p
	Yes	No	
Gestation	51 (44.5-59)	49 (42-56)	NS
12 months	51 (42-59)	46 (39-53)	0.0001
24 months	53 (42-59)	45 (36-52)	<.0001

Mothers reporting child SE problems had higher scores on a global measure of psychological symptoms concurrently and during the previous year

Maternal Behavioral Health

BSI Global Symptom Index at:	36m CBCL Total Problem T-Score ≥ 60 Median (25%-75%)		p
	Yes	No	
Gestation	51 (39-63)	50 (44-56)	NS
12 months	54 (42-60)	47 (41-55)	NS
24 months	56 (39-61)	46 (39-53)	.0353
36 months	53 (42-59)	44.5 (33-54)	.0176

Mothers reporting child SE problems had higher scores on a global measure of psychological symptoms concurrently and during the previous year

Maternal Temperament

TEMPS Cyclothymic Score	12m BITSEA Possible Problem Median (25%-75%)		p
	Yes	No	
during gestation	4 (1-6)	2 (1-4)	<.0001

TEMPS Cyclothymic Score	24m BITSEA Possible Problem Median (25%-75%)		p
during gestation	4 (2-7)	2 (1-4)	<.0001
At 24 months	3 (1-6)	1 (0-3)	<.0001

TEMPS Cyclothymic Score	36m CBCL Total Problem T-Score ≥ 60 Median (25%-75%)		p
during gestation	4 (2-6)	3 (1-5)	NS
At 24 months	5 (2-7)	2 (0-4)	.0093

Maternal Depression

EPDS score at:	12m BITSEA Possible Problem Median (25%-75%)		p
	Yes	No	
4 weeks	5 (2-9)	3 (1-6)	<.0001
12 months	5 (2-9)	2 (1-5)	<.0001

EPDS score at:	24m BITSEA Possible Problem Median (25%-75%)		p
4 weeks	5 (3-9)	3 (1-6)	0.0319
12 months	6 (2-10)	3 (1-6)	0.0059

EPDS score at:	36m CBCL Total Problem T-Score ≥ 60 Median (25%-75%)		p
4 weeks	8 (5-12)	3 (1-6)	.0003
12 months	7 (5-11)	3 (1-6)	.0008

Parenting Stress (PSI)

Total Stress percentile at:	12m BITSEA Possible Problem Median (25%-75%)		p
	Yes	No	
12 months	50 (10-80)	10 (1-35)	<.0001

Total Stress percentile at:	24m BITSEA Possible Problem Median (25%-75%)		p
12 months	50 (5-80)	15 (5-50)	0.0107
24 months	65 (20-90)	15 (5-55)	<.0001

Total Stress percentile at:	36m CBCL Total Problem T-Score ≥ 60 Median (25%-75%)		p
12 months	72.5 (10-90)	20 (5-60)	0.0164
24 months	75 (15-90)	15 (5-60)	0.0101
36 months	80 (45-95)	15 (5-60)	<.0001

Child Abuse Potential

Above cut score at:	12m BITSEA Possible Problem N (%)		p
	Yes	No	
12 months	47 (23)	37 (7)	<.0001

Above cut score at:	24m BITSEA Possible Problem N (%)		p
12 months	23 (25)	20 (7)	<.0001
24 months	32 (29)	26 (9)	<.0001

Above cut score at:	36m CBCL Total Problem T-Score ≥ 60 N (%)		p
12 months	9 (33)	12 (11)	.0047
24 months	9 (32)	15 (13)	.0163
36 months	14 (40)	20 (16)	.0015

Child Physical Characteristics

Variable	12m BITSEA Possible Problem		P
	Yes	No	
Gestational age, M(SD)	38.42 (2.20)	38.78 (1.71)	NS
Gender, n(%)			NS
• Female	82 (47)	154 (49)	
• Male	94 (53)	159 (51)	
Birth weight %ile, M(SD)	29.46 (23.67)	35.98 (26.22)	.007
Birth length %ile, M(SD)	48.13 (29.28)	54.16 (27.83)	.027

- Infants with reported SE problems at 12 months had **lower birth weight and length** percentiles.
- By 24 months, no differences in birth weight or length or gestational age were noted. Postnatal growth measured at 12, 24 or 36 months showed no significant group differences.

Child Developmental Status

Bayley-III Measure	12m BITSEA Possible Problem		p
	Yes	No	
Cognitive risk at 12m, N (%)	33 (18.8)	45 (14.4)	NS

Bayley-III Measure	24m BITSEA Possible Problem		p
Cognitive risk at 12m, N (%)	7 (9.3)	23 (13.8)	NS
Cogn Score at 24m Median	8 (7-9)	9 (7-10)	0.0141
Lang Score at 24m Median	16 (14-18)	17 (16-20)	0.0269

Bayley-III Measure	36m CBCL Total Problem T-Score ≥ 60		p
Cognitive risk at 12m, N (%)	2 (9)	18 (19)	NS
Cogn Score at 24m Median	8 (6-9)	8 (7-9)	NS
Lang Score at 24m Median	15 (12-18)	17 (14-19)	.0166
Cogn Score at 36m Median	8 (7-9)	8 (7-9)	NS
Lang Score at 36m Median	18 (16-20)	18 (16-20)	NS

Prediction of Possible SE Problems at 12m

Variable	Odds Ratio	95% CI	p
Total maternal stress at 12m	1.019	1.012-1.027	<.0001
Maternal age	0.954	0.916-0.994	.0235
Maternal MH symptoms at 12m	1.027	1.003-1.051	.0302
Cyclothymic score, gestation	1.087	1.006-1.175	.0347

Possible SE problems at 12 months were associated with:
- Maternal-reported **stress** at 12 months
- Maternal age **(older mothers reported less SE problems)**
- Maternal-reported **total mental health symptoms** at 12 months
- Maternal **cyclothymic temperament** reported during gestation

Prediction of Possible SE Problems at 24m

Variable	Odds Ratio	95% CI	p
Total maternal stress at 12m	1.022	1.012-1.032	<.0001
Cyclothymic score, gestation	1.224	1.096-1.368	0.0003
Maternal age	0.910	0.852-0.971	0.0044

Maternal-reported child SE problems at 24 months were associated with:
- Maternal-reported **stress** at 12 months
- Maternal **cyclothymic temperament** reported during gestation
- Maternal age **(older mothers reported less SE problems)**

Prediction of Possible SE Problems at 36m

Variable	Odds Ratio	95% CI	p
Maternal depression at 4w	1.185	1.042-1.347	0.0099
Abuse Score > cutoff at 12m	5.213	1.230-22.100	0.0250

Maternal-reported child SE problems at 36months were associated with:
- Maternal **depression** at 4 weeks
- Mothers attaining an **abuse score above cutoff levels** at 12 months

Parent Child Interaction

Parent Child Interaction Teaching Scale

- Observed parent-child interaction in teaching task

- 12m, 24m

- Parent and Child scales and subscales

Parent Child Interaction Teaching Scale

Caregiver Subscales

- Sensitivity to cues
- Response to distress
- Socioemotional growth fostering
- Cognitive growth fostering

- CAREGIVER TOTAL SCORE

Child Subscales

- Clarity of cues
- Responsiveness to caregiver

- CHILD TOTAL SCORE

PCI Teaching Scale – 12m

	BITSEA Possible Problem at 12 m M (SD)		p
	Yes	No	
Caregiver subscales			
•Sensitivity to cues	8.24 (1.54)	8.05 (1.50)	.200
•Response to distress	8.63 (2.01)	9.08 (1.80)	.017
•SE growth fostering	7.61 (1.93)	7.77 (1.69)	.350
•Cognitive growth fostering	10.43 (2.91)	10.62 (2.75)	.484
Caregiver total score	34.91 (6.28)	35.53 (5.75)	.297
Child subscales			
•Clarity of cues	9.19 (.95)	9.12 (.95)	.484
•Responsiveness to caregiver	9.46 (2.38)	9.12 (2.36)	.155
Child total score	18.65 (2.99)	18.25 (2.99)	.177
Caregiver/child total score	53.56 (7.44)	53.77 (6.81)	.758

Mothers reporting possible SE problems at 12 months had lower response to distress scores.

PCI Teaching Scale – 24m

	BITSEA Possible Problem at 24m M (SD)		p
	Yes	No	
Caregiver subscales			
•Sensitivity to cues	8.31 (1.43)	8.45 (1.41)	.461
•Response to distress	7.95 (2.66)	8.95 (2.10)	.003
•SE growth fostering	7.36 (1.95)	7.76 (1.95)	.130
•Cognitive growth fostering	10.64 (2.68)	11.39 (2.60)	.036
Caregiver total score	34.27 (6.18)	36.55 (6.11)	.006
Child subscales			
•Clarity of cues	9.08 (1.18)	8.77 (1.36)	.072
•Responsiveness to caregiver	9.13 (2.67)	8.83 (2.25)	.358
Child total score	18.22 (3.47)	17.60 (3.07)	.156
Caregiver/child total score	52.48 (7.40)	54.15 (7.07)	.086

Mothers reporting possible SE problems at 24 months had lower response to distress, cognitive growth fostering, and caregiver total scores.

PCI Predicting Possible SE Problems at 12m

Variable	Odds Ratio	95% CI	p
Maternal education			0.026
< high school vs. college degree+	2.872	1.328-6.208	0.007
High school vs. college degree+	1.996	1.065-3.741	0.031
Maternal sensitivity to cues 12 mo	1.151	1.003-1.320	0.045
CAPI rigidity scale at 12 mo	1.020	1.006-1.034	0.006

With introduction of Parent-Child Interaction Teaching Scale scores, maternal-reported child SE problems at 12 months were associated with:
- Maternal **education**
- Less than **high school vs. college/professional** degree
- **High school/GED/technical school vs. college/professional** degree
- **Maternal sensitivity to child cues** during observed interaction 12 mo
- Maternal-reported **potential for abuse, rigidity** subscale at 12 mo

PCI Predicting Possible SE Problems at 24m

Variable	Odds Ratio	95% CI	p
Maternal depression at 4 weeks	2.639	1.158-6.013	0.021
CAPI rigidity scale at 24 mo	1.028	1.009-1.048	0.004
Response to distress at 24 mo	0.878	0.047-.878	0.047

With introduction of Parent-Child Interaction Teaching Scale scores, maternal-reported child SE problems at 24 months were associated with:
- Maternal-reported **depression** at 4 weeks
- Maternal reported **potential for abuse, rigidity** subscale at 24 months
- Maternal **response to child's distress** during observed parent-child interaction at 24 months

Conclusions

- In a predominantly low income African-American population, regression models show that **parenting stress, younger maternal age, behavioral symptoms** during gestation, and **maternal depression** during the child's first year, are associated with child SE problems during the first 3 years.

- Reported child SE problems are associated with **risk for abuse**.

- Maternal behavioral health factors may mediate or moderate more direct effects of parent-child interaction on SE development.

- There is a need to evaluate early opportunities to prevent child SE problems.

Future Analyses in SE/Cognitive Development

- Observations of parent-child interaction complementing reported SE outcomes – C. Graff
- Interactions? e.g. depression with social support, family discord, race? – N. Williams
- What factors influence cognitive development?
- What are specific developmental trajectories of risk and resiliency? Structural equation modeling and related analyses are planned.
- Is stress a mediator? How does stress "get under your skin?"
  - Cortisol measures in mother and child – S. Anand

Ancillary Investigations

- Diet and cognition: E. Voelgyi, M. Hare
- Feeding practices and growth: N. Williams, M. Hare
- Sleep patterns: G. Beeman, M. Hare, G. Presbury
- Folate intake and asthma: K. Carroll, Vanderbilt; C. Piyathilake, UAB
- Genetics
  - GWAS and phenotyping database: R. Williams
  - Methylation studies: J Krushkal, R. Adkins
  - Paternal genetics: R. Williams
- Body composition, physical activity and executive function (MEG): E. Voelgyi
- Insulin-like growth factor, genetics and growth: R. Ferry
- Dental caries in mothers and children: L. Hong

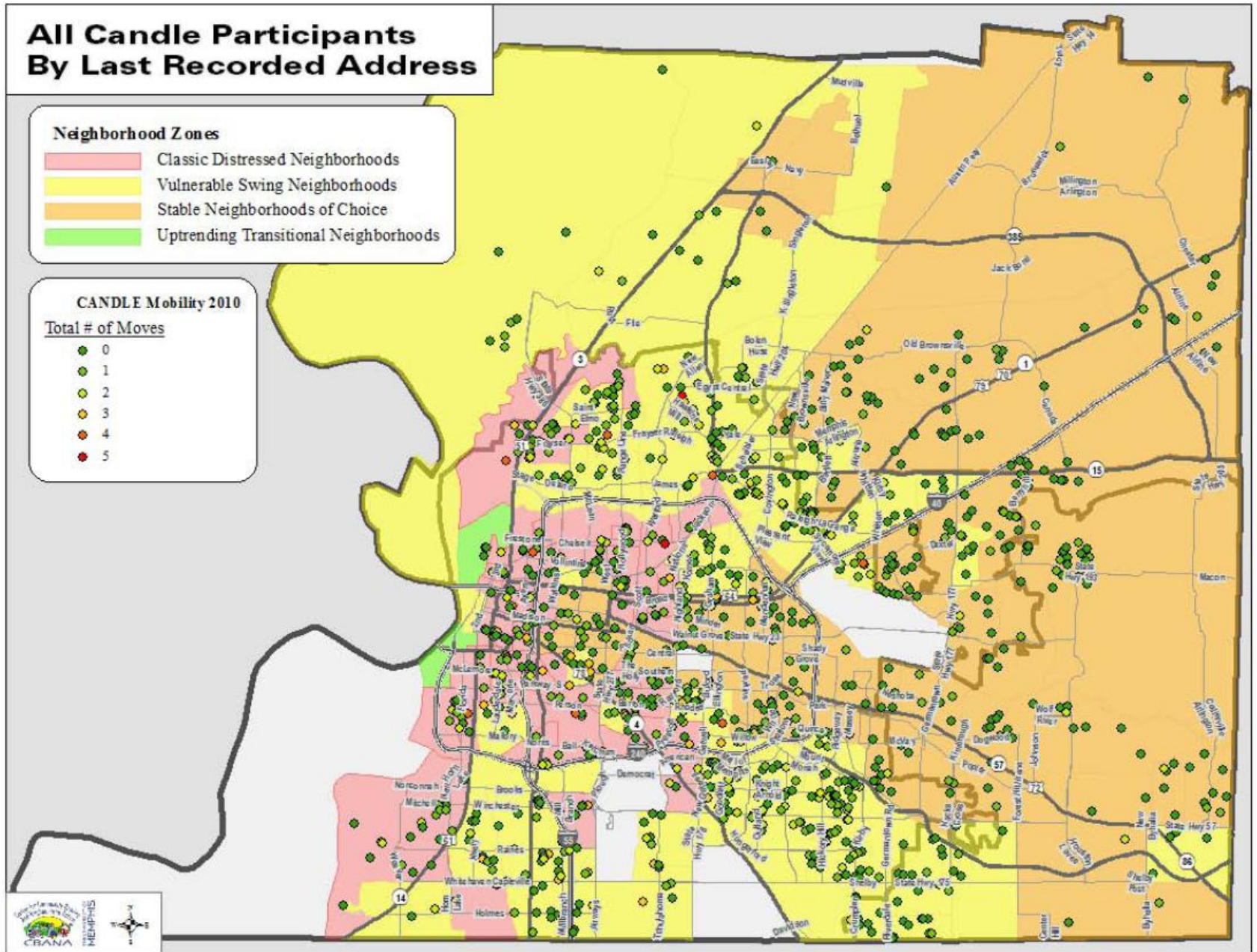# All Candle Participants By Last Recorded Address

Neighborhood Zones

- Classic Distressed Neighborhoods
- Vulnerable Swing Neighborhoods
- Stable Neighborhoods of Choice
- Uptrending Transitional Neighborhoods

CANDLE Mobility 2010

Total # of Moves

- 0
- 1
- 2
- 3
- 4
- 5

Implications for Intervention: Preschool models

- **Perry Preschool studies (1963-2005)**
  - Improved outcomes across lifespan
    - Ready for school @ 5y
    - High school graduation rate
    - Less crime as adults
    - Better health and family relations
  - Large return on investment 17:1

  Schweinhart, et al., 1993, 2005

- **Chicago Longitudinal Study (1979-2011)**
  - Improved outcomes across lifespan
    - High school graduation rate
    - Higher SES
    - Less substance abuse
   - Less arrests
  - Greatest benefits
    - Mothers < HS ed
    - Males

  Reynolds et al. ,2011

Implications for Intervention: Home visiting models

- Nurse-Family Partnership, Memphis
  - Mothers, 12 years later
    - Less role impairment due to alcohol and drug use
    - Longer partner relationships
    - Greater "sense of mastery"
    - Less food stamps and TANF expenditures
  - Child at age 12
    - Less tobacco, alcohol and marijuana use
    - Less internalizing behavior problems
    - Better academic achievement

Olds, et al., 2010; Kitzman, et al., 2010

Rates of return to human capital investment

Heckman, Science 2006
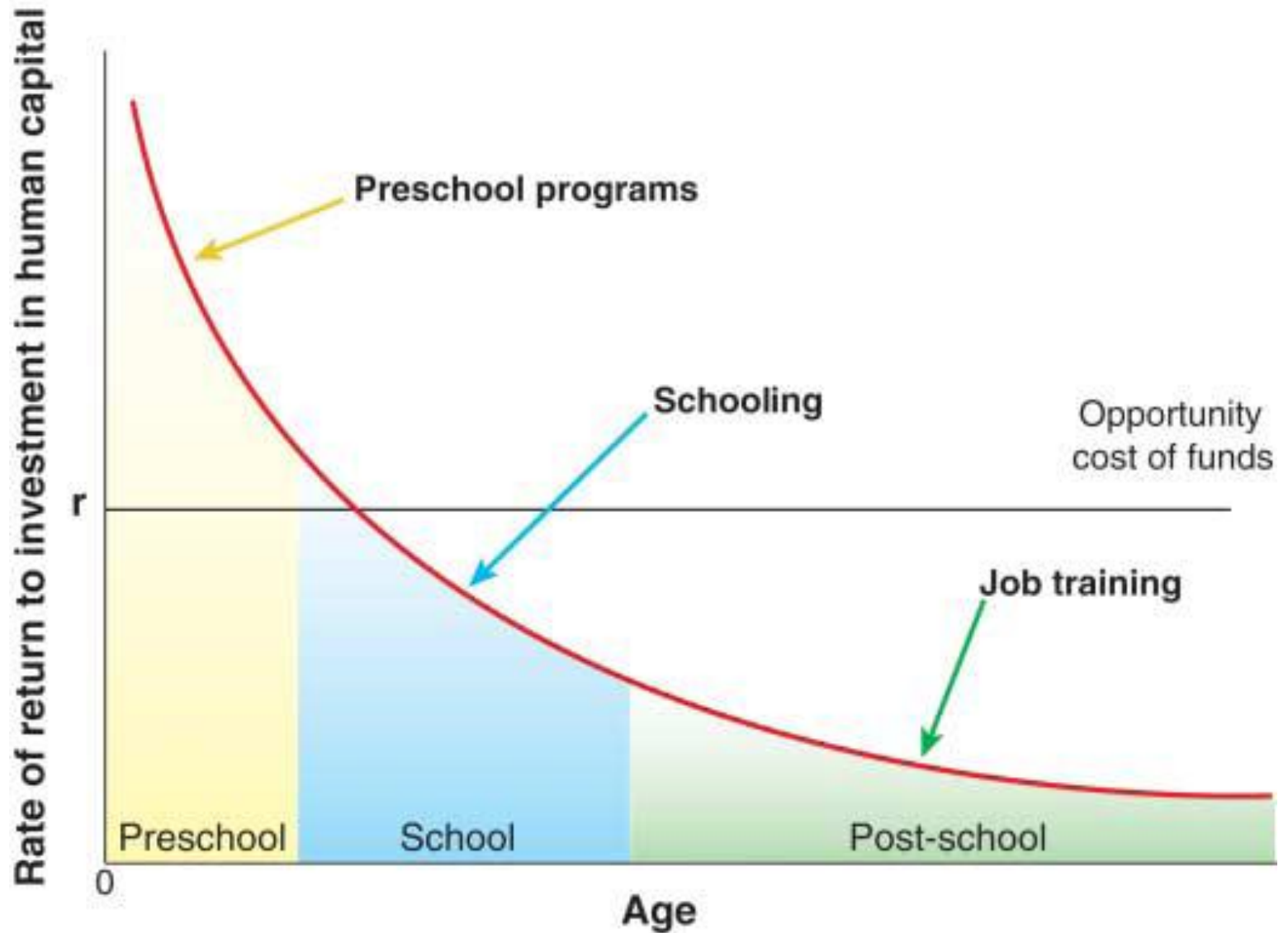
Thank you CANDLE Investigators, Examiners, Staff and Collaborators

- University of Tennessee Health Science Center
  - College of Medicine
    - Preventive Medicine
    - Pediatrics
    - Boling Center for Developmental Disabilities
  - College of Nursing
- The Urban Child Institute
- University of Memphis

- Regional Medical Center
- Vanderbilt University
- University of Alabama, Birmingham
- Tulane University
- Texas Tech University
- University of North Carolina, Charlotte
- University of Montreal

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