Dual-Centered ANCOVA with Interaction: A Solution for Lord's Paradox . . In Longitudinal Analyses

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Outline

- Can't test Tx X Pretest Interaction in Diffs-in-Diffs
  - . . . Without changing it to ANCOVA
- Dual-centering data produces robust estimates of original diff-score Tx estimate
- ANCOVA of dual-centered data can then test Tx X Pretest Interaction in a diffs-in-diffs model

Tx X Pretest interactions in diffs-in-diffs

- To my knowledge, no accepted way to test Pretest X Tx interactions in diffs-in-diffs
  - Adding interaction requires
  - Adding Pretest as main effect
  - . . . which changes Tx effect to ANCOVA

Pseudo-Robustness #1

- $Y_2 - Y_1 = \gamma_0 + \gamma_1 X_1 + e$ (diffs-in-diffs)
- $Y_2 = b_0 + b_1 X_1 + b_2 Y_1 + e$ (ANCOVA)
- $Y_2 - Y_1 = \gamma_0 + \gamma_1 X_1 + \gamma_2 Y_1 + e$ (combined)
- $Y_2 = \gamma_0 + \gamma_1 X_1 + (1+\gamma_2) Y_1 + e$
  - Adding pretest makes $\gamma_1 = b_1$
    - $b2 = 1+\gamma 2$
- Must add pretest to diffs-in-diffs to test Pretest X Tx interaction.

ANCOVA of dual-centered data

- Centering all data on pretest group means
  - Keeps each person's diff-score the same
  - ANCOVA and diffs-in-diffs produce robust Tx estimates
    - But . . . Same as diffs-in-diffs before centering
- ANCOVA of dual-centered data can
  - Estimate diffs-in-diffs Tx effects AND
  - Test Tx X Pretest interactions in diffs-in-diffs with Pretest as a main effect

Example

- Therapy for depression on change in depression over next 4 years (FFCW data)
  - *N* = 3285
  - Depression severity: 13-point scale from Composite Internat'l Dx Interview (short form)
- Data from both waves centered on pretest group means (therapy vs. not)

Results

- Standard ANCOVA: Therapy makes depression worse (b_1 = 1.74 ***)
- Standard diffs-in-diffs & Dual-Centered ANCOVA → depression decreases more for Tx than for Controls (d_1 = -2.31***)

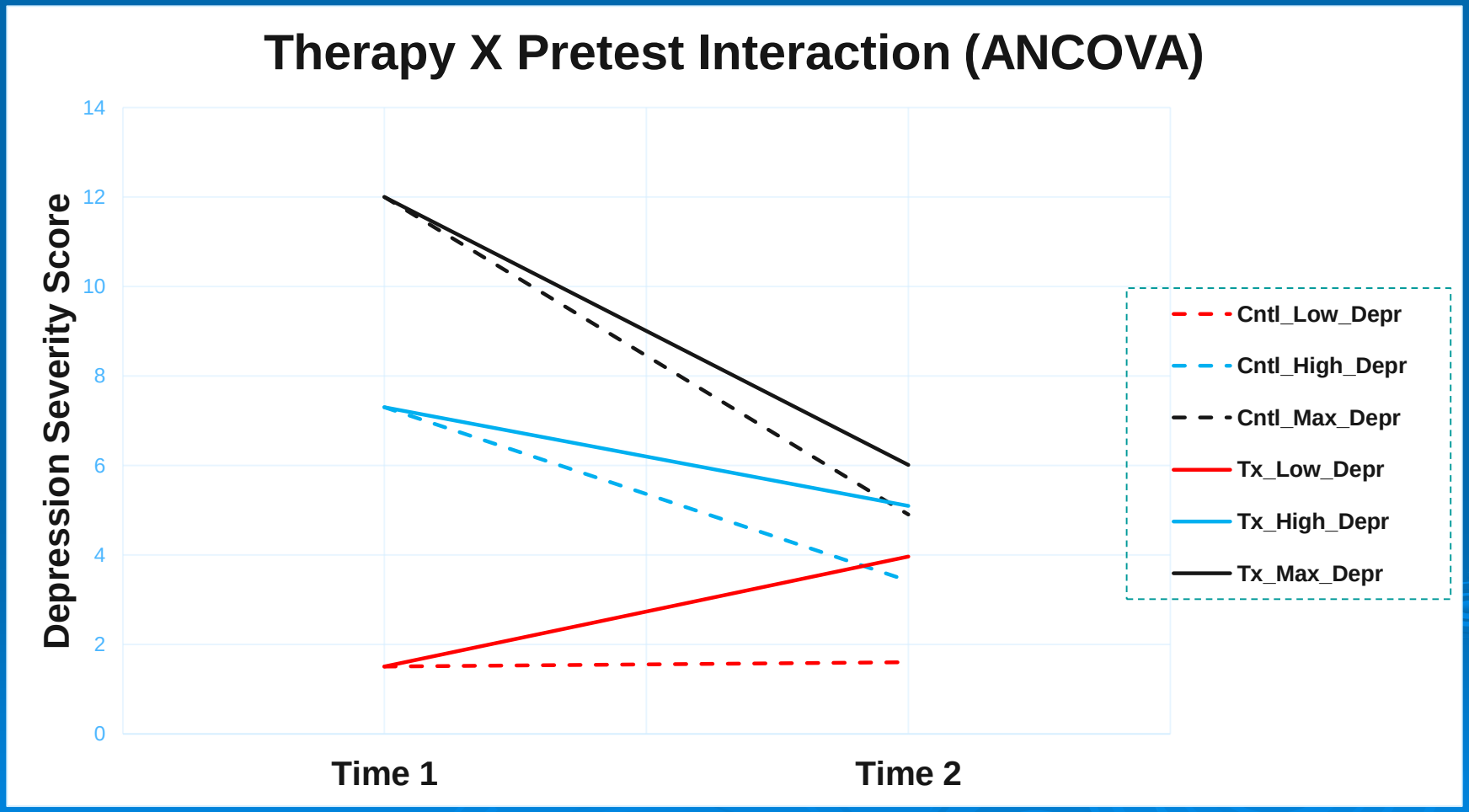
Diffs-in-diffs, ANCOVA, & DC-ANCOVA of Tx for Depression

	Diff-scores	ANCOVA		
	d_1	b_1	b_3 (TxXPre)	$t(b_3)$
Without Tx X Pre				
Original data	-2.31***	1.74****		
Centered data	-2.31***	-2.30***		
With Tx X Pretest				
Original data		2.54*	-.12*	-2.12
Centered data		-2.30***	-.12*	-2.12

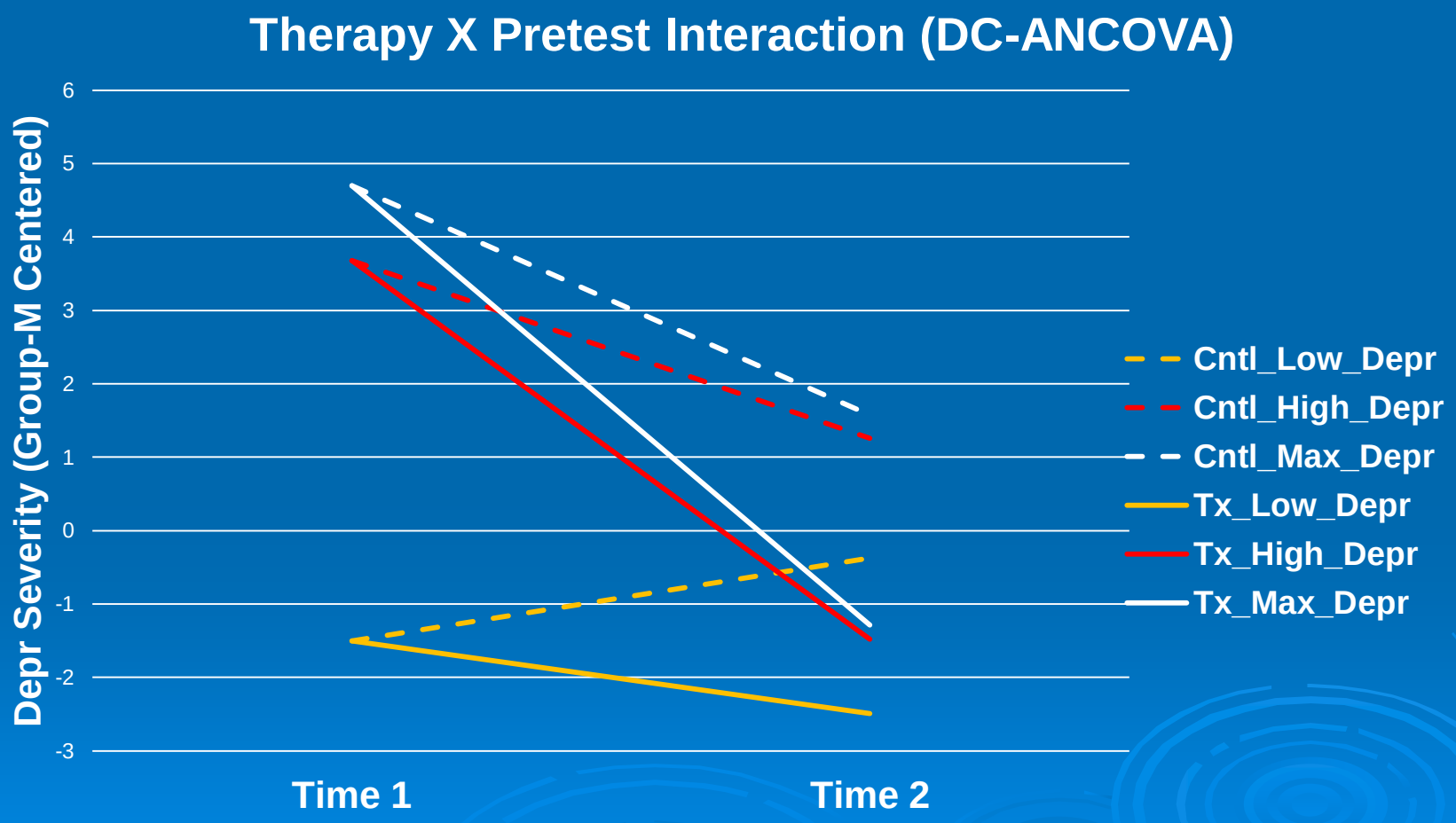
Conclusions

- ANCOVA biased against Tx
- Diffs-in-diffs makes Tx look effective
- Tx X Pretest test identical in 2 ANCOVA's
- Testing Tx X Pretest interaction in diffs-in-diffs changes model to ANCOVA bias
- Testing Tx X Pretest interaction in dual-centered ANCOVA retains Tx estimates from diffs-in-diffs

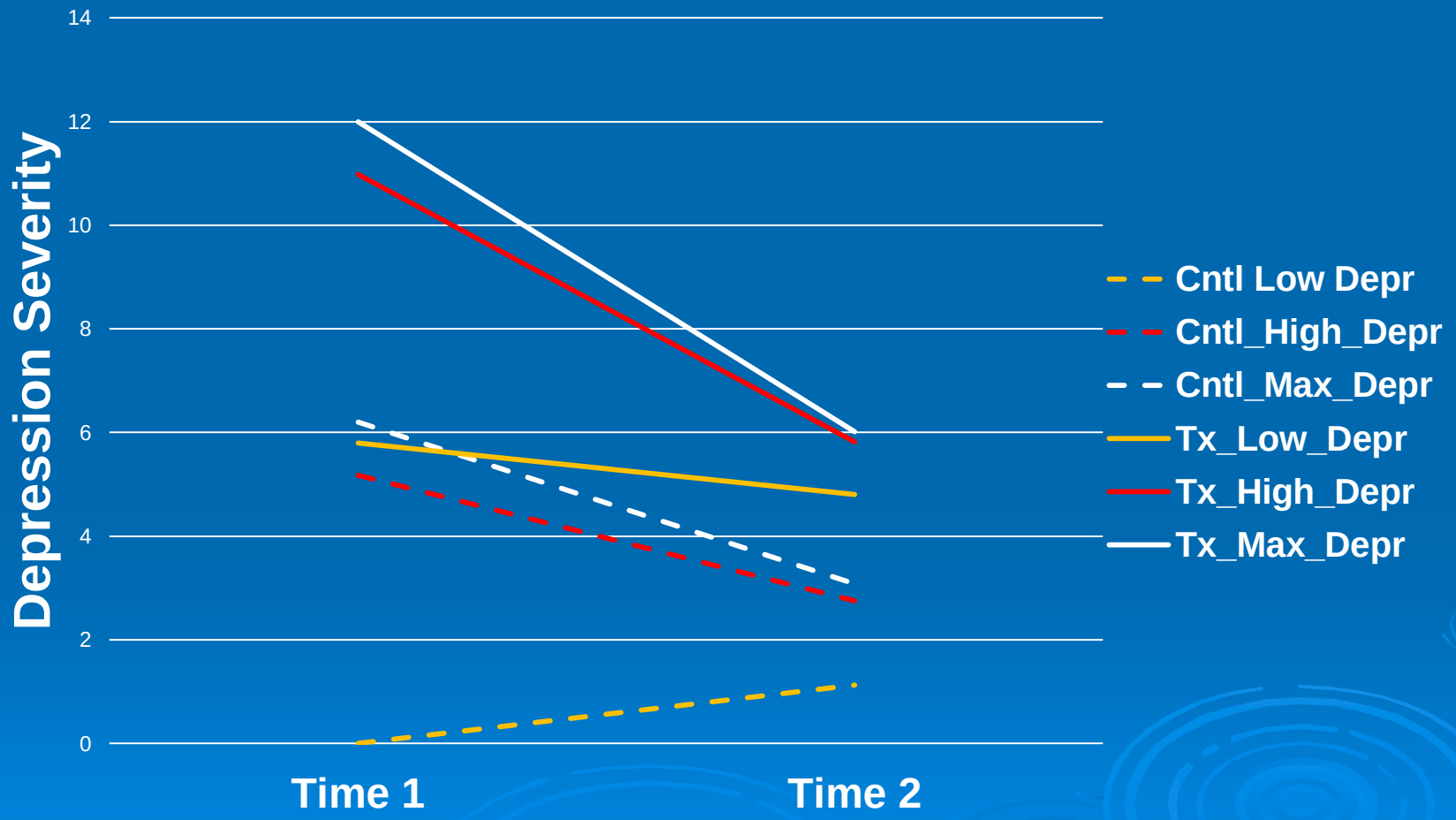
Tx X Pretest (ANCOVA)



Tx X Pretest (DC-ANCOVA)



Tx X Pretest (Diffs-in-Diffs)



Conclusions

- Dual-Centered ANCOVA can test a Tx X Pretest Interaction in diffs-in-diffs
  - Use pick-a-point to interpret the interaction
    - In dual-centered data
    - In original data
  - No bias in *se* of Tx x Pretest interaction

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Thank You