Predicting growth in reading skills from change in white matter properties in children born preterm and full term

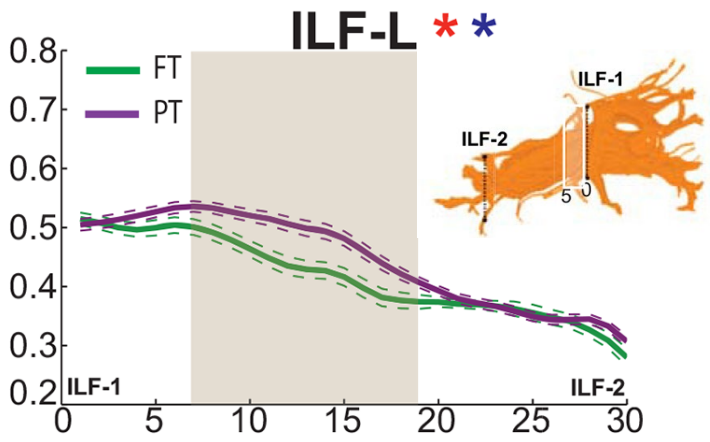
DEPARTMENT OF PEDIATRICS MEETING

THURSDAY, MAY 20

LISA BRUCKERT, PHD

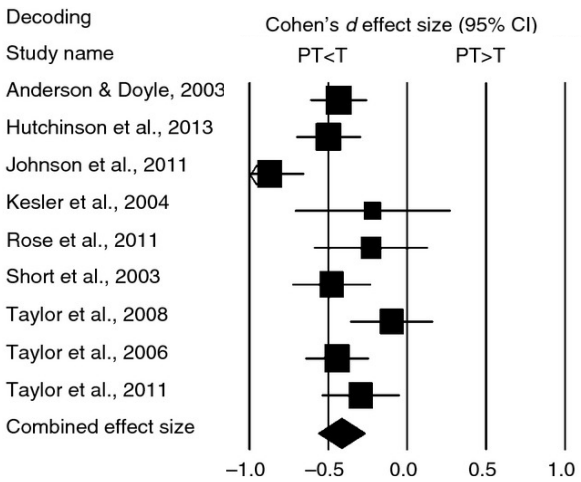
Stanford MEDICINE

Background



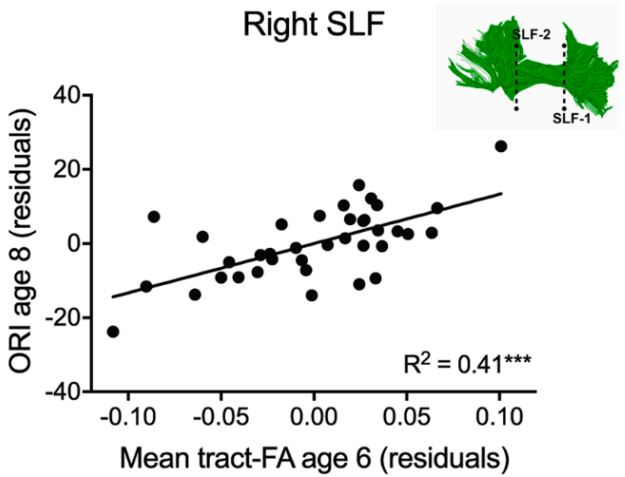
Travis et al., 2015

- Differences in white matter characteristics between children born PT and full-term (FT) persist to school age.



Kovachy et al., 2014

- Children born PT also show poorer reading skills than their age-matched FT peers.



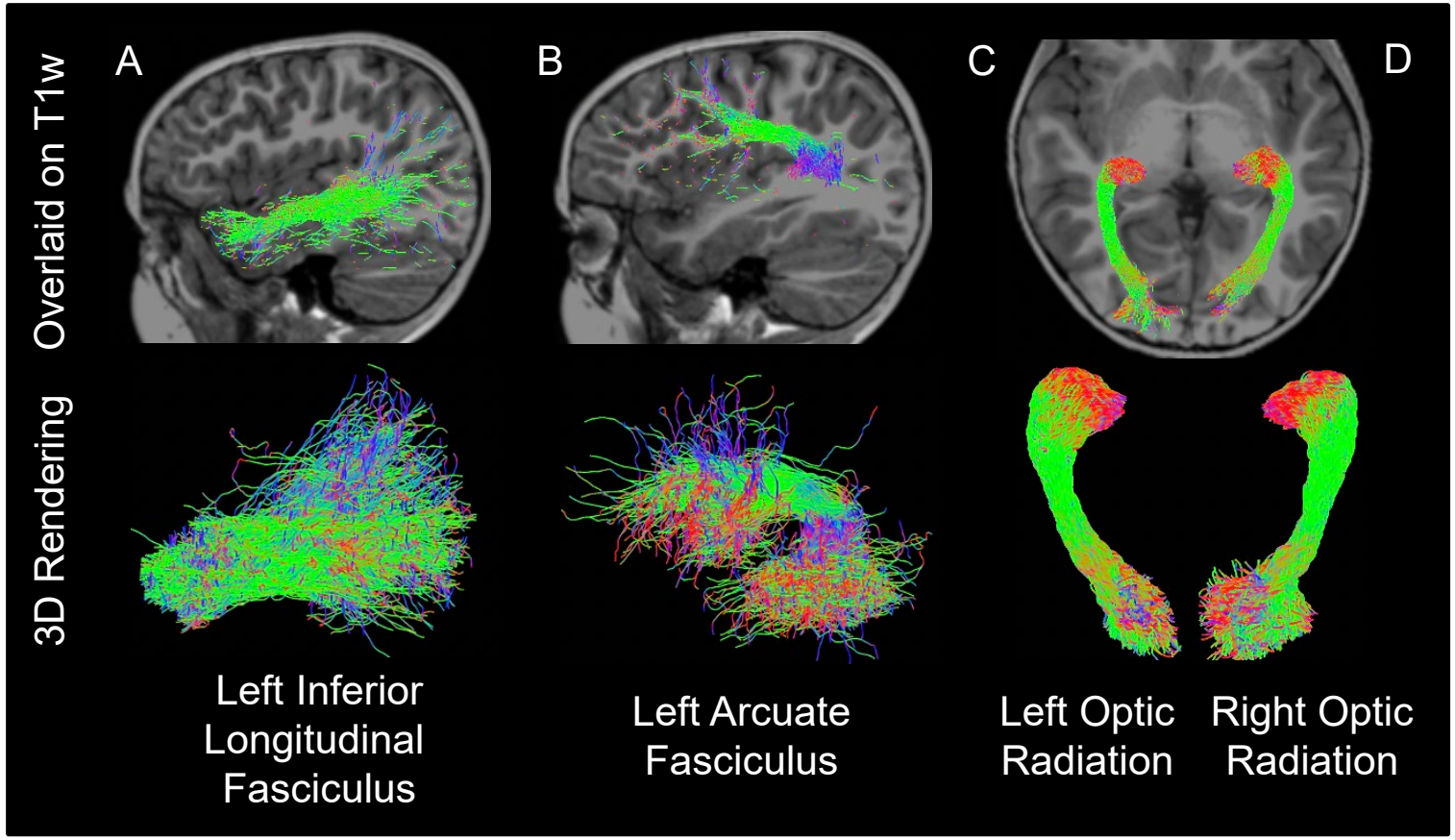
Borchers et al., 2018

- White matter tracts have been implicated in the neurobiology of reading development.

Stanford MEDICINE

Objective

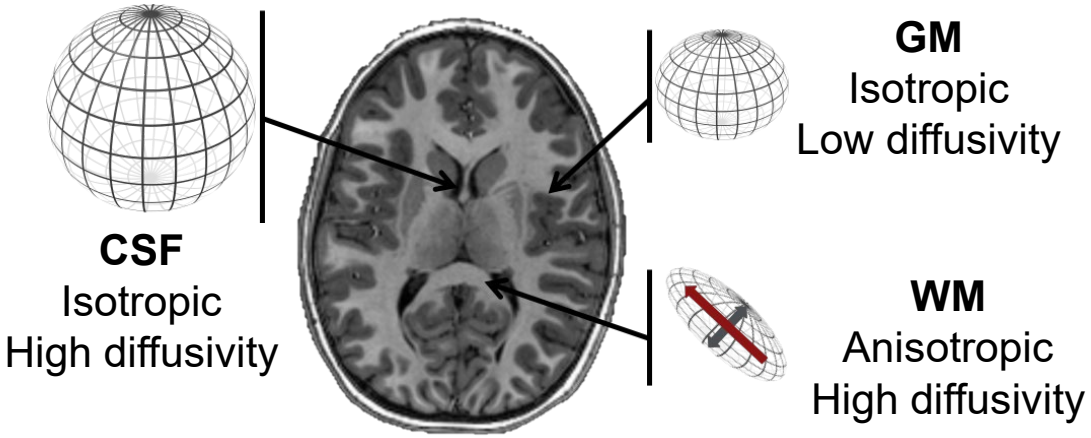
To determine if change in the characteristics of white matter tracts from age 6 to 8 years predicts reading growth in children born PT and FT during the same period.

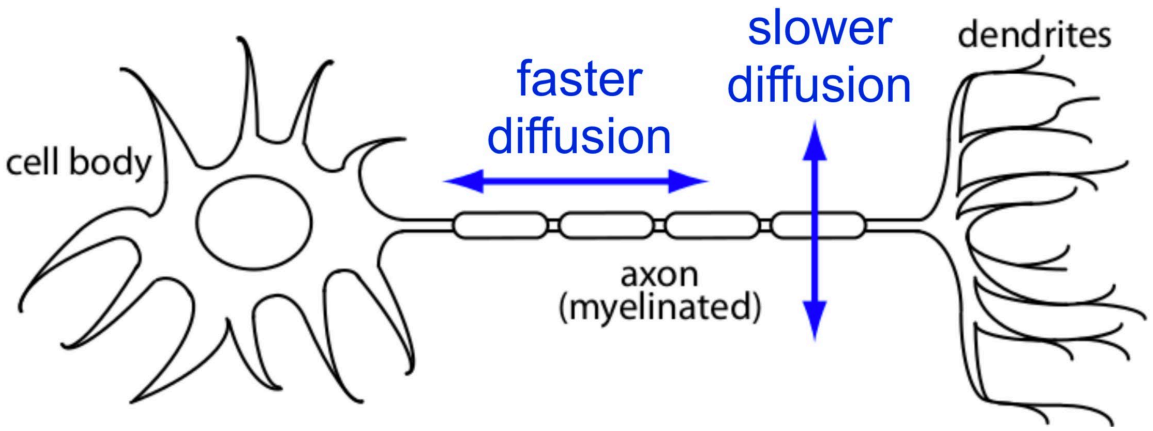


Stanford MEDICINE

Methods: Diffusion MRI

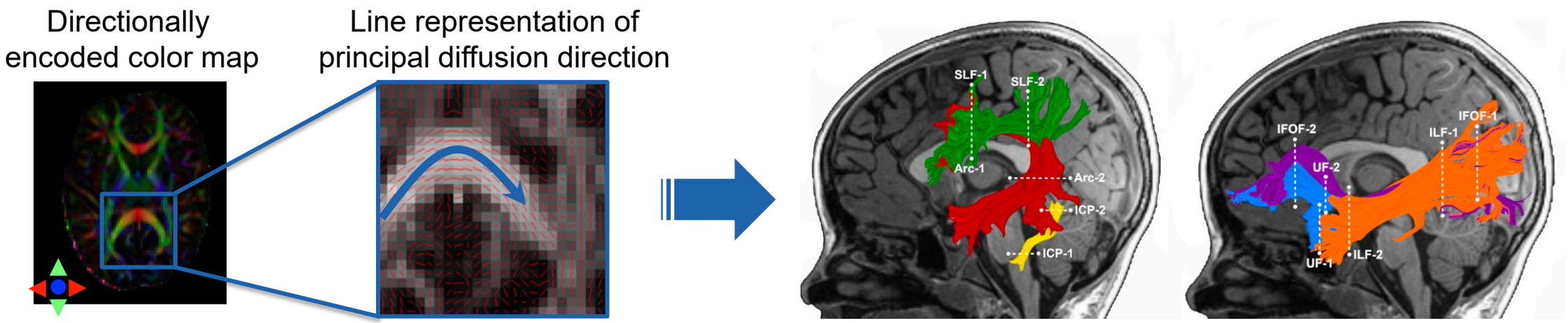
- Diffusion MRI is a specific MRI sequence sensitized to movement of water molecules.
- Patterns of water diffusion in white matter reflect the tissue microstructure: Fractional anisotropy (FA) quantifies how strongly directional the diffusion of water molecules is.





Stanford MEDICINE

Methods: Diffusion MRI Tractography



- The main diffusion direction relates to the direction of fiber orientations and can be used for fiber tracking.
- An automated probabilistic tractography pipeline was used to identify in each child our four tracts of interest: left inferior longitudinal fasciculus, left arcuate fasciculus, and the left and right optic radiation.

Stanford MEDICINE

Methods: Study Design

PT birth < 32 weeks gestational age

FT birth ≥ 37 weeks gestational age

<u>Exclusion:</u>
Neurological/Medical conditions (other than prematurity or its complications) that might impact learning to read.

Visit 1: 6 years

Neurocognitive:
IQ, Language & Reading

MRI:
Diffusion (96dir, b=2500)

Visit 2: 7 years

Neurocognitive:
Reading (WRTM-III)

Visit 3: 8 years

Neurocognitive:
IQ, Language & Reading

MRI:
Diffusion (96dir, b=2500)

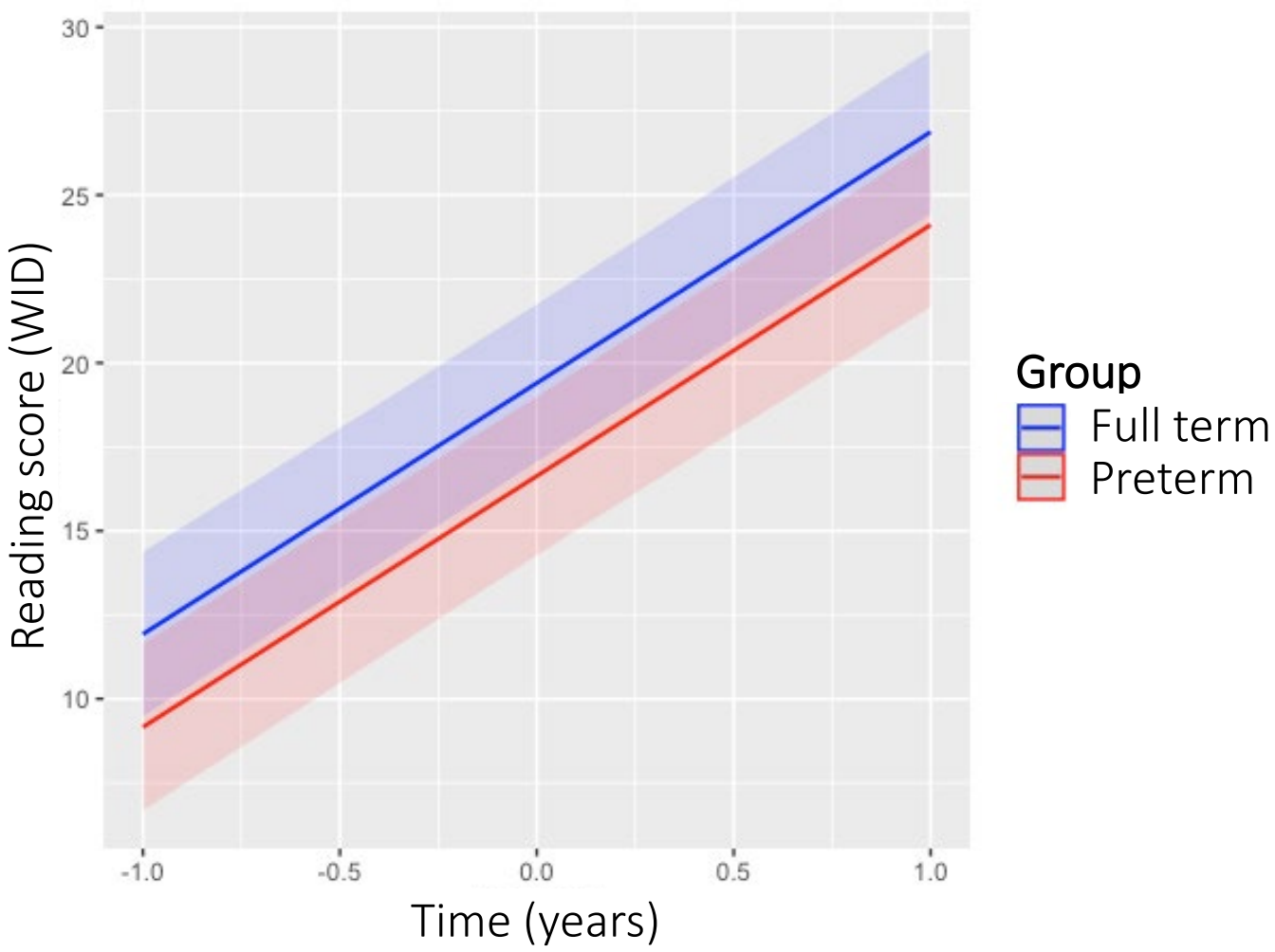
Stanford MEDICINE

Results: Cohort Characteristics

N = 68	Preterm (n = 34) N (%) or M (SD)	Full term (n = 34) N (%) or M (SD)	t or X^2	p-value
Demographics				
Male	22 (64.7)	16 (47.1)	2.15	.143
SES	54.6 (12.6)	58.8 (10.1)	-1.50	.138
GA (weeks)	29.6 (2.50)	39.5 (1.54)	-19.6	**< .001**
Birthweight (grams)	1323 (501)	3361 (447)	-17.7	**< .001**
Age at time 1	6.17 yrs (2.27 mon)	6.20 yrs (2.26 mon)	-0.80	.429
Age at time 2	7.17 yrs (2.44 mon)	7.14 yrs (1.72 mon)	0.86	.392
Age at time 3	8.22 yrs (2.32 mon)	8.16 yrs (1.99 mon)	1.33	.188
Reading proficiency				
WID at time 1	8.33 (8.74)	12.4 (10.4)	-1.63	.109
WID at time 2	16.9 (7.22)	19.6 (8.02)	-1.44	.156
WID at time 3	24.6 (5.06)	26.2 (6.92)	-1.10	.275

Stanford MEDICINE

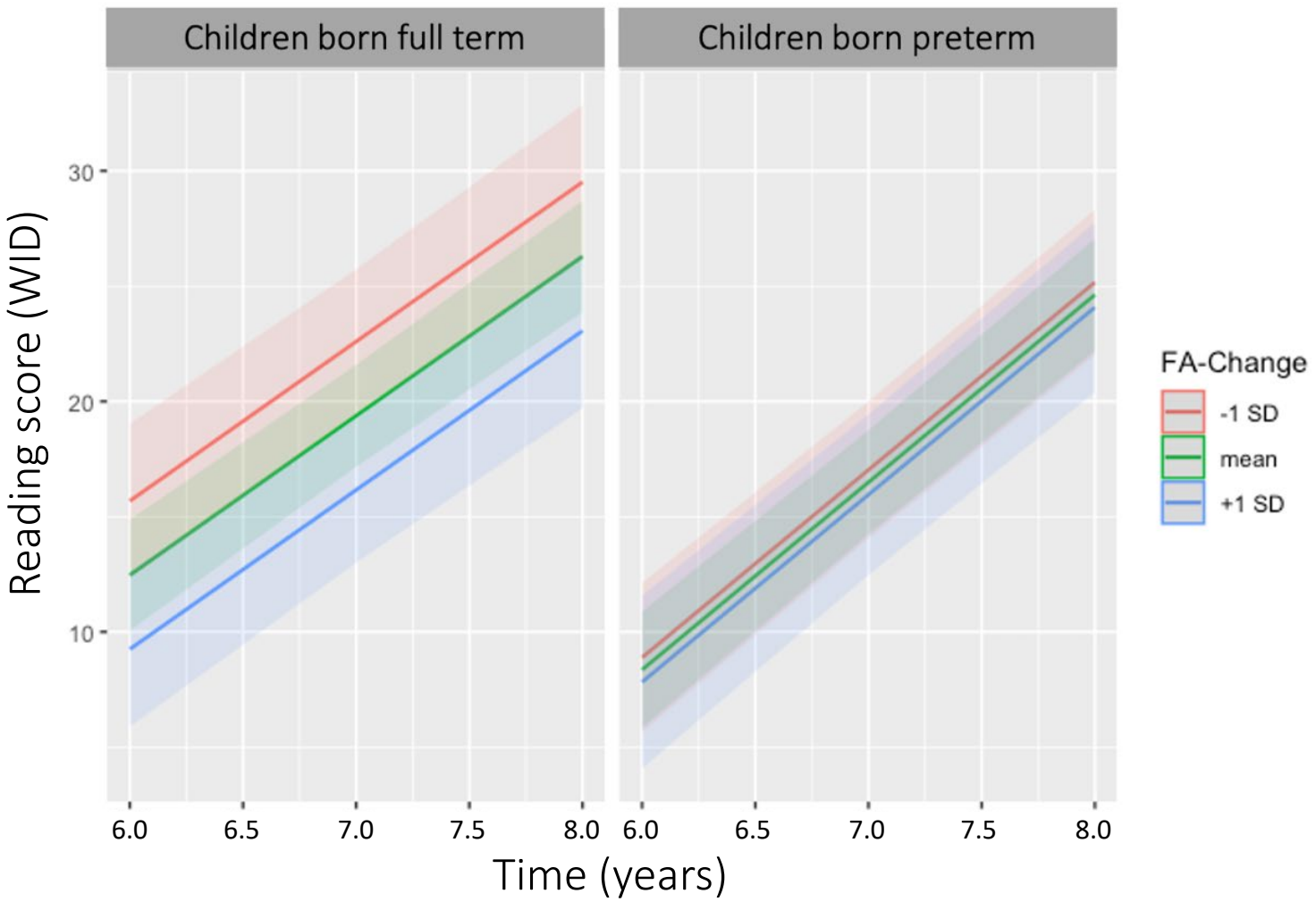
Results: Reading Growth



- **Model 1:** Time and birth group were entered as fixed factors to examine reading growth as indexed by WID.
- Reading scores increased over time in both birth groups ($p<.001$).
- PT group did not significantly differ from FT group in overall reading scores ($p=.108$).

Stanford MEDICINE

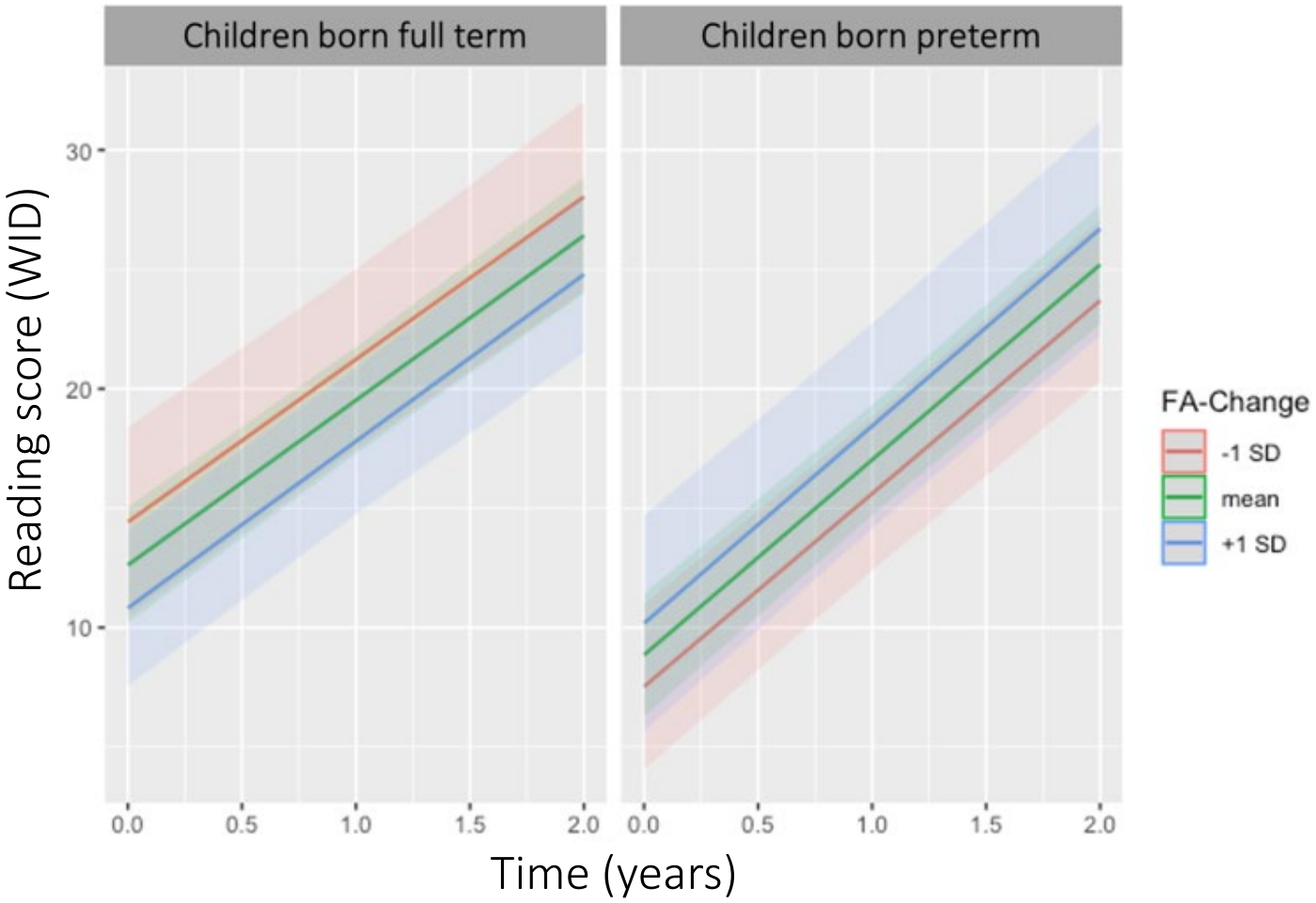
Results: Left ILF



- **Model 2A:** FA-change in the left ILF from age 6-8 years was added as a fixed factor.
- Variation in FA-change was associated with reading growth (*p*=.006).
- Relation between FA-change and reading growth was marginally stronger in the FT than PT group (p=.090).

Stanford MEDICINE

Results: Left OR

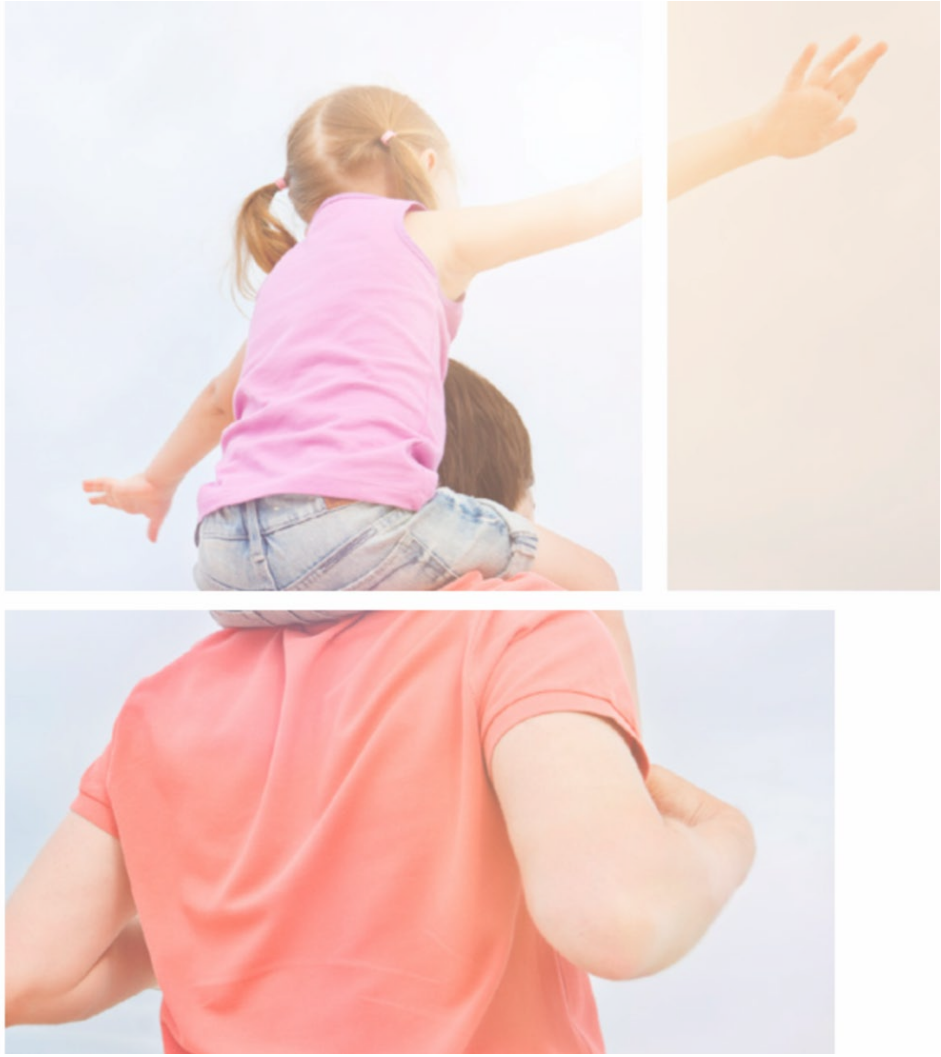


- **Model 2B:** FA-change in the left OR from age 6-8 years was added as a fixed factor.
- Variation in FA-change was associated with reading growth (*p*=.008).
- FA decrease was associated with reading growth in the FT; FA increase was associated with reading growth in the PT group (p=.070).

Stanford MEDICINE

Conclusions

- Children born FT and PT improve in reading from age 6 to 8 years.
- Associations of white matter change and growth in reading appeared to be different in the two groups; if this result is replicated in larger samples this would suggest that patterns of neurobiological prediction of reading development are different in children born FT and PT.
- Associations of FA decrease with reading growth may indicate changes in axonal diameter in FT children, while associations of FA increase with reading growth may indicate changes in myelination or fiber coherence in PT children.



Stanford MEDICINE

THANK YOU

FOR YOUR ATTENTION.

THANK YOU TO MY MENTORS & THE DBP RESEARCH TEAM

HEIDI M. FELDMAN, MD, PHD

KATHERINE E. TRAVIS, PHD

VIRGINIA MARCHMAN, PHD

STANFORD MATERNAL & CHILD HEALTH RESEARCH INSTITUTE

Stanford Children's Health

Stanford MEDICINE