

High School Start Times and Teenage Driver Crashes

Robert Foss, PhD

Director, Center for the Study of Young Drivers
Highway Safety Research Center
University of North Carolina – Chapel Hill

10th International Conference on Managing Fatigue
San Diego, CA
March 20, 2017

Drowsy driving crashes

~ 4% of all U.S. crashes

NHTSA CDS (2000-2003)

Drivers < 25, majority of NC drowsy crashes

Pack et al (1995)

Drivers < 21 heavily overrepresented, U.S.

6% of drivers, 20% of drowsy crashes

NHTSA (2005)



Adolescent sleep phase shift

Circadian rhythms change in adolescence

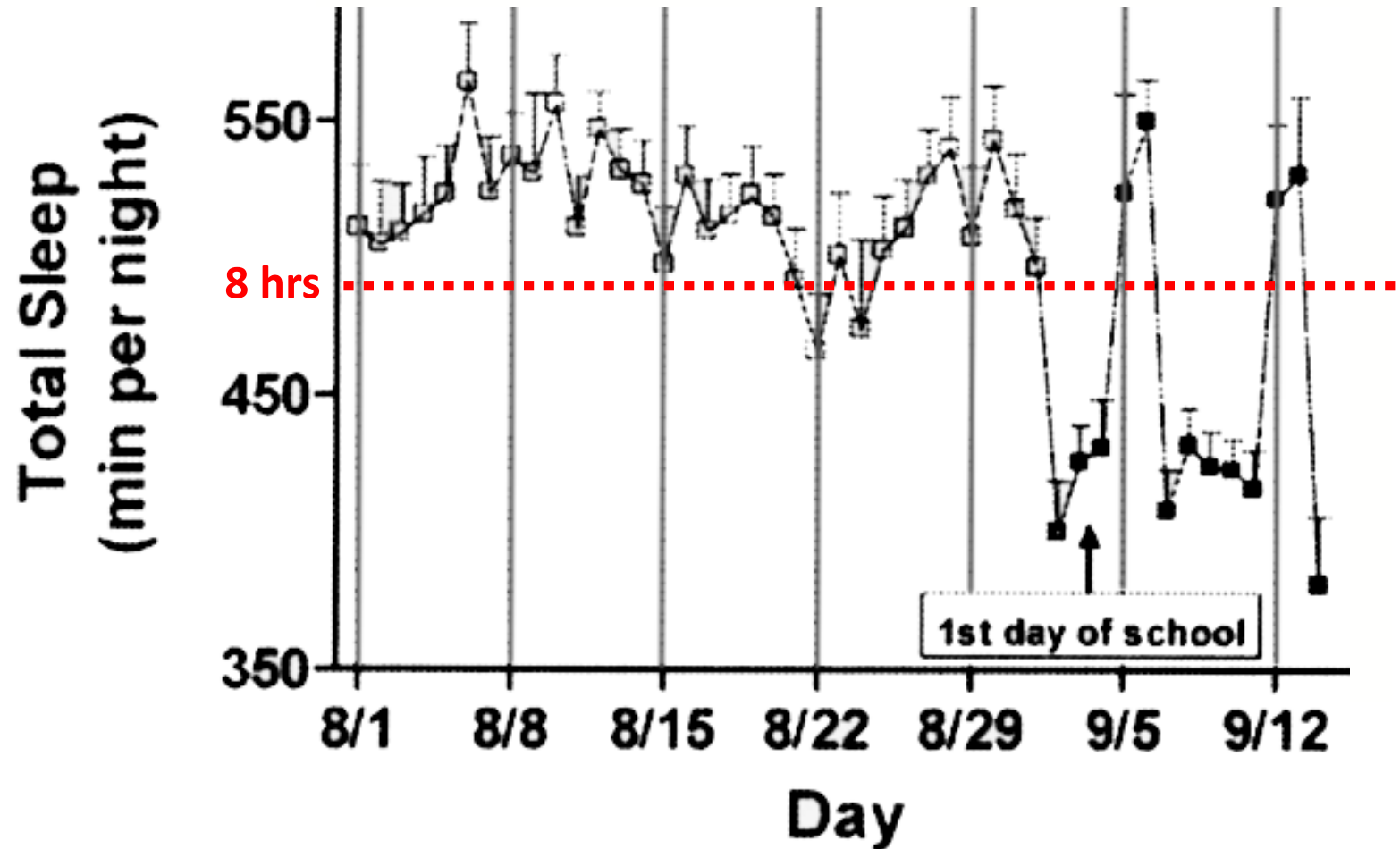
Unavoidable biological process

Need to be asleep from 6-7 a.m.

Early school start interferes



School disrupts teen sleep



Community adaptation

Many have adjusted H.S. start time

Improved academic performance

Decreased disruptive behavior

Decreased motor vehicle crashes

Kentucky – Danner & Phillips (2008)

Virginia – Vorona et al. (2011)

Methodologic problems



The North Carolina study

Forsyth County (pop. ~320,000)

Altered school start time 7:30 → 8:45 a.m.

All public high schools (8) in county

August 2003

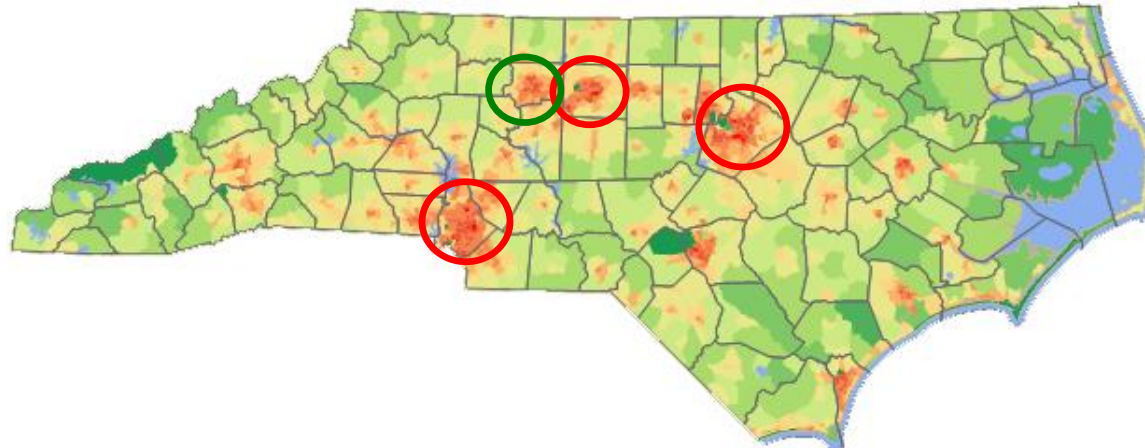
3 comparison counties

No change in start times

Study design

Intervention + 3 comparison counties

County	N	Fall 2003 Enrollment	Original start time	New start time
Forsyth	8	12,500	7:30 am	8:45 am
Guilford	14	18,150	8:40 am	Same
Mecklenburg	15	27,950	7:15 am	Same
Wake	16	28,150	7:36 am*	Same



The North Carolina study

Data sources

NC Crash data file – Jan. 2000 to June 2007

NC State Demographer – County pop. estimates

School calendars – Days in session

Summer, weekends, holidays excluded

The North Carolina study

Measure

Population-adjusted monthly 16-17-yr-old
crash rate per school day in session

Example:

18 school days

24 crashes

and 5,000 16&17-yr-olds in county

Monthly Rate = $(24 / 18) / 5,000 = 1.33 / 5,000 = 2.67$ per 10,000

The North Carolina study

Measure

Population-adjusted monthly 16-17-yr-old
crash rate per school day in session

Grouped into pseudo-months (10/year)

Month 1 Jan 10 – Feb 9 (2000)

Month 2 Feb 10 – Mar 9

Month 35 **Aug 10 – Sep 9** ← *School start time changes*

Month 74 Apr 10 – May 9

Month 75 May 10 – Jun 7 (2007)

The North Carolina study

Analysis

ARIMA Interrupted time-series

Total crashes

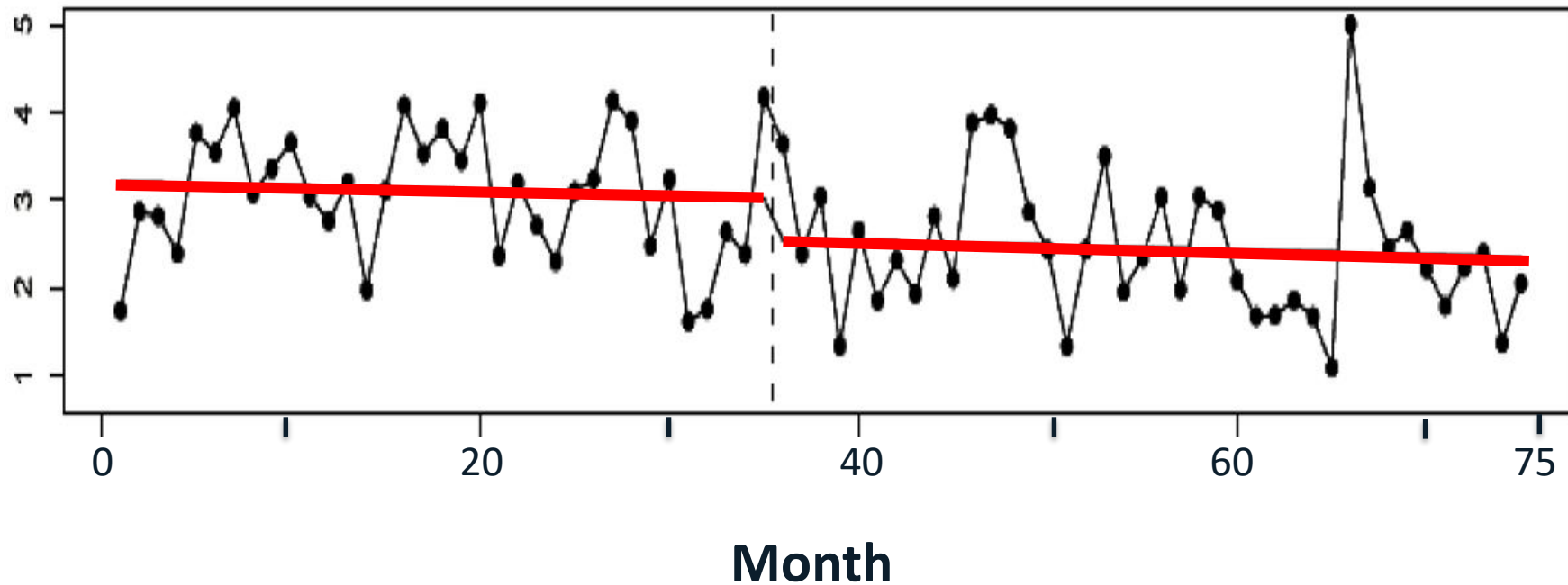
Crashes by single hour of day

Model selection (AIC, BIC, AICC, Lyung-Box)

Simple model, adjusted for seasonality, fit well

Monthly crash rate* per school day

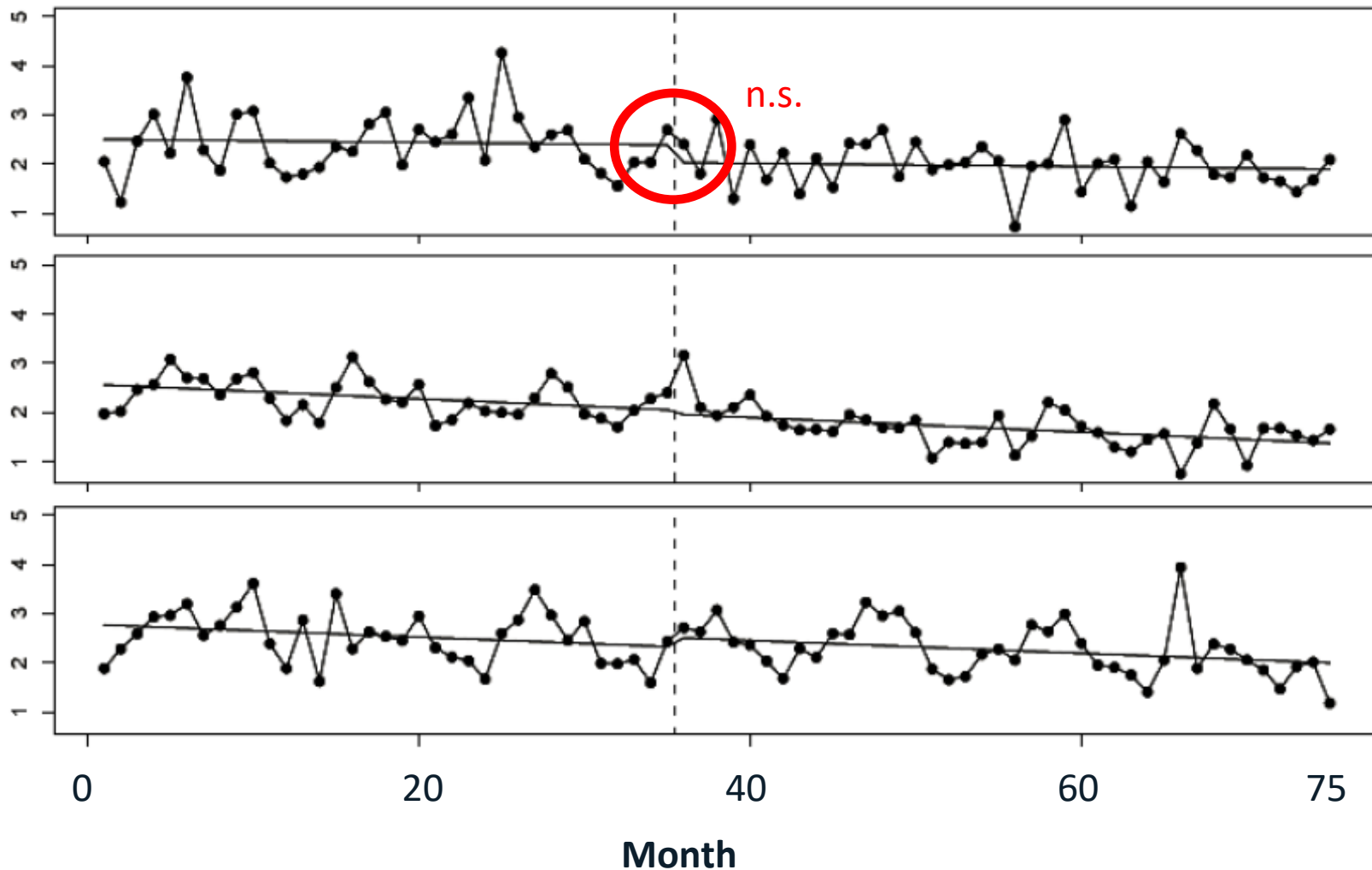
Forsyth County



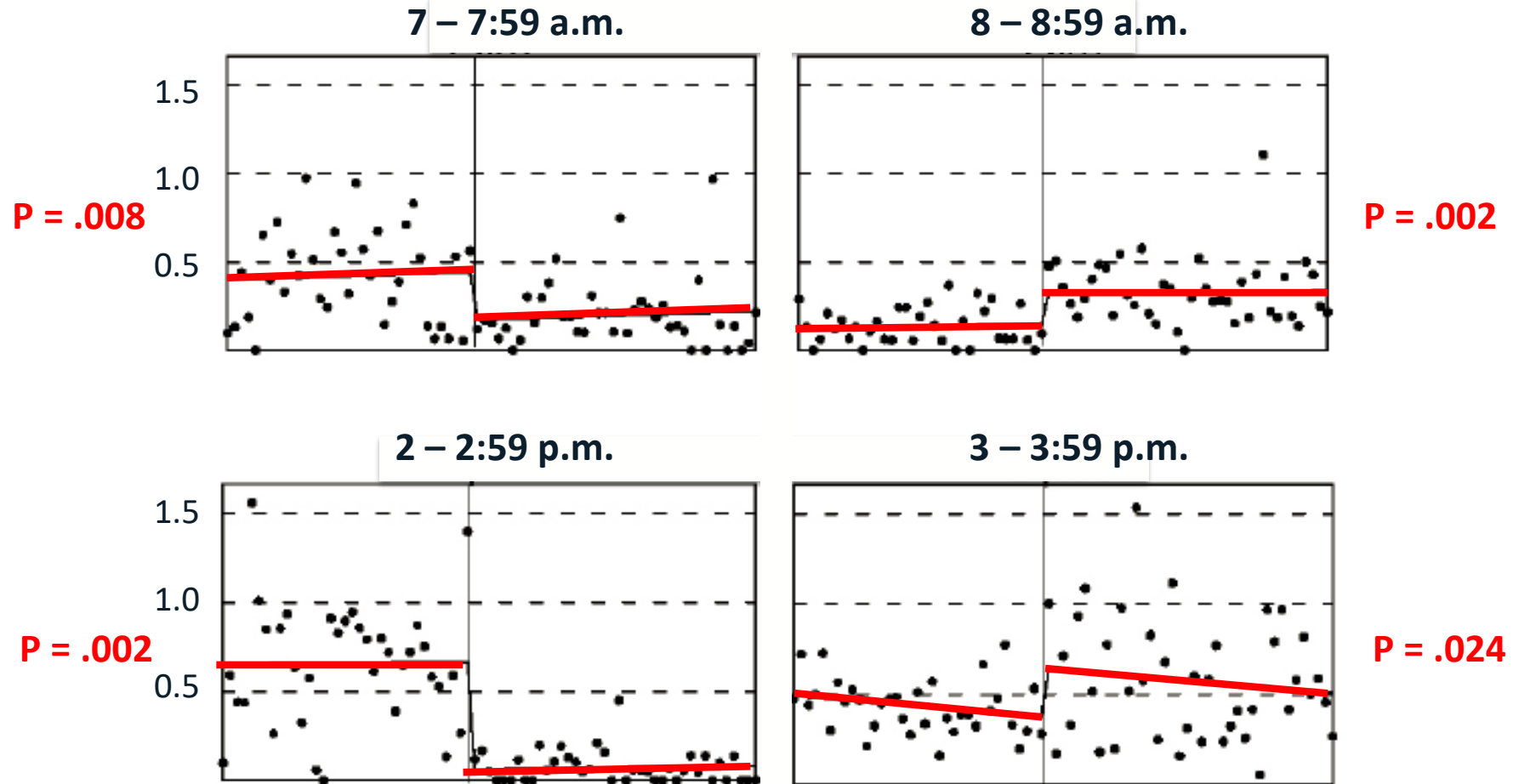
* Per 10,000 pop.

Monthly crash rate per day in school

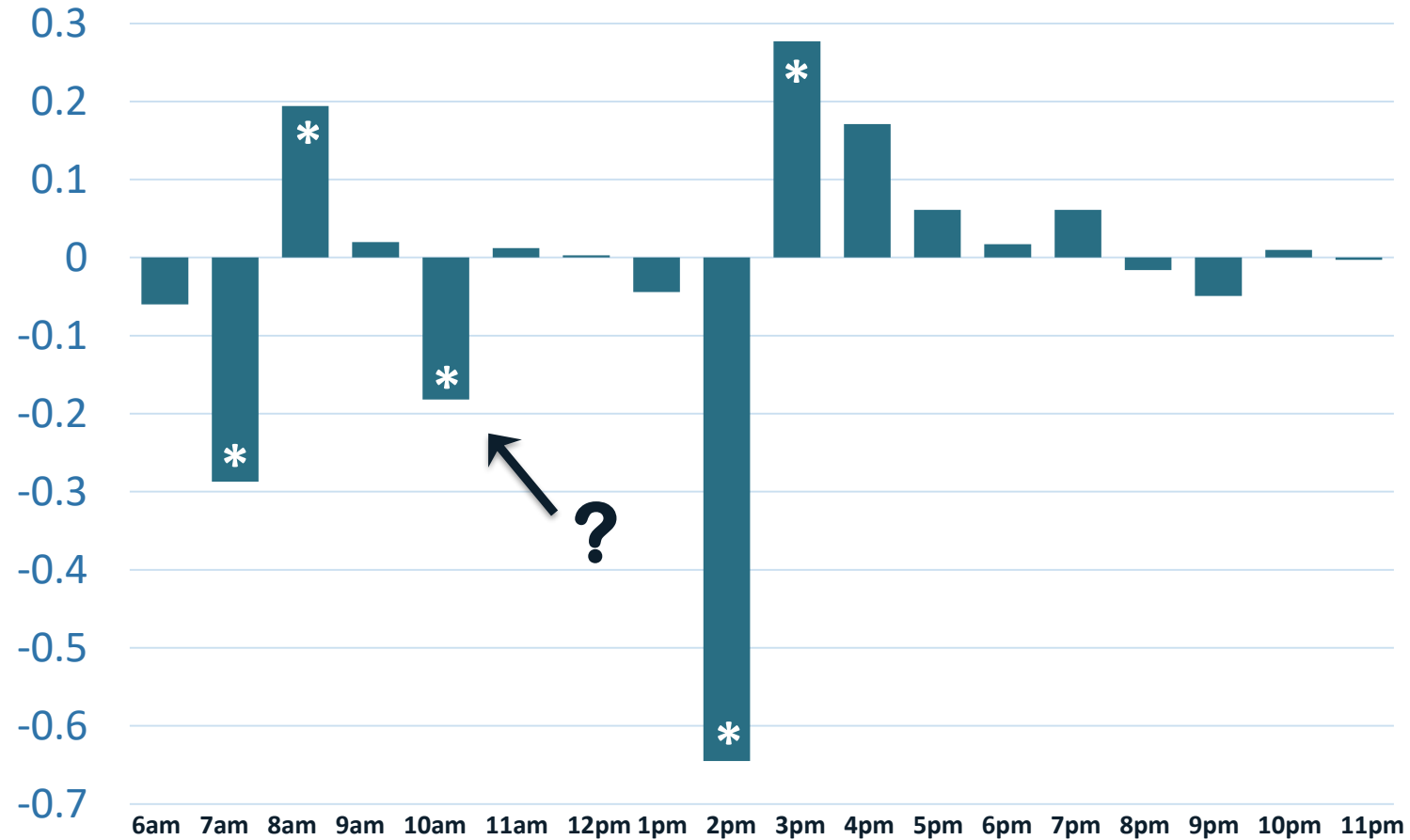
Comparison Counties



Notable shifts by hour – Forsyth County



Hourly change ($\hat{\beta}$) - Forsyth



* p < .05

Conclusions

1. Crashes appear to have decreased due to change
2. Unclear whether reduced drowsiness was the reason
75 min. shift compressed available time for post-school driving

Acknowledgements

Colleagues:

Prof. Richard L. Smith, Ph.D. – Statistical modeling

Natalie O'Brien, M.A. – Collection of school calendar data

Funding:

National Highway Traffic Safety Administration

University of North Carolina