Research Society on Alcoholism
San Antonio, TX
22 June 2015

Age & Sex Differences in Cognitive, Motor, & Sleep Indices: Initial Findings of the National Consortium on Alcohol & NeuroDevelopment in Adolescence

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NCANDA FUNDING: NIAAA • NIMH • NICHD • NIDA

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Fiona Baker, Brad Hasler, Ian Colrain, Duncan Clark, Michael De Bellis, Bonnie Nagel, Sandra Brown, Torsten Rohlfing, Kilian Pohl, Nolan Nichols, Weiwei Chu, Steven Hooper, Devin Prouty, Rosemary Fama, Adolf Pfefferbaum, Susan Tapert, Edith Sullivan

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Disclosures

Financial and Academic Interests

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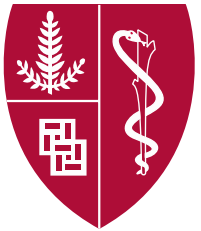
Professor

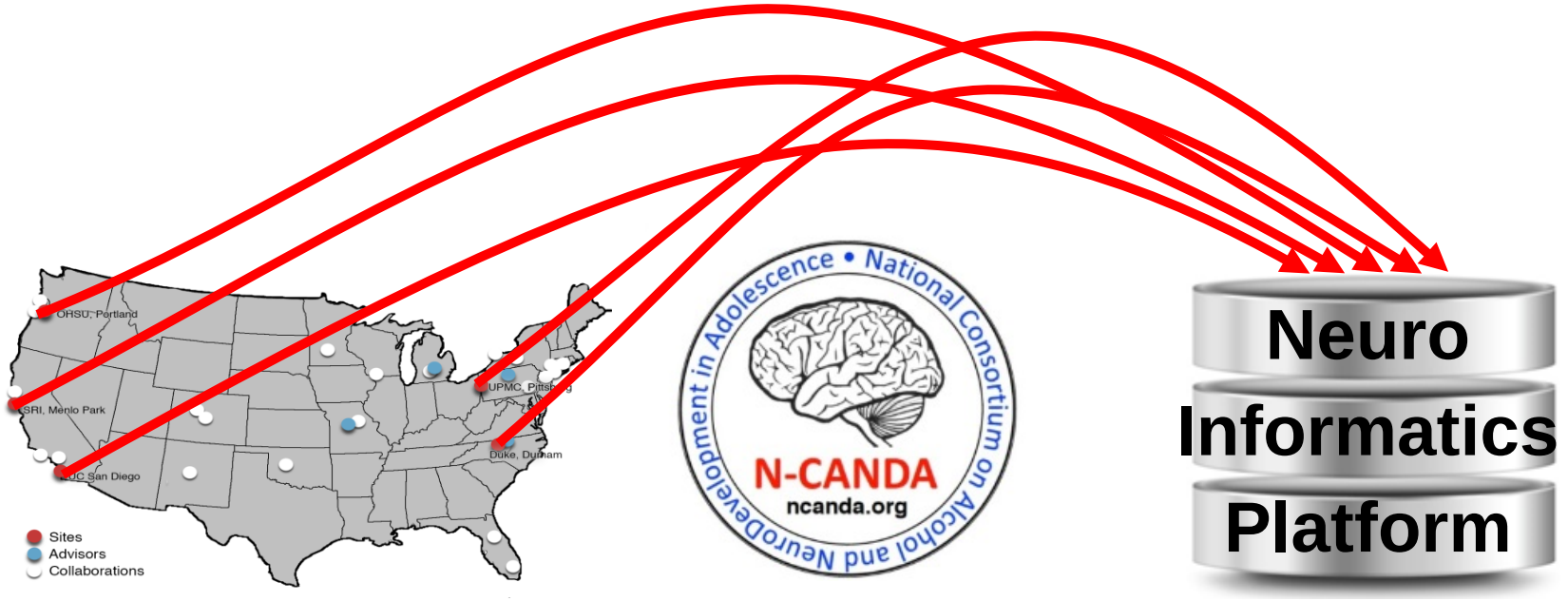
Department of Psychiatry & Behavioral Sciences
Stanford University School of Medicine



Editor-in-Chief

Salary and research support

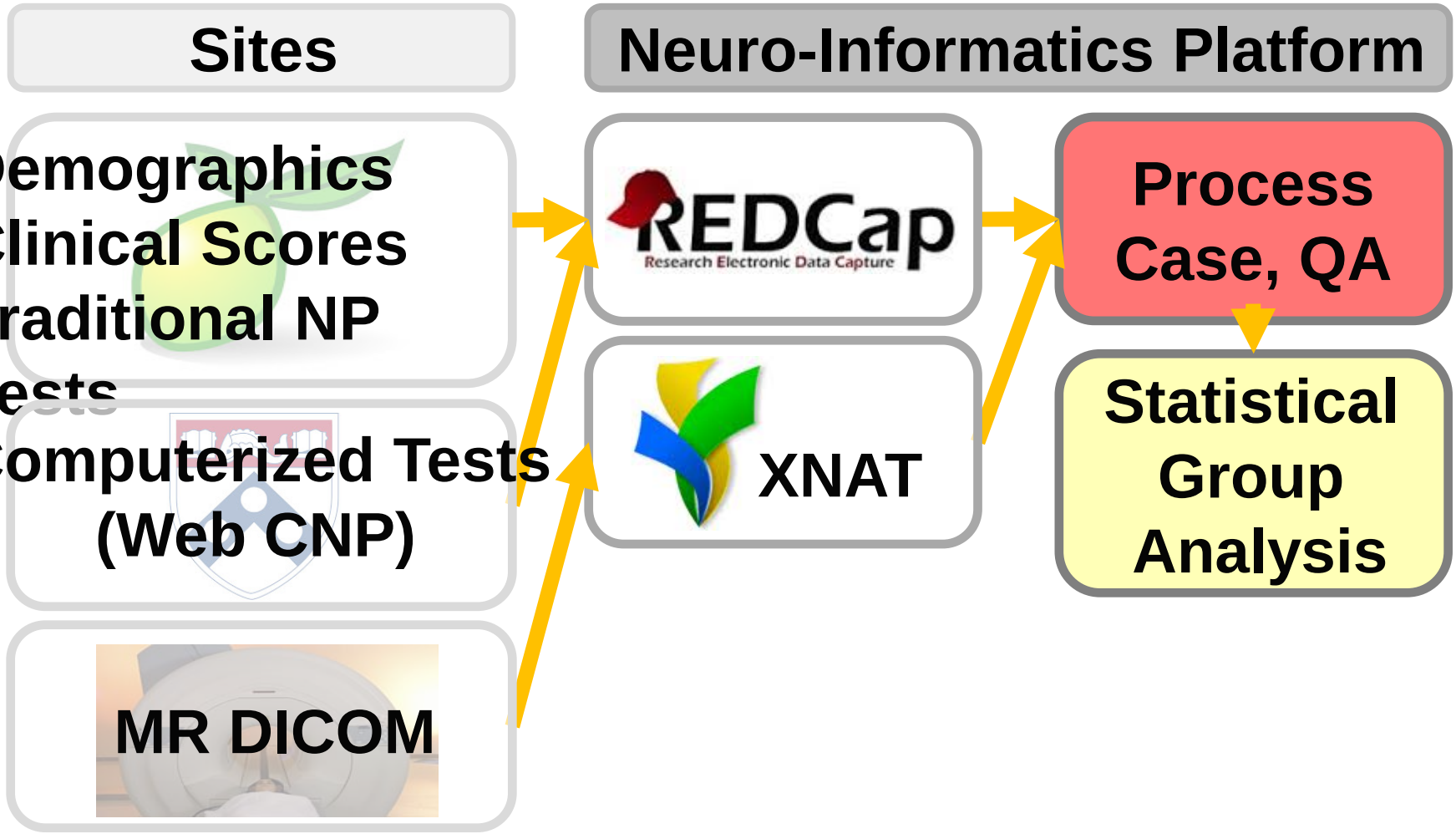
NCANDA - Data Analysis



Monitoring brain development of 831 adolescents over a 5 year period and recruited from 5 U.S. sites to

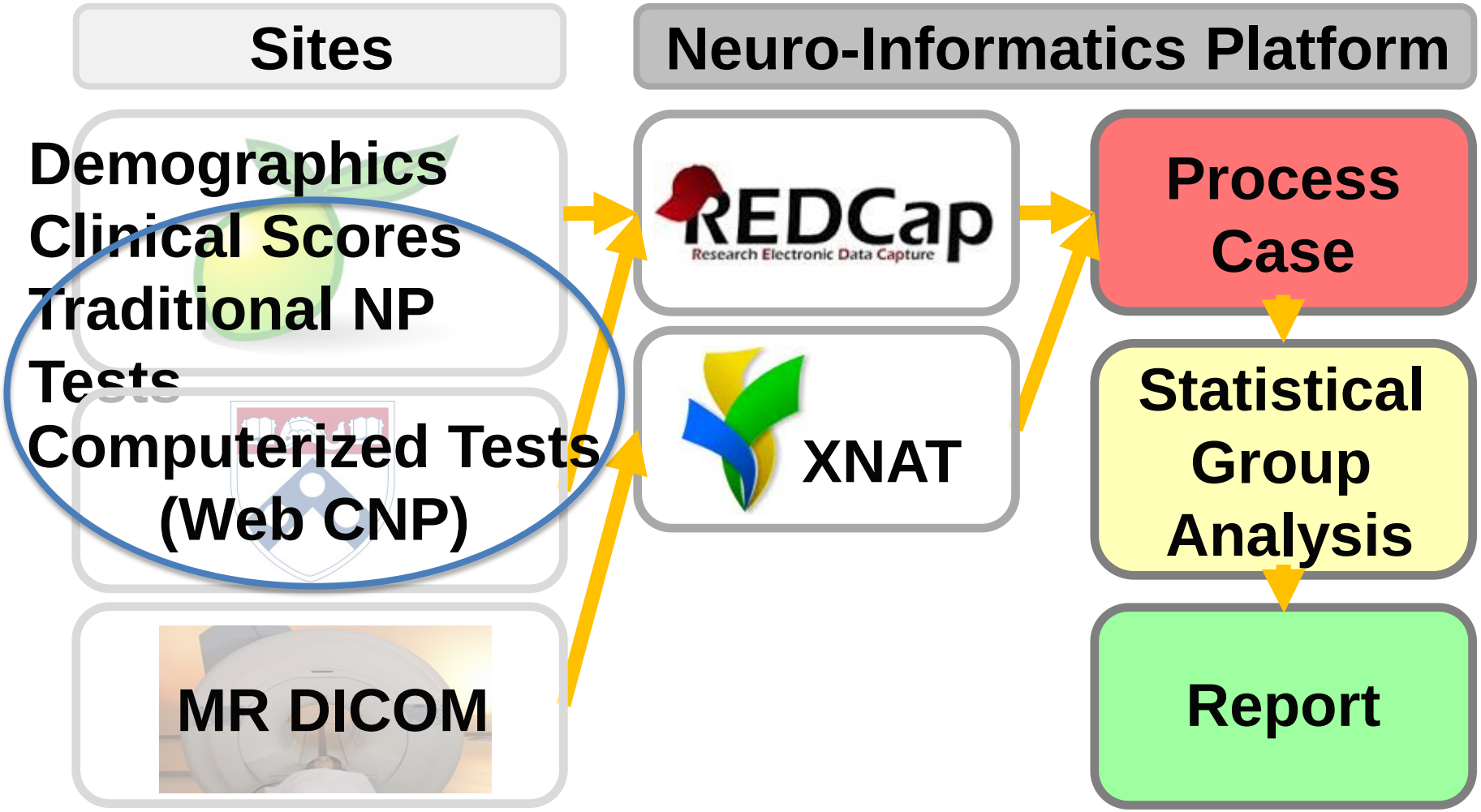
- **determine the effects of early, heavy alcohol use on brain structure and function**
- **identify factors that predict Alcohol Use Disorder**

NCANDA – Data Flow



Fusing data across time, sites, and modalities

NCANDA – Data Flow

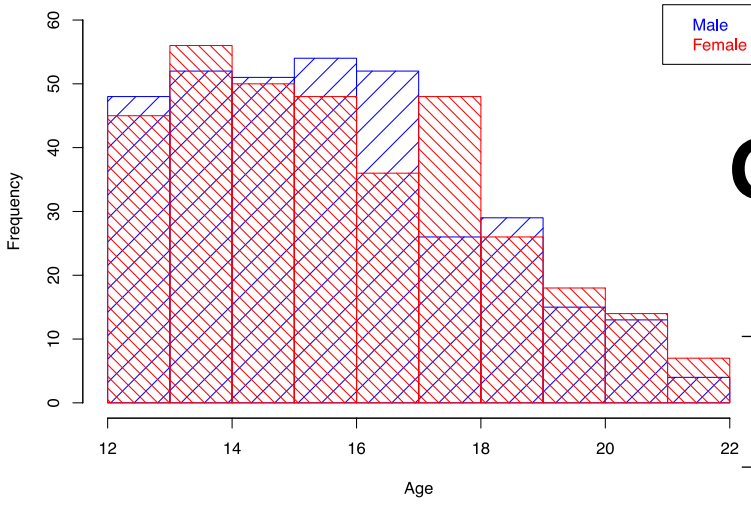


Provide comprehensive report of measurements to scientists

Neuropsychology Testing Procedures

- **Combination of traditional pencil & paper tests and computerized tests (UPenn Computerized NP Battery-WebCNP)**

- **Examiners at each site were initially trained and continue to undergo annual calibration with two team leaders**
  - **Devin Prouty, Ph.D.** from SRI and **Lindsay Squeglia, Ph.D.** now at MUSC oversee test administration, data scoring, data entry, and data uploading to Redcap
  - **Kevin Cummins, M.A.** at UCSD installs programs and upgrades on all test computers at each site
  - **Weiwei Chu, M.A.** at SRI curates all Redcap data by conducting range and ID checking, identifying misclassified data, and finding missing data. She reports errors to sites for correction.



Group Characteristics

age = 12-21 years

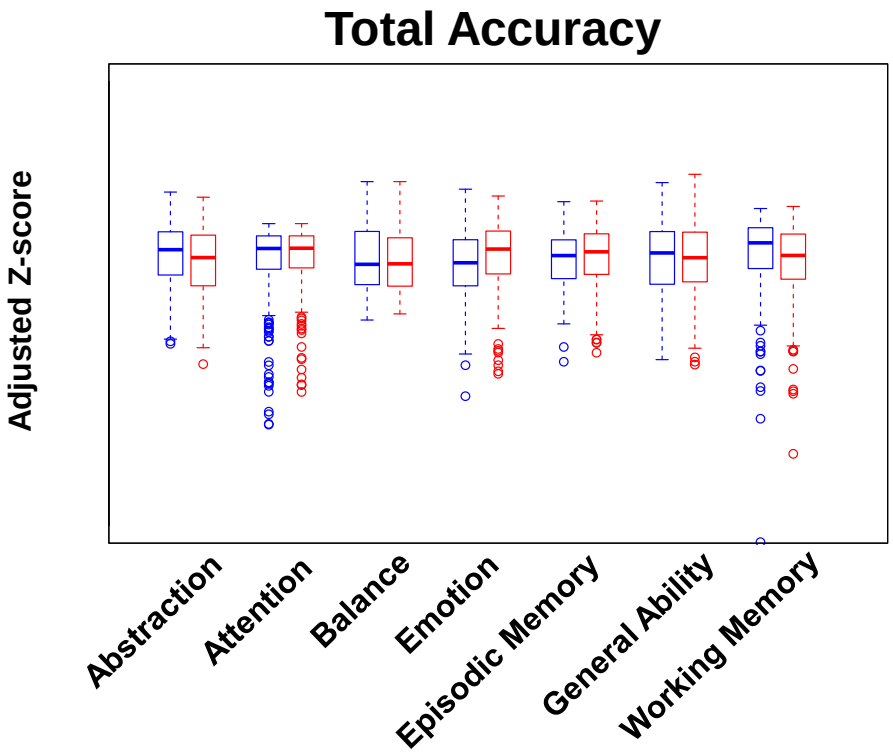
		No/Low Drinker (N=692)	
		Male	Female
Age (years)	mean	15.6	15.8
	N	344	348
Pubertal Development Scale	median	3.0	3.6
	N	339	345
Socioeconomic status	mean	17.0	16.6
	N	326	326
Handedness	L/R/A	33/261/49	23/290/35
Self-declared Ethnicity			
Caucasian	N	251	235
African-American		34	53
Asian		27	25
Pacific Islander		1	3
American Indian		3	0
Mixed		28	32

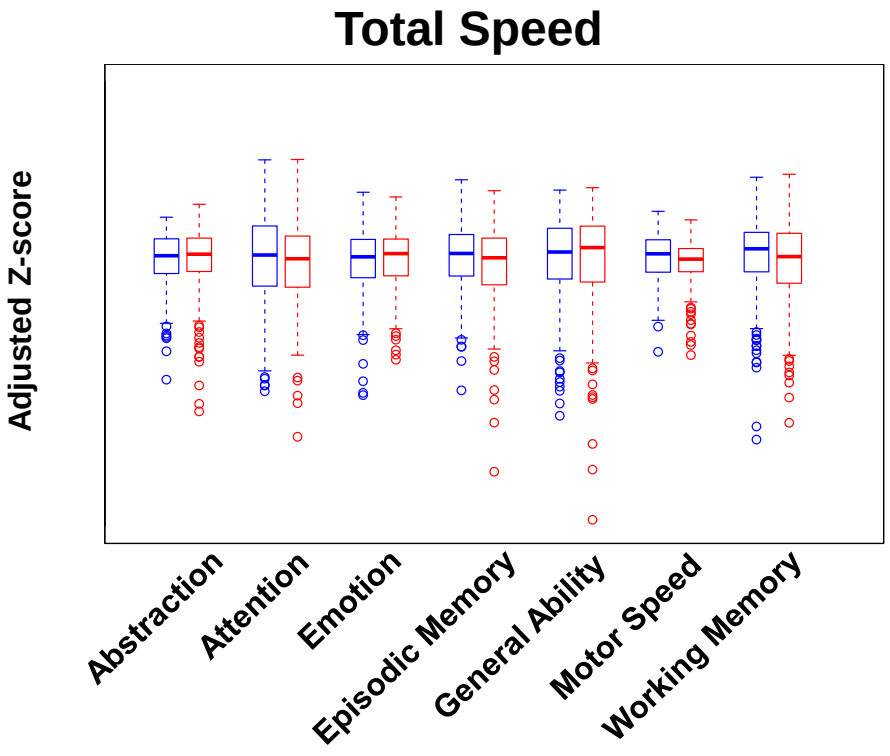
Creation of Neuropsychological Test Composite Scores

- **Data reduction**
  - Computerized tests yield accuracy and speed measures
  - Create composite scores reflecting 8 target functional domains

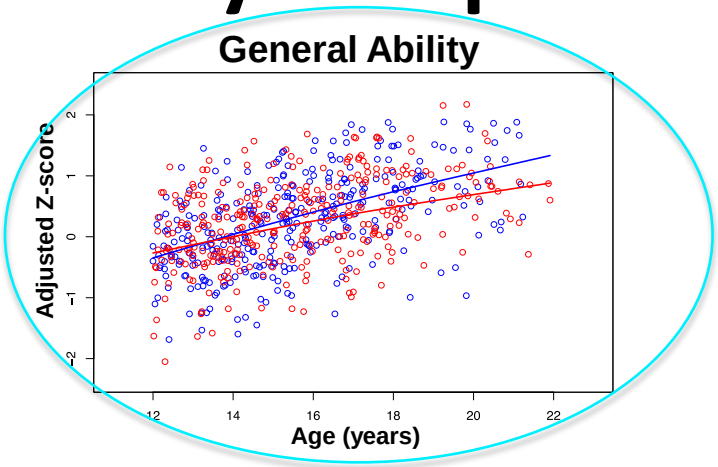
- **Test composite construction → 3-step process**
  - Standardize each measure on scores achieved by all no/low drinking male and female adolescents and express them as a Z-score, with a mean = 0 ± SD
  - Transform all scores (including reaction time) so that higher score reflect better performance
  - Calculate the mean Z-score of all measures that comprised a composite

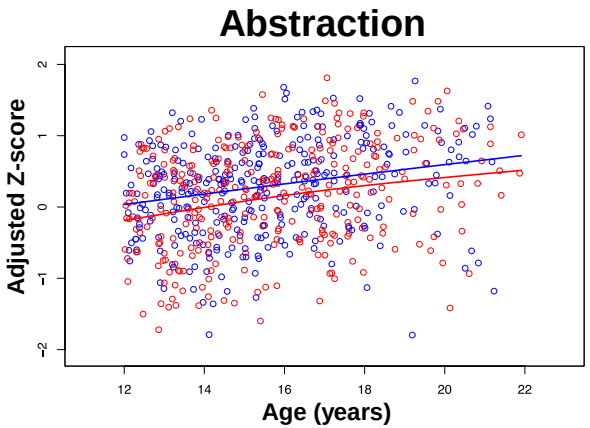
Individual and Total Composite Scores

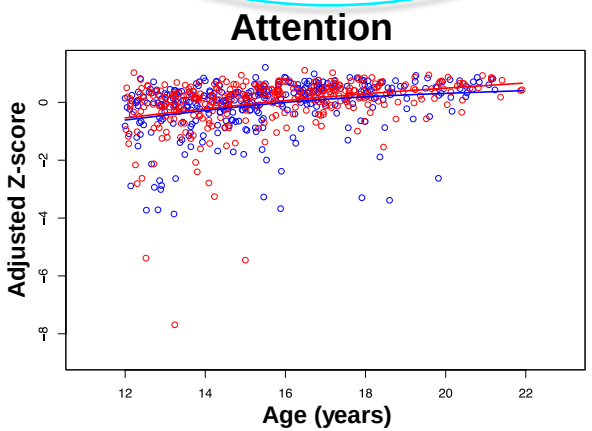


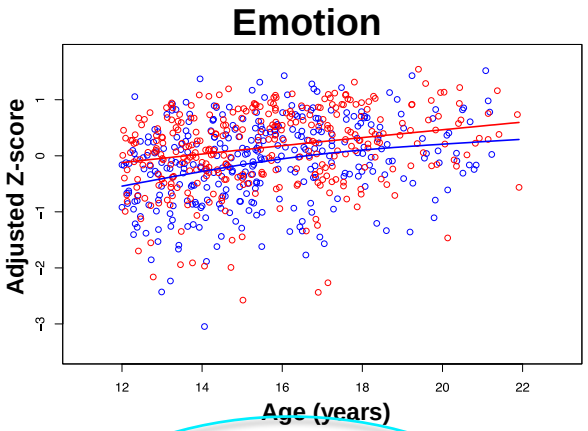


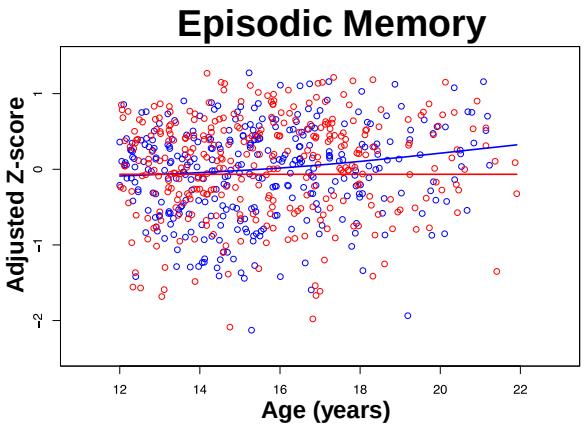
Accuracy Composites

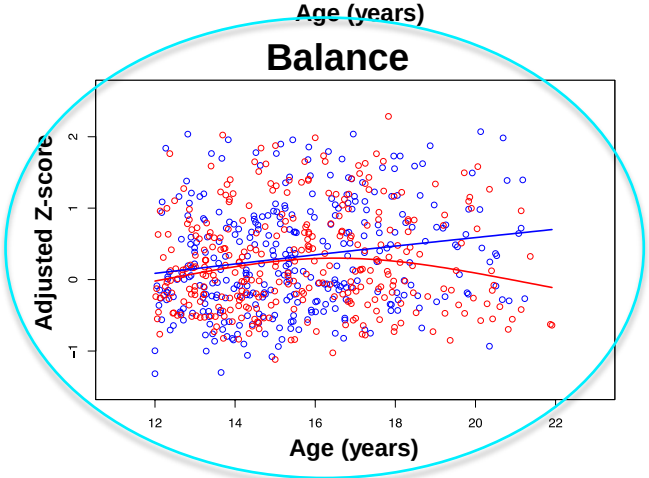






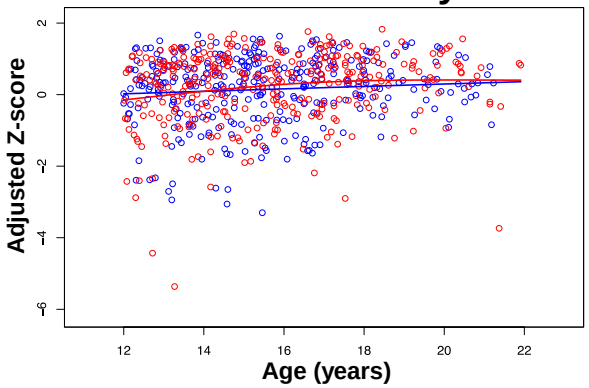




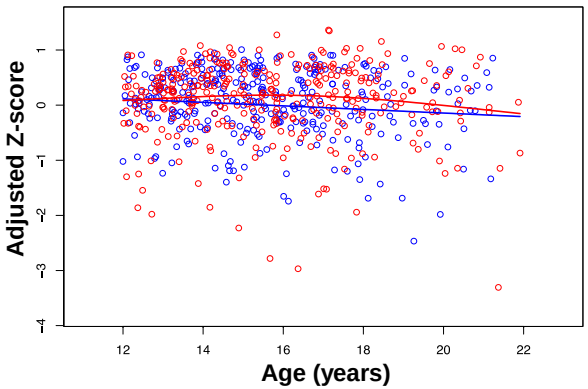


Speed Composites

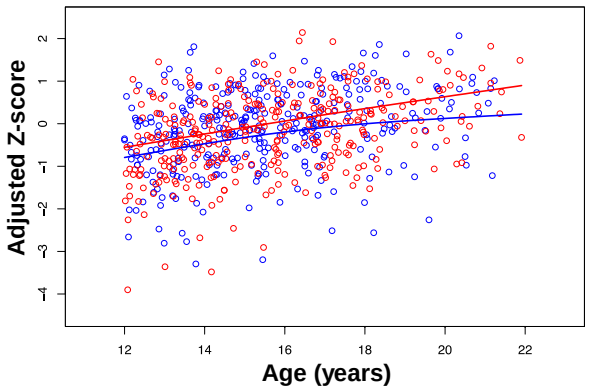
General Ability



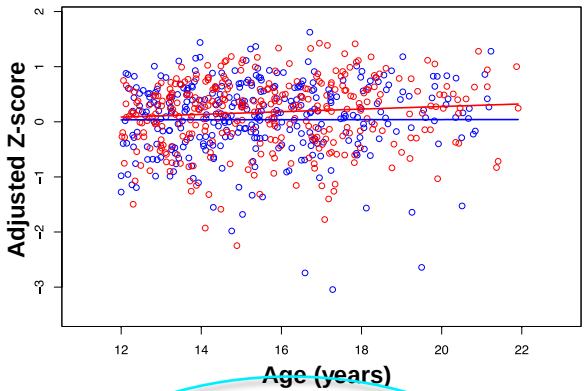
Abstraction



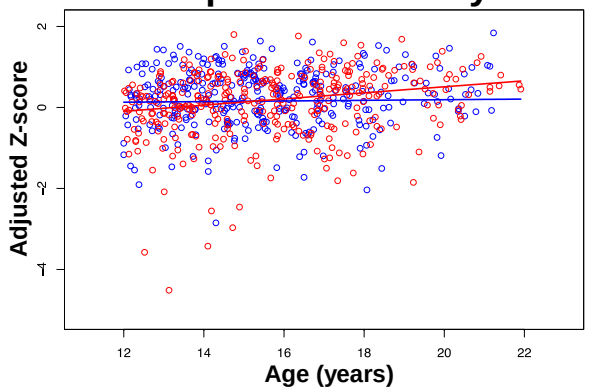
Attention



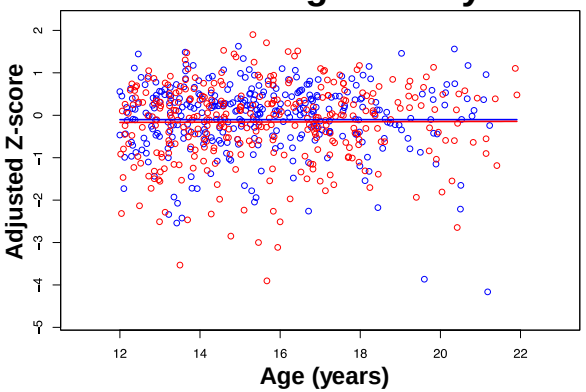
Emotion



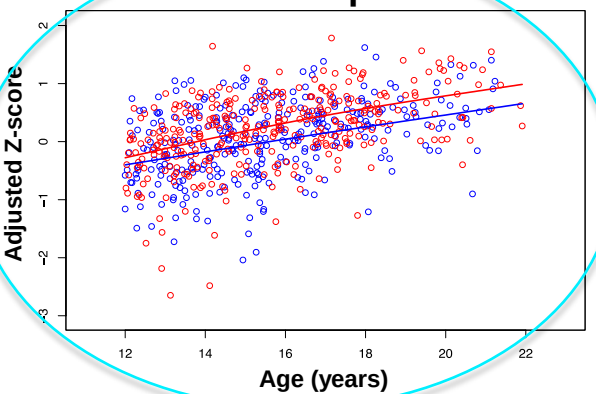
Episodic Memory



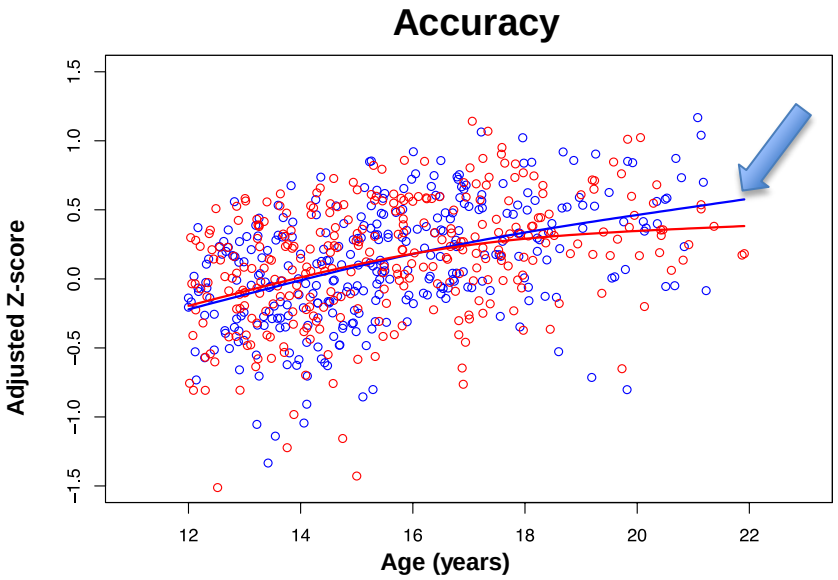
Working Memory

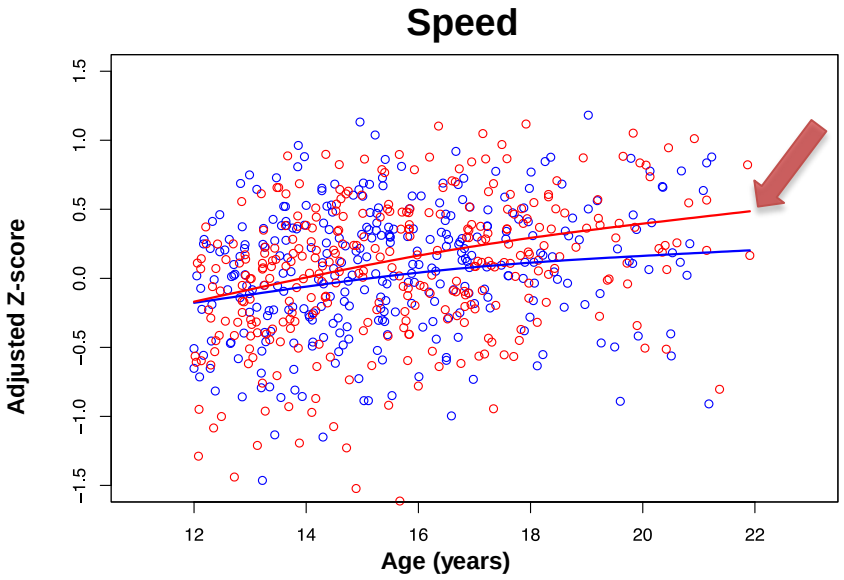


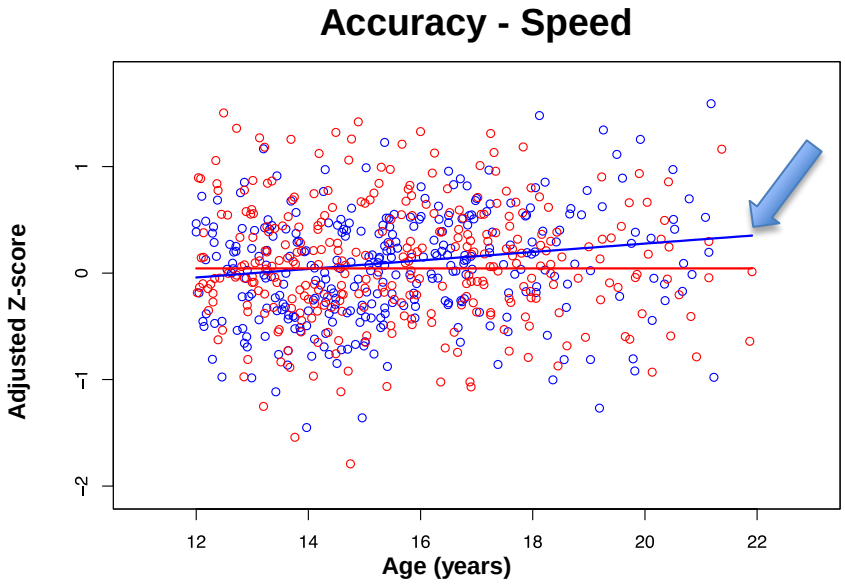
Motor Speed



Total Composites

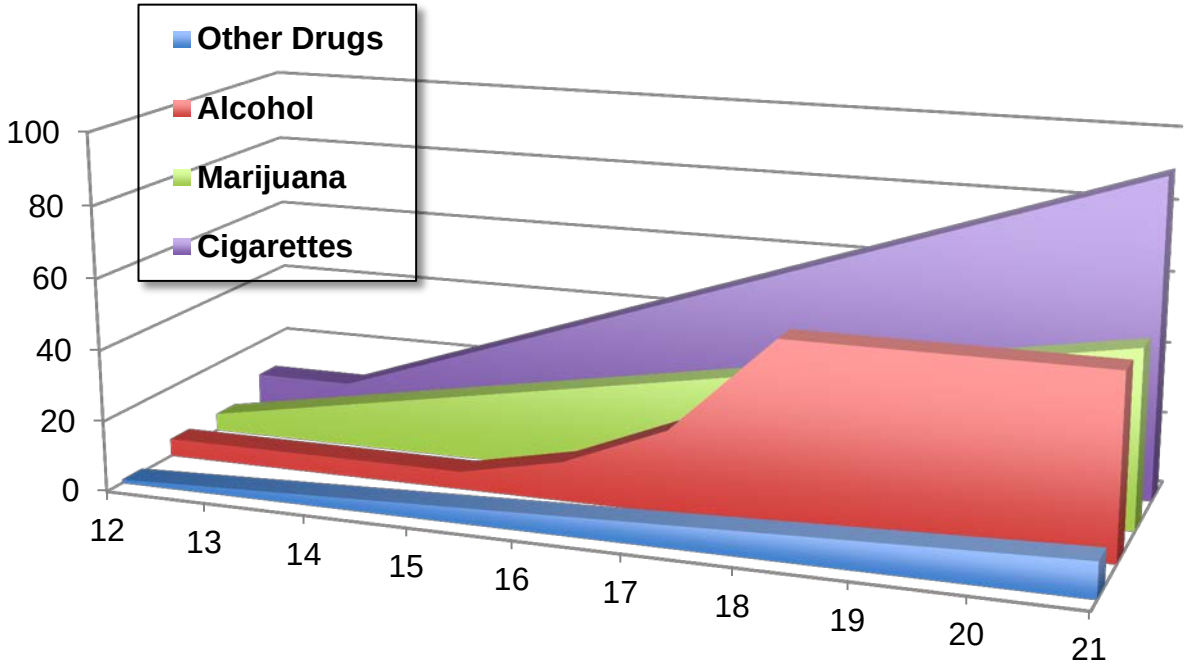


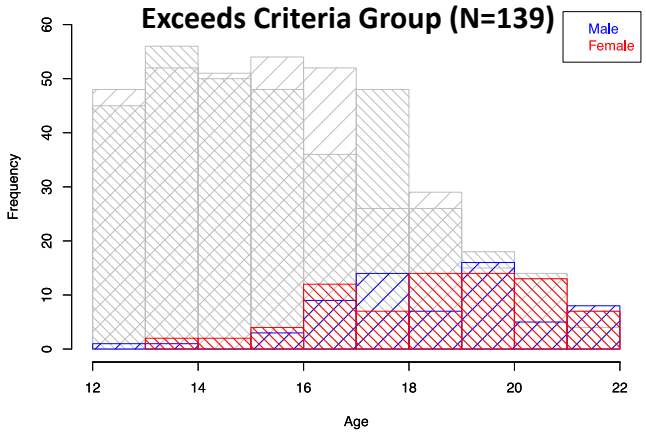




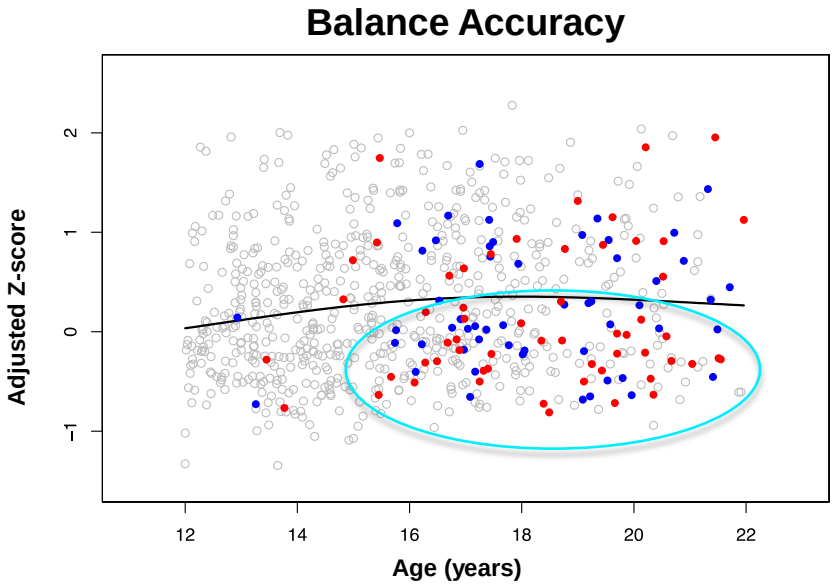
Alcohol and Drug Use Criteria

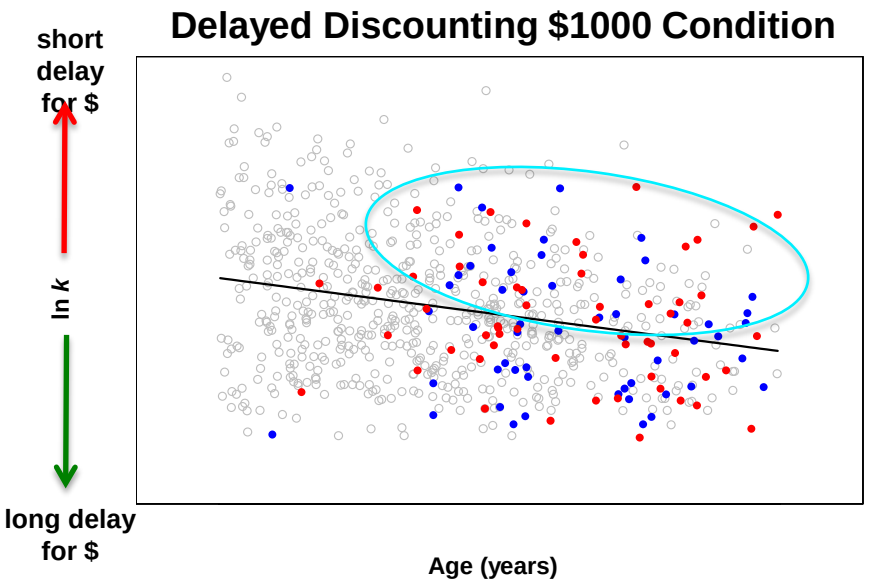
No/low vs. Exceeds



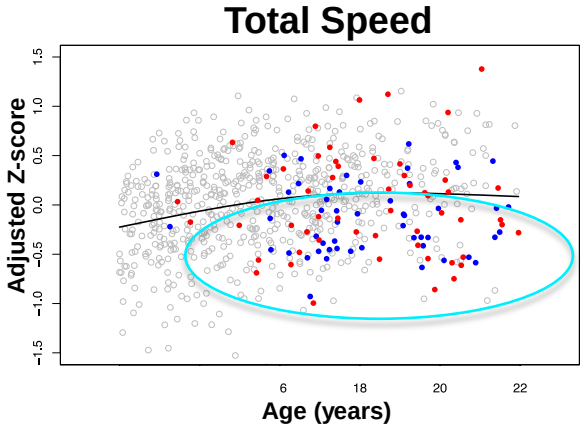


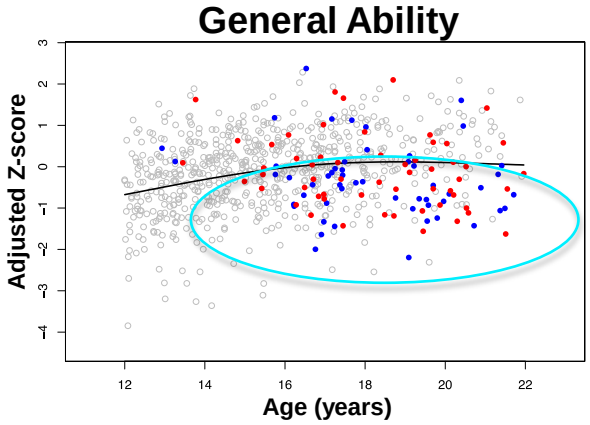
Accuracy: No/Low > Exceeds Drinkers

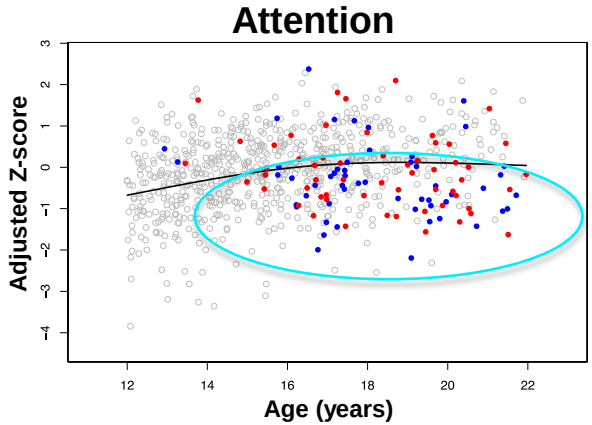


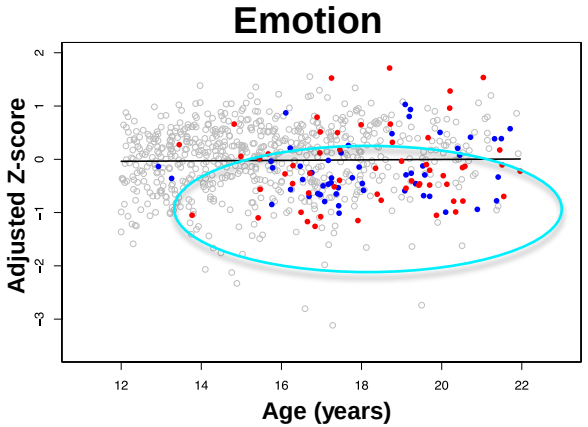


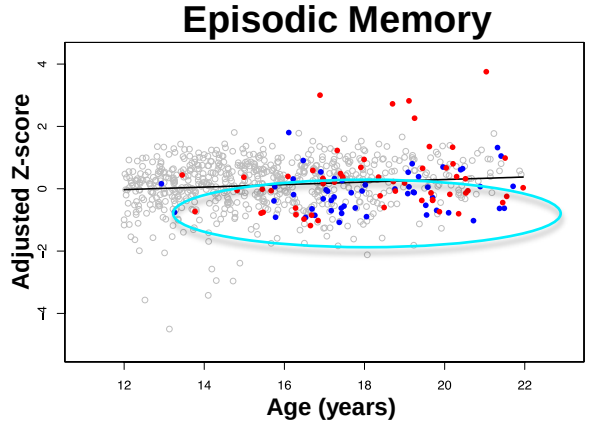
Speed Composites: No/Low > Exceeds Drinkers

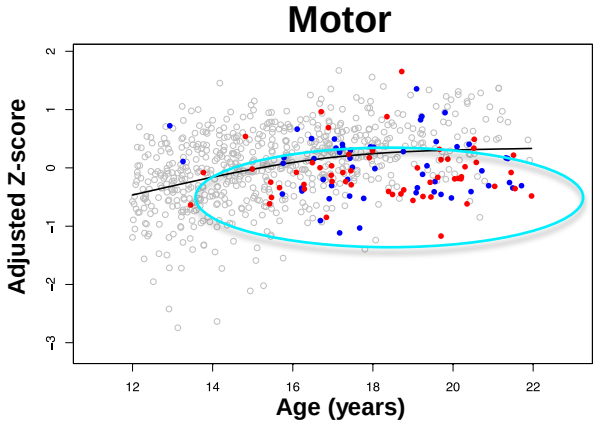


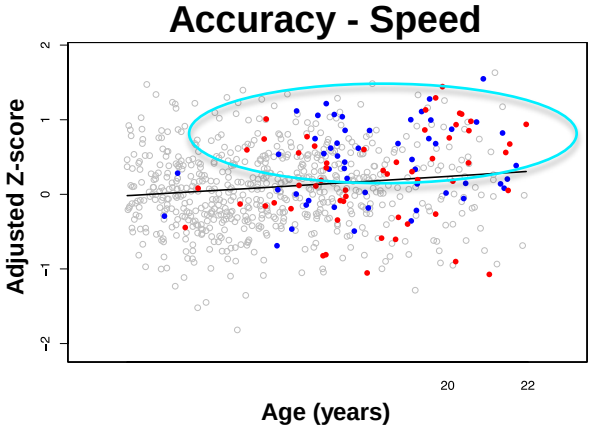












Neuropsychological Test Summary

- **No/low drinking group**
  - Age differences were greater in Accuracy composite scores (General Ability, Abstraction, Attention, Emotion, and Balance) than Speed scores.
  - Delay Discounting performance in younger boys and girls was consistent with poor impulse control

- **Exceeded-threshold group**
  - After accounting for age, sex, and other demographic factors, the exceeded-threshold group performed significantly below the no/low-drinking group:
    - Balance and response time (General Ability, Attention, Episodic Memory, Emotion, and Motor)
  - Speed-accuracy trade-off → Faster speed at the expense of accuracy
  - Delay Discounting performance was consistent with poor impulse control in exceed group regardless of age
  - Even where statistically significant, identified differences were modest.

Neuropsychological Test Summary

- **Whether the performance differences between no/low-drinking adolescents and those who exceeded drinking thresholds are attributable to drinking or to other modulating factors requires the ongoing, longitudinal study of this NCANDA cohort.**

Disclosures

Financial and Academic Interests

Fiona C. Baker, Ph.D.

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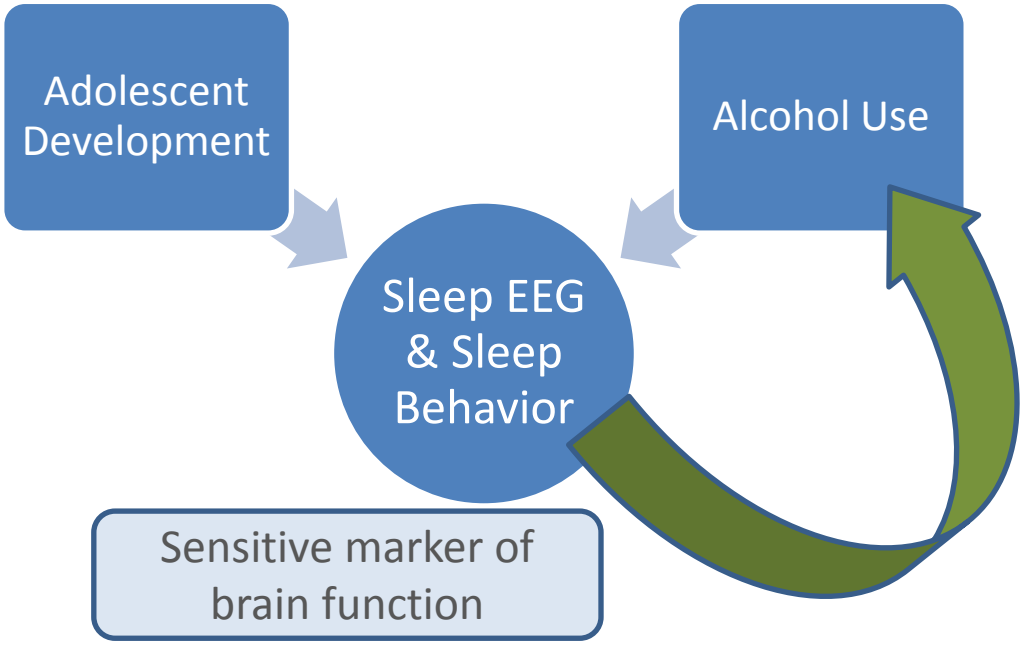
and
Brain Function Research Group, University of the Witwatersrand, South Africa

Salary and research support: NIAAA, NHLBI

Why Consider Sleep?

1. Examine the developmental trajectory of functional sleep measures and how they are impacted by alcohol exposure.
2. Examine sleep behavior as a predictor of hazardous alcohol drinking in adolescents.



Consequences of poor sleep in adolescents

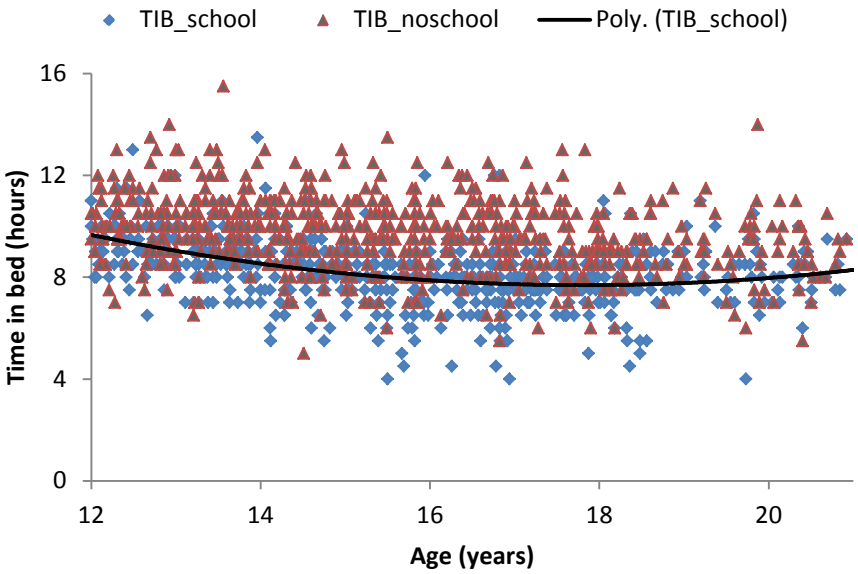
- Adolescents with sleep problems report more mood disturbances, inattention and memory problems, conduct disorders, and increased drug and alcohol use.
- Poor sleep quality and chronic insomnia predict alcohol use in adolescents.
- Shorter sleep duration predict alcohol-related problems.
- A tendency towards eveningness is associated with greater alcohol and other substance use.
- A larger weekday–weekend sleep difference is linked to increased risk-taking behaviors, substance use, and depressed mood.

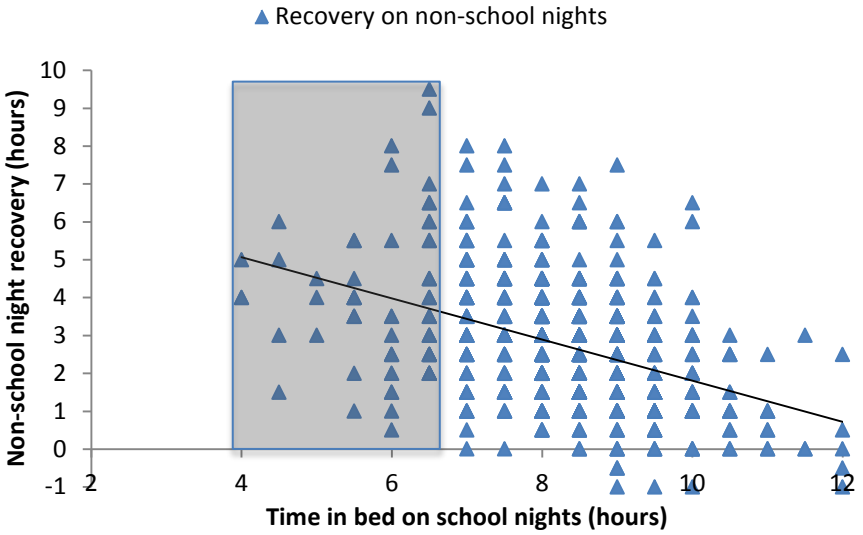
Shibley et al., J Psychiat Prac 2008; Wong et al., Alcohol Clin Exp Res 2015; Roberts et al., J Adolesc Health 2008; Hasler and Clark, Alcohol Clin Exp Res 2013

NCANDA Sleep Behavior Metrics

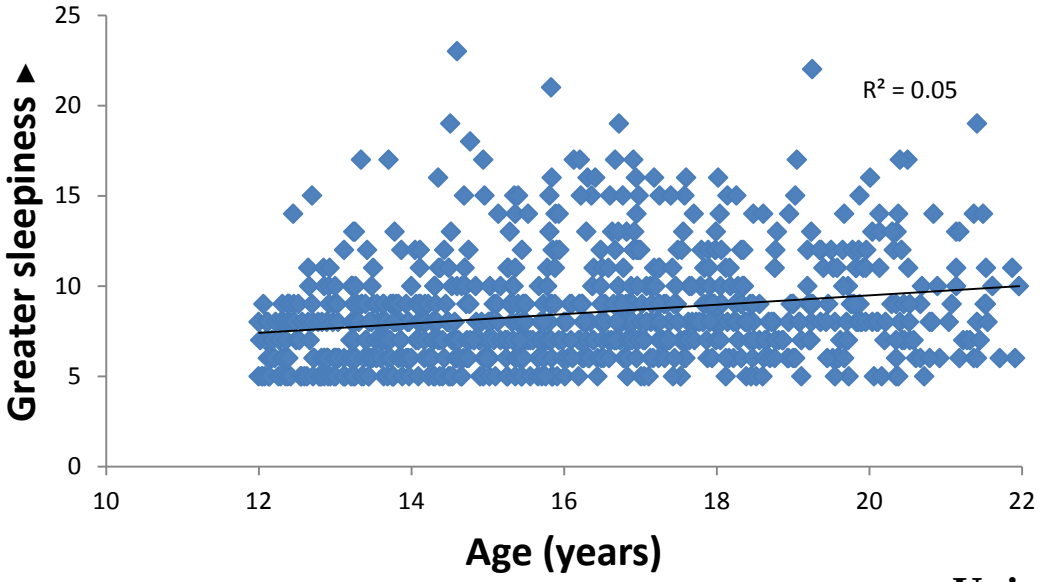
Sleep Quality	• Pittsburgh Sleep Quality Index (Buysse et al., 1989) • During the past month, how would you rate your sleep quality overall? (Very good – Very bad)
Daytime sleepiness	• Cleveland Adolescent Sleepiness Questionnaire (Spilsbury et al., 2007) • In the morning when I am in school, I fall asleep (Never – Always)
Chronotype	• Composite Scale of Morningness (Smith et al., 1989) • One hears about “morning” and “evening” types of people. Which ONE of these types do you consider yourself to be? (Extreme evening – Extreme morning)
Sleep Behavior	• Bedtimes and Wakeup times • Weekdays and weekends

NCANDA Baseline Sleep Data: Time in Bed

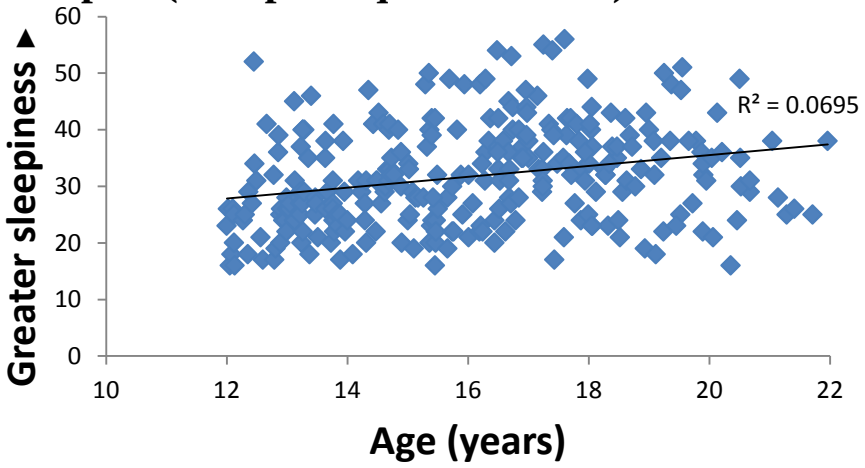




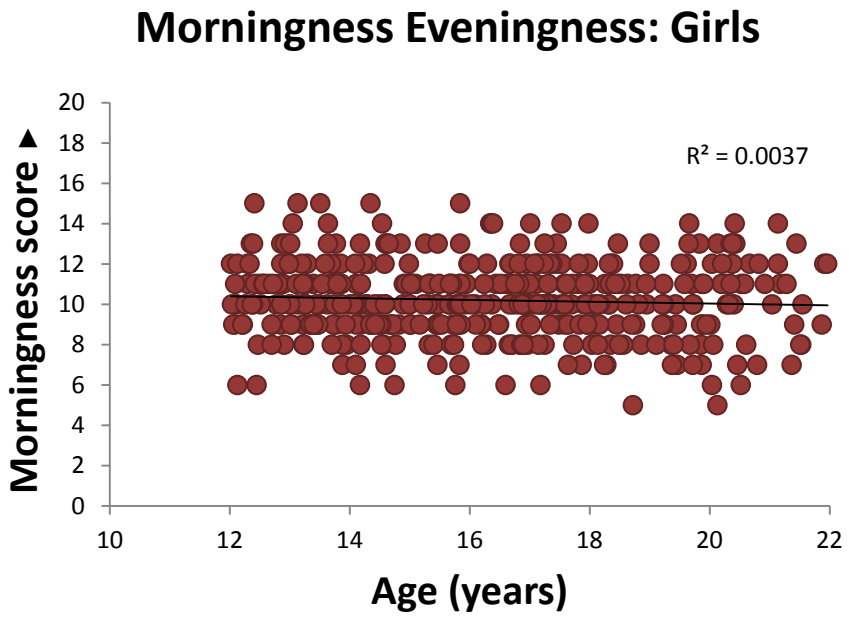
Daytime Sleepiness

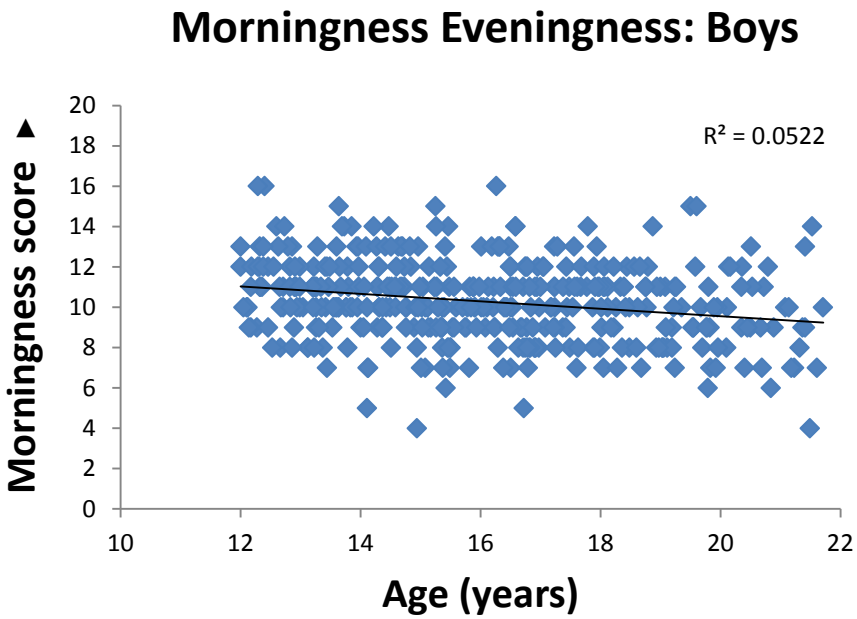


University of Pittsburgh and SRI International samples (Complete questionnaire)

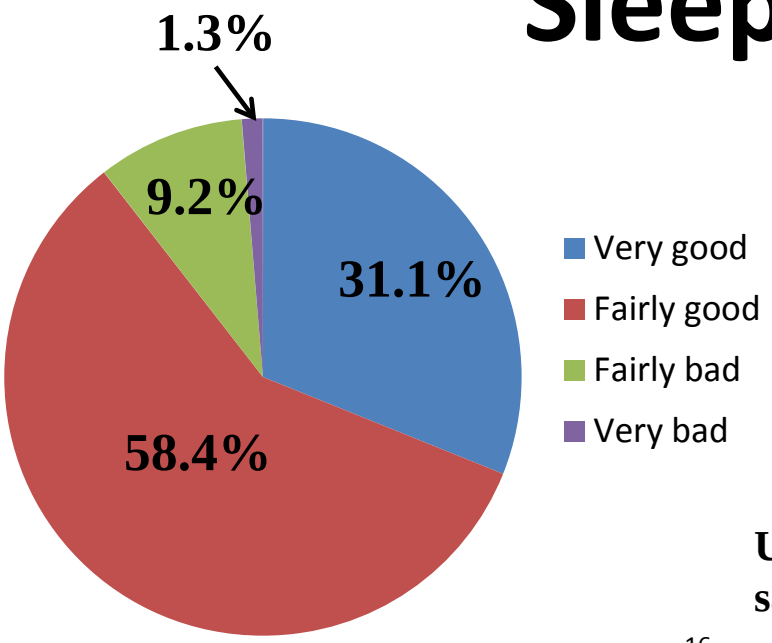


Chronotype


Morningness Eveningness: Girls
Morningness score ▲
20
18
16
14
12
10
8
6
4
2
0
R² = 0.0037
10
12
14
16
18
20
22
Age (years)


Morningness Eveningness: Boys
Morningness score ▲
20
18
16
14
12
10
8
6
4
2
0
R² = 0.0522
10
12
14
16
18
20
22
Age (years)

Sleep Quality



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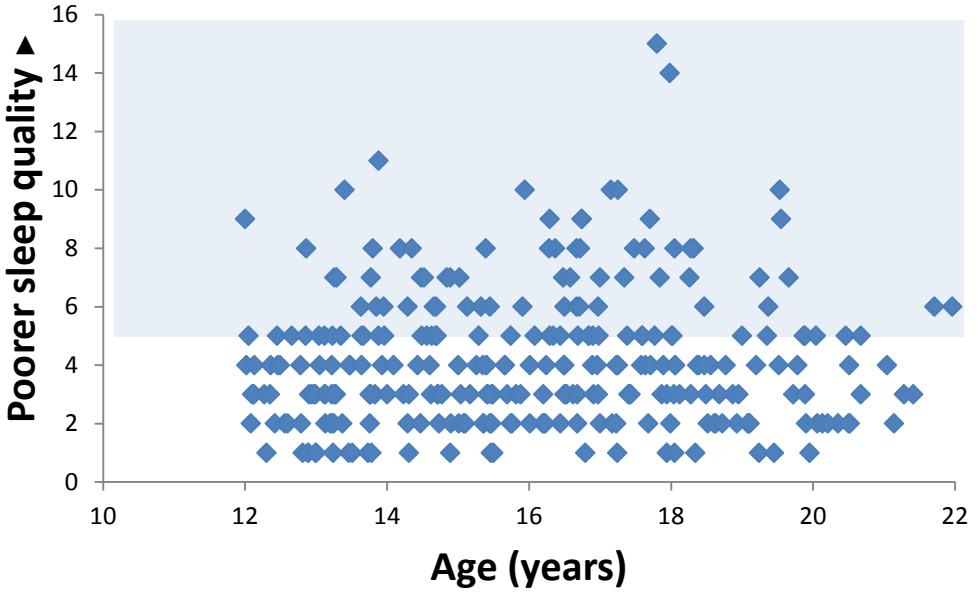
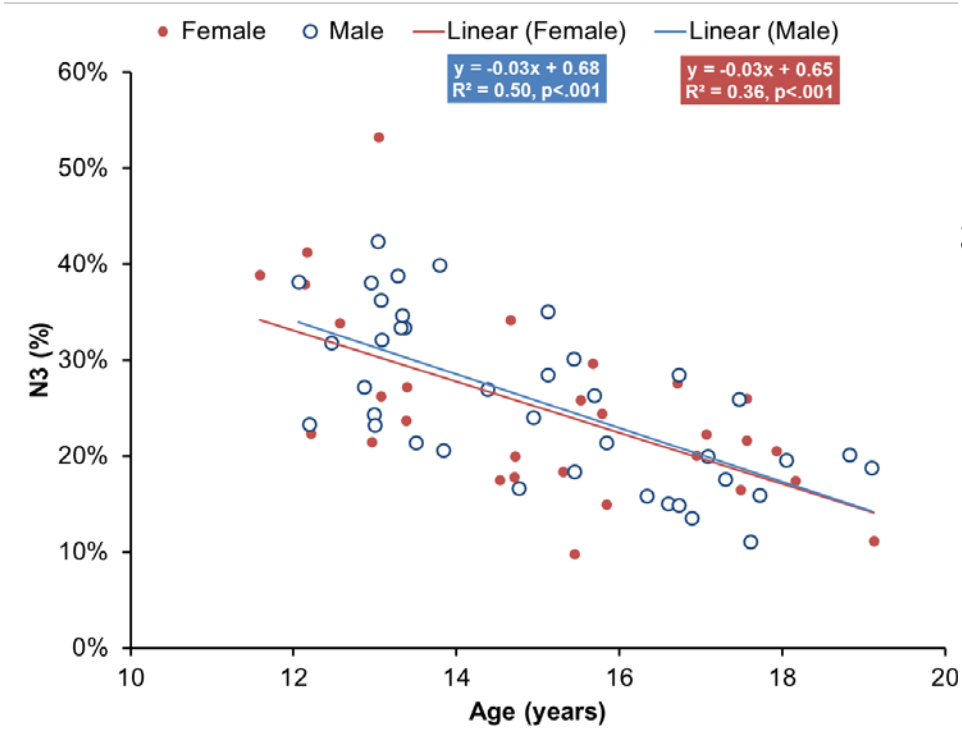
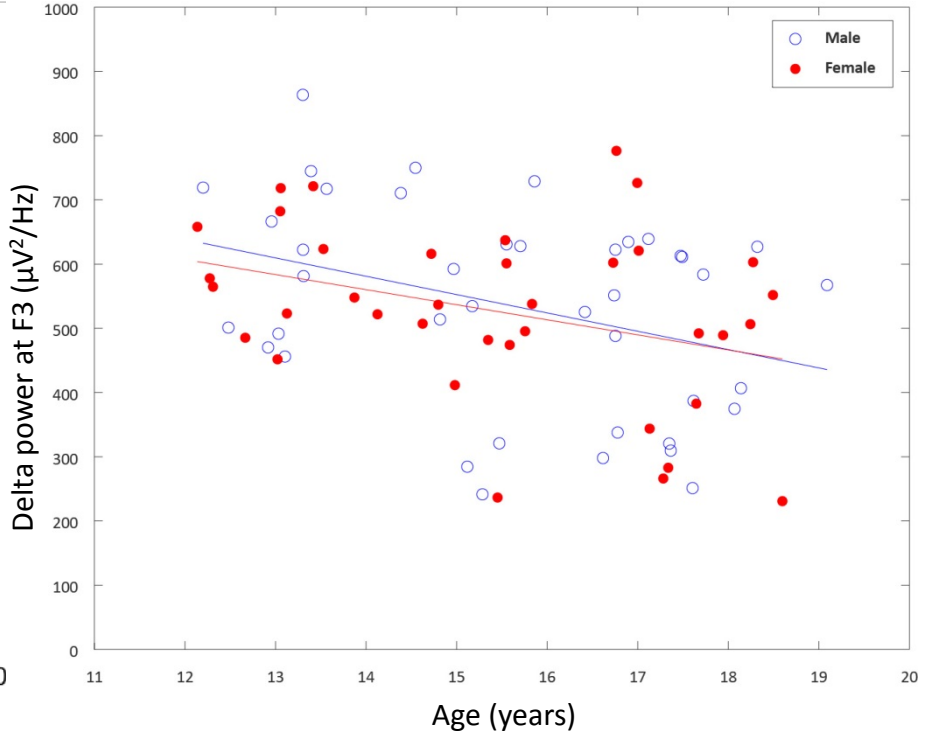


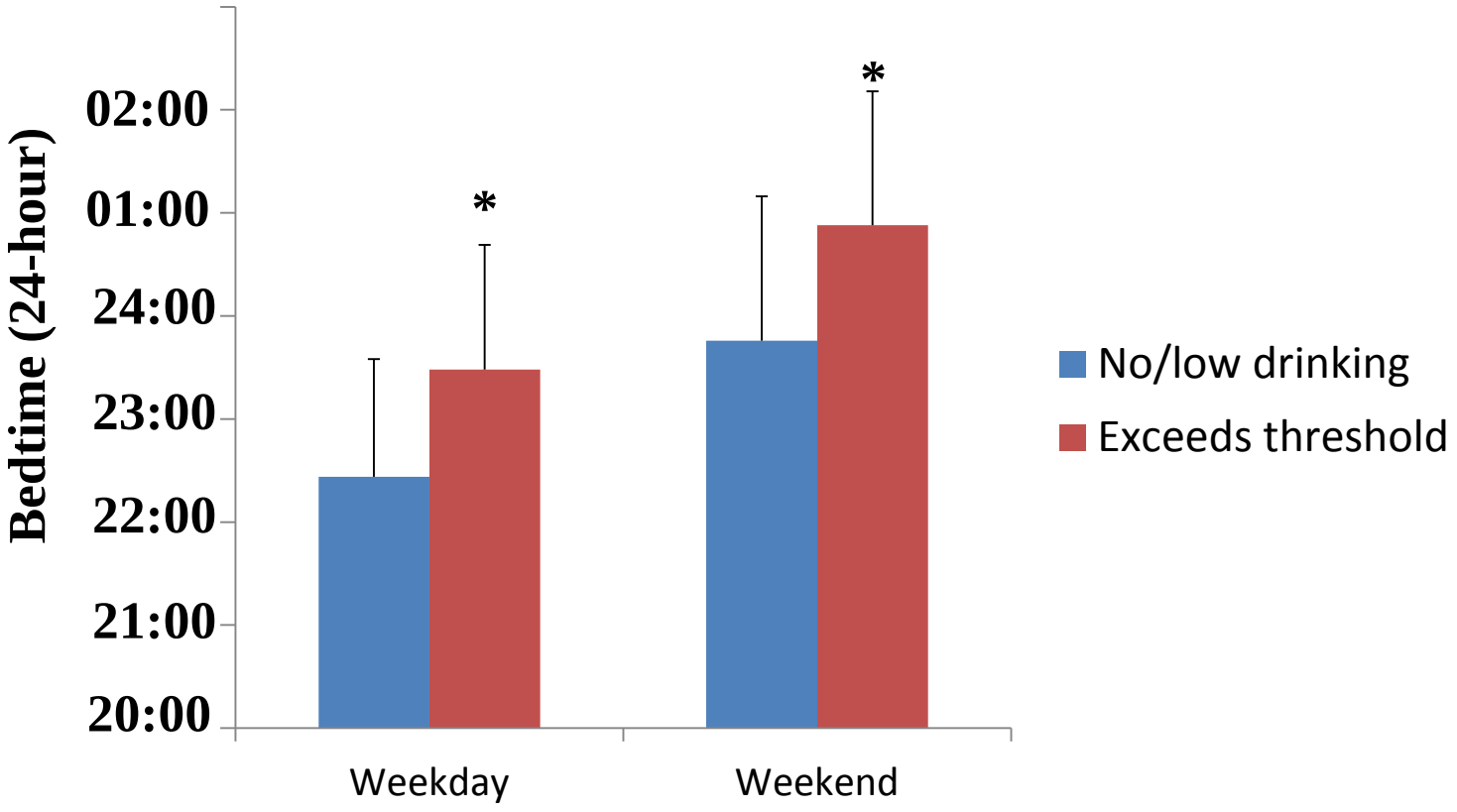
NCANDA Baseline Sleep EEG

Age-related differences in slow wave sleep (N3) and frontal EEG delta power

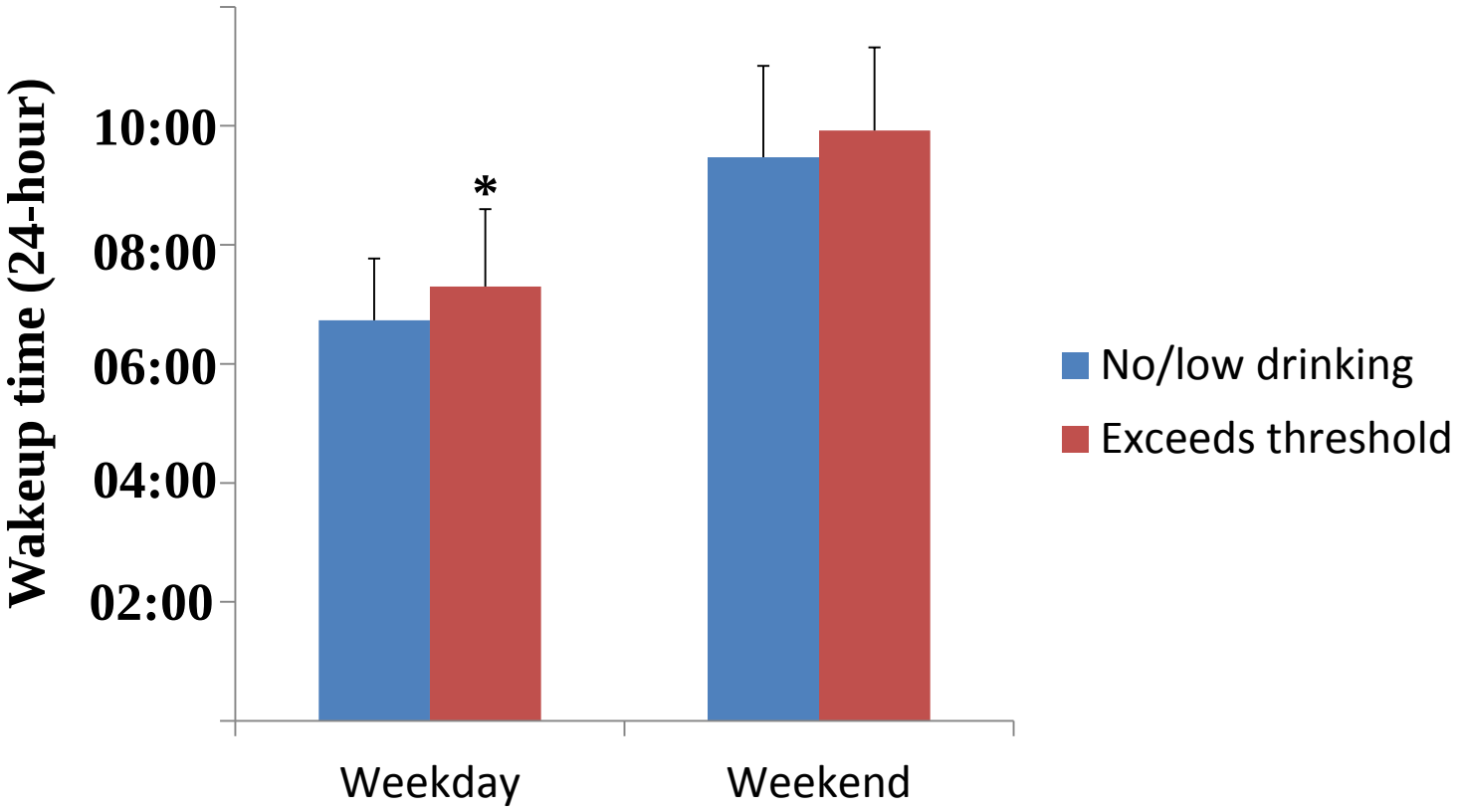




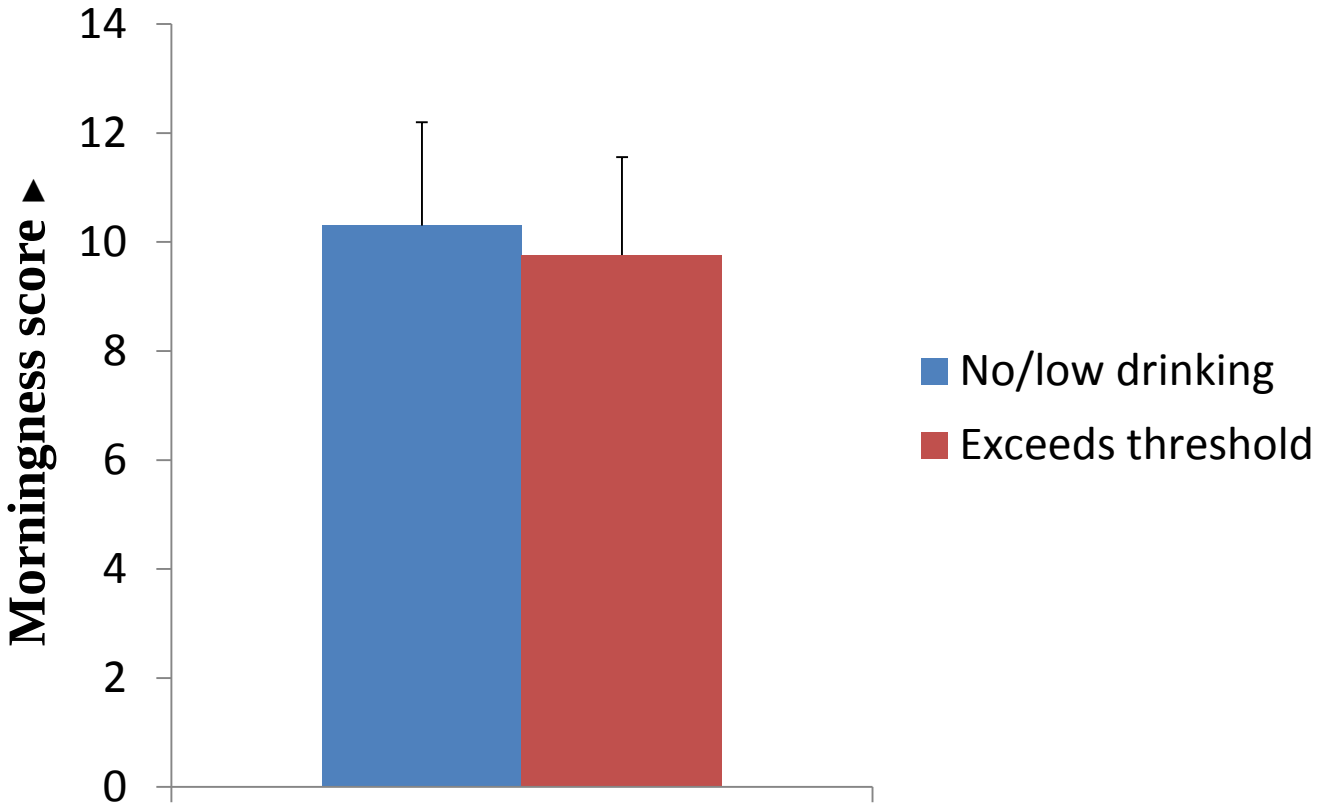
No/low Drinking vs Exceeded Threshold: Bedtime



No/low Drinking vs Exceeded Threshold: Wake-up time



No/low Drinking vs Exceeded Threshold: Chronotype



Summary of baseline sleep behavior

- Cross-sectional results confirm findings of others showing that older adolescents have shorter time in bed and later bedtimes.
- Older adolescents are more likely to be evening-types, particularly evident in boys.
- Adolescents show high weekday-weekend variability in time in bed.

Summary continued…

- Adolescents who exceed drinking thresholds have later bedtimes on both weekdays and weekends, and later wake-up times on weekdays than others.
- Adolescents who exceed drinking thresholds tend to have greater eveningness tendency and a poorer sleep quality.

With a longitudinal design, NCANDA will be able to evaluate the impact of sleep behavior on subsequent alcohol use in adolescents and how the transition to alcohol use impacts sleep behavior.

NCANDA will also longitudinally explore associations between neuropsychological performance, sleep behavior, and alcohol use in maturing adolescents.

Composites with Greatest PDS Sex Effects