

NCANDA Symposium
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Executive Functioning Deficits and Problem Drinking

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NCANDA Executive Function Assessment

Problems with executive functioning in everyday life

- Behavior Rating Inventory of Executive Function

Performance-based cognitive tests

- Attention: Continuous Performance Test
- Working memory: Short Fractal N-Back Test

Delay Discounting task

fMRI Antisaccade Task: Pittsburgh & Duke sites

Behavior Rating Inventory of Executive Function

- 80 self-report items: often, sometimes, never
- Age adjusted t-scores: higher is worse
- Validity: inconsistency, extreme responses
 - 4 subjects with invalid scores were excluded

Global Executive Composite [GEC]

Behavioral Regulation

Inhibitory Control

Shift: Behavior/Cognition

Emotional Control

Monitoring

Metacognition

Working Memory

Tasks: Plan

Tasks: Organize

Tasks: Complete

Behavior Rating Inventory of Executive Function

Face validity: Example items

Behavioral Regulation

- Inhibitory Control: “I have trouble waiting my turn.”
- Shift: Behavior/Cognition: “I get upset by a change in plans.”
- Emotional Control: “I have angry outbursts.”
- Monitoring: “I don’t know when my actions bother others.”

Metacognition [Task Efficiency]

- Working Memory: “I forget instructions easily.”
- Tasks: Plan “I start projects without the right materials.”
- Tasks: Organize “My desk/workspace is a mess.”
- Tasks: Complete “I have problems completing my work.”

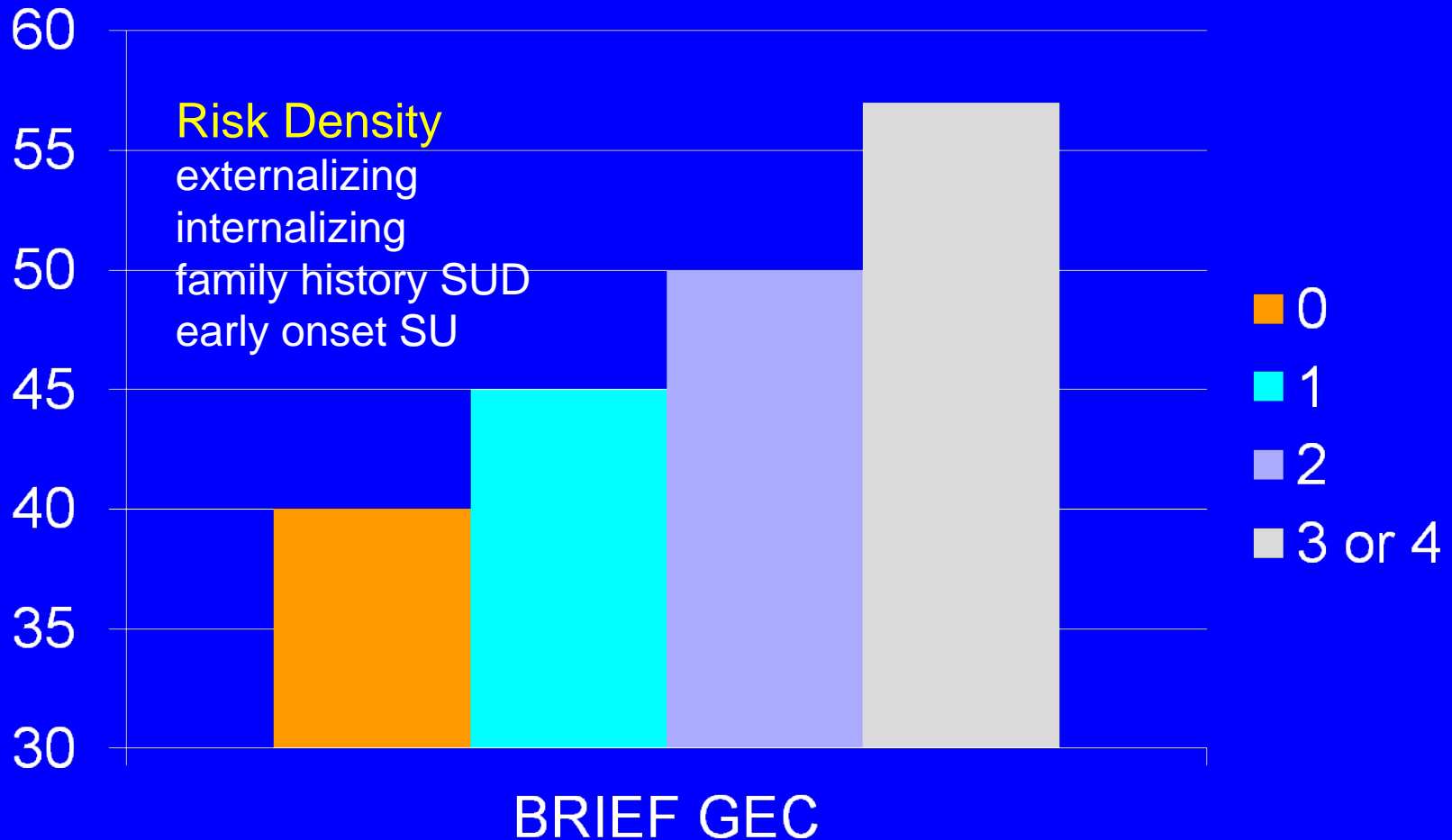
BRIEF GEC correlations

| Concurrent Validity | r |
|------------------------------|--------|
| UPPS Premeditation (lack of) | .44*** |
| UPPS Perseverance (lack of) | .33*** |
| UPPS Urgency (positive) | .45*** |
| UPPS Urgency (negative) | .48** |
| UPPS Sensation Seeking | .10 |

| Stability | r |
|----------------------|--------|
| GEC BL x GEC 1 yr FU | .71*** |

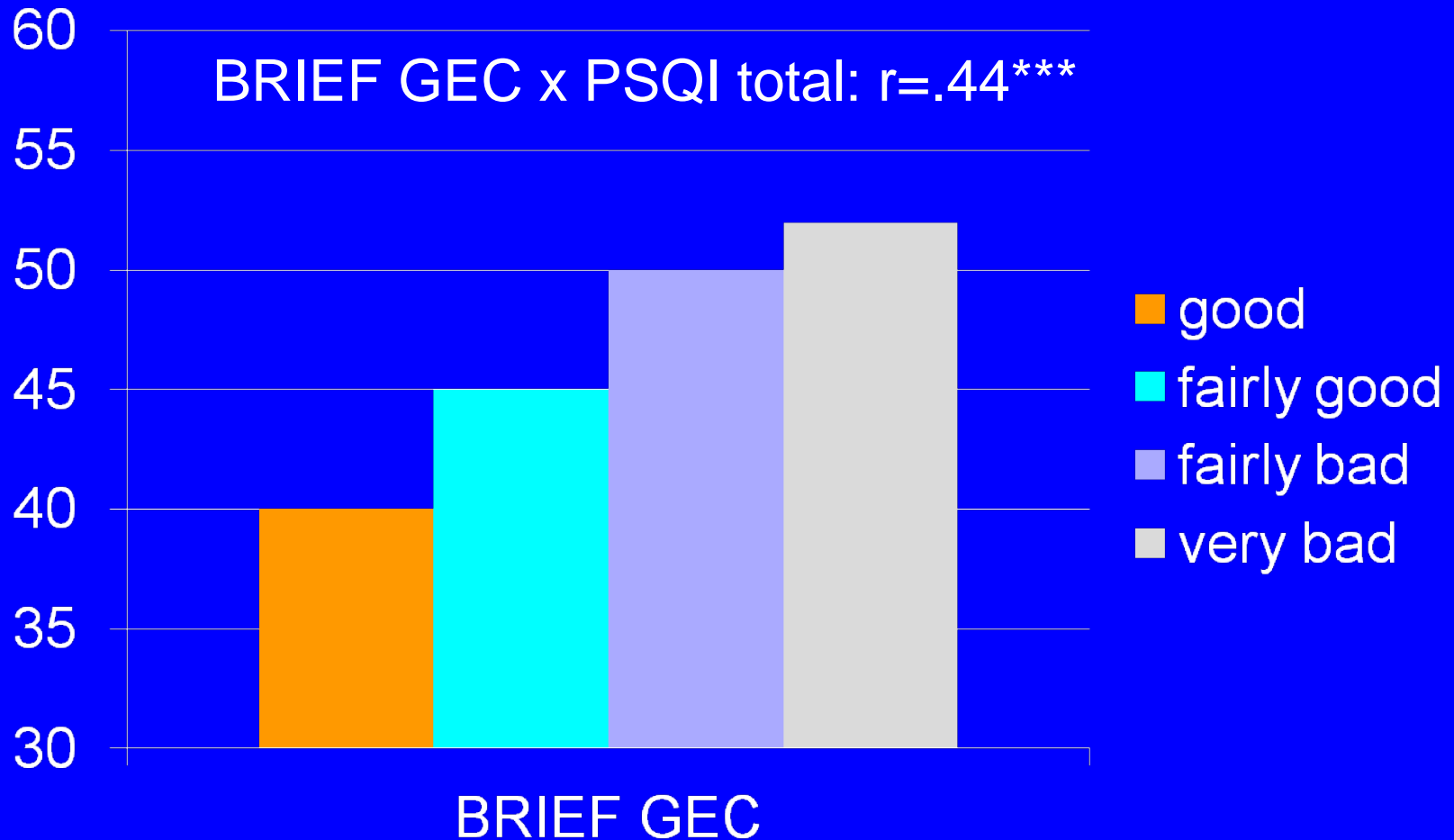
p: *<.05; **<.01; ***<.001

Higher Risk Density & Worse Executive Functioning



F=52.3, df 3,727, p<.001; covariates: age, sex, SES; s.d.= 10;
see Brown et al. 2015 J Studies Alc Drugs for NCANDA Risk definition

Poorer Sleep Quality & Worse Executive Functioning



$F=28.3$, $df\ 3,724$, $p<.001$: covariates: sex, age, SES

Life Events Questionnaire

- 67 self-report items: yes or no
- Items classified by
 - Uncontrollable or controllable
 - Discrete or chronic
 - Positive or negative
- Composite Scales, e.g.
 - Negative Uncontrollable
 - Negative Controllable
 - Negative Composite

Life Events Questionnaire

Example items ...during the past year...

Discrete Negative Uncontrollable: “My parents divorced...”

Discrete Negative Controllable: “...I ran away from home”

Chronic Negative Uncontrollable: “my parent had problems at work”

Chronic Negative Controllable: “...arguments with my parents...”

Discrete Ambiguous Uncontrollable: “Our family moved...”

Discrete Positive Controllable: “I received a special award...”

BRIEF GEC x LEQ correlations

| | r |
|----------------------------------|---------|
| Discrete Negative Uncontrollable | .19*** |
| Chronic Negative Uncontrollable | .22*** |
| Discrete Negative Controllable | .25*** |
| Chronic Negative Controllable | .41*** |
| | |
| Negative Composite | .39*** |
| | |
| Discrete Positive Controllable | -.13*** |

p: *<.05; **<.01; ***<.001; covariates: age, sex, SES

NCANDA Cognitive Performance Tests

Attention: Continuous Performance Test

Working Memory: Short Fractal N-Back Test

Emotion: Emotion Recognition; Differentiation

General Ability: Vocabulary, Reading, Math

Summary scores: accuracy & speed (z scores)

Sullivan et al. (2016) *Neuropsychology* 30 (4): 449-473

BRIEF x cognitive test correlations

| BRIEF GEC | accuracy | speed |
|-----------------|----------|-------|
| Attention | -.05 | -.03 |
| Working Memory | .02 | -.01 |
| Emotion | .02 | .08 |
| General Ability | -.04 | .05 |

[p: *<.05; **<.01; ***<.001; Covariates: age, sex, SES]

BRIEF x Delay Discounting

Delay Discounting: Expressed preference for smaller amount today vs larger amount later

| BRIEF scale | \$100 | \$1000 |
|---------------------------|--------------|---------------|
| Inhibitory Control | .10* | .12** |
| Flexibility | .06 | .07 |
| Task Organization | .03 | .01 |
| Task Completion | .04 | .04 |

[p: *<.05; **<.01; ***<.001; Covariates: age, sex, SES]

Sullivan et al. (2016) Neuropsychology 30 (4): 449-473

BRIEF x MR structural: gray indices

BRIEF GEC

| | volume | thickness | surface area |
|-----------|--------|-----------|--------------|
| Frontal | -.04 | -.05 | -.01 |
| Temporal | -.01 | -.03 | .02 |
| Parietal | -.02 | -.03 | .01 |
| Occipital | -.05 | -.03 | -.02 |
| Cingulate | -.05 | -.04 | -.02 |
| Insula | -.04 | -.07* | -.02 |
| TOTAL | -.04 | -.06 | .00 |

p: *<.05; **<.01; ***<.001; Covariates: age, SES

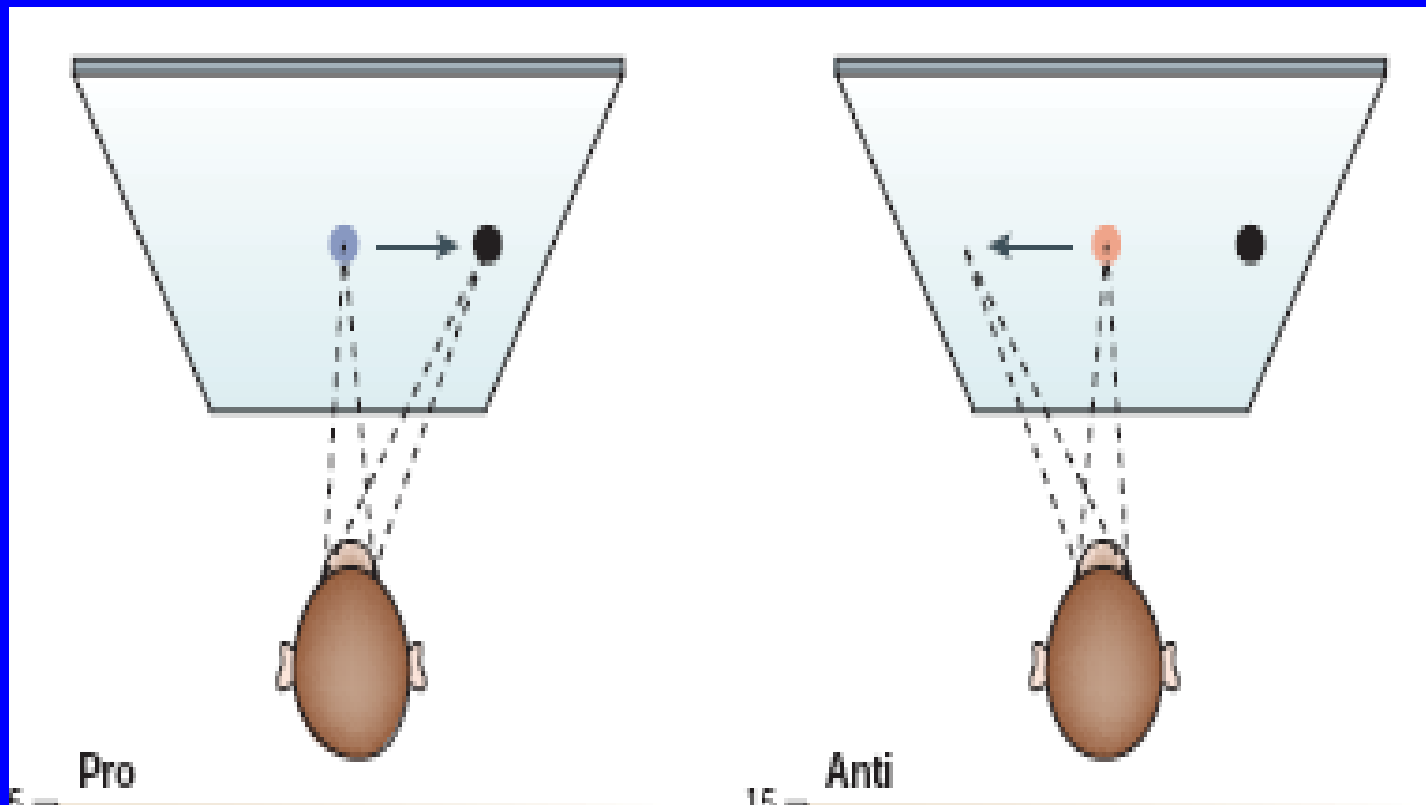
BRIEF x DTI indices: association fibers

| | BRIEF GEC | | | |
|-----------------------------|-----------|------|-------|------|
| | FA | MD | L1 | LT |
| <i>Fasciculi</i> | | | | |
| Superior longitudinal | -.07 | .05 | .01 | .02 |
| Superior frontal-occipital | -.08* | -.01 | -.07 | .01 |
| Sagittal stratum | .02 | -.01 | .02 | -.04 |
| Uncinate | -.08* | .06 | .00 | .06 |
| <i>Limbic tracts</i> | | | | |
| Fornix | .01 | .03 | .04 | .01 |
| Striatia terminalis | .00 | .04 | .09* | -.02 |
| Anterior mid cingulum | -.02 | .10* | .11** | .01 |
| Inferior cingulum | .00 | -.01 | .01 | -.03 |

p: *<.05; **<.01; ***<.001; Covariates: age, sex, SES

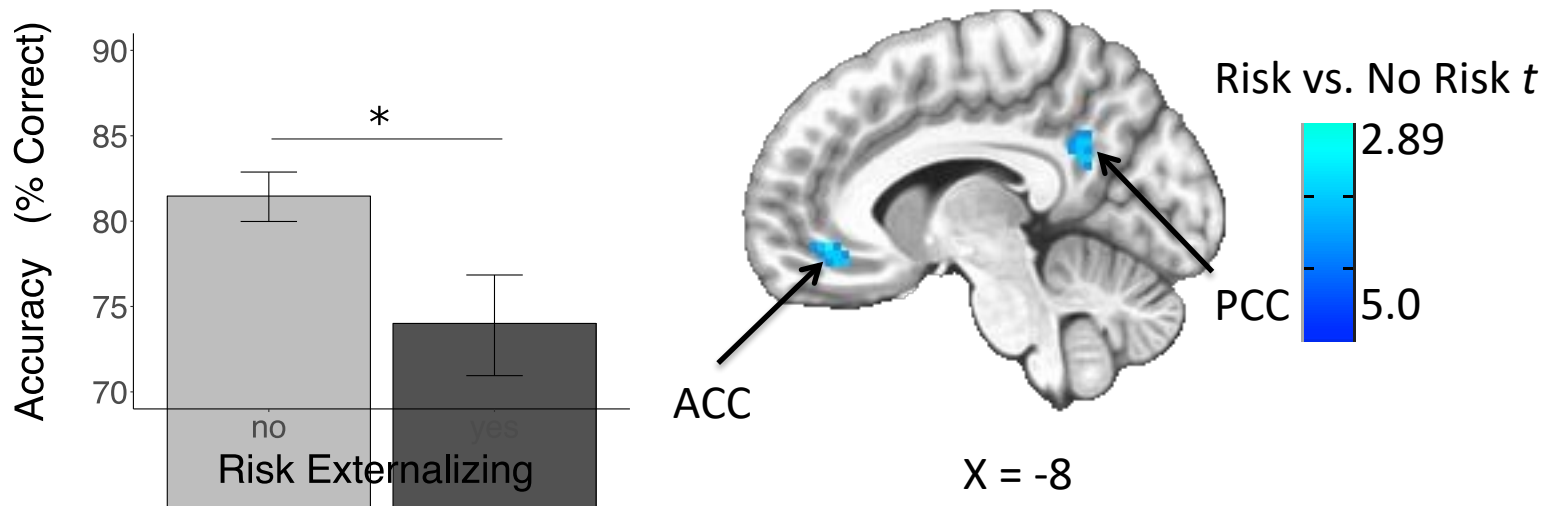
Behavioral regulation: Anti-Saccade Task

Look to the “mirror” location of the target



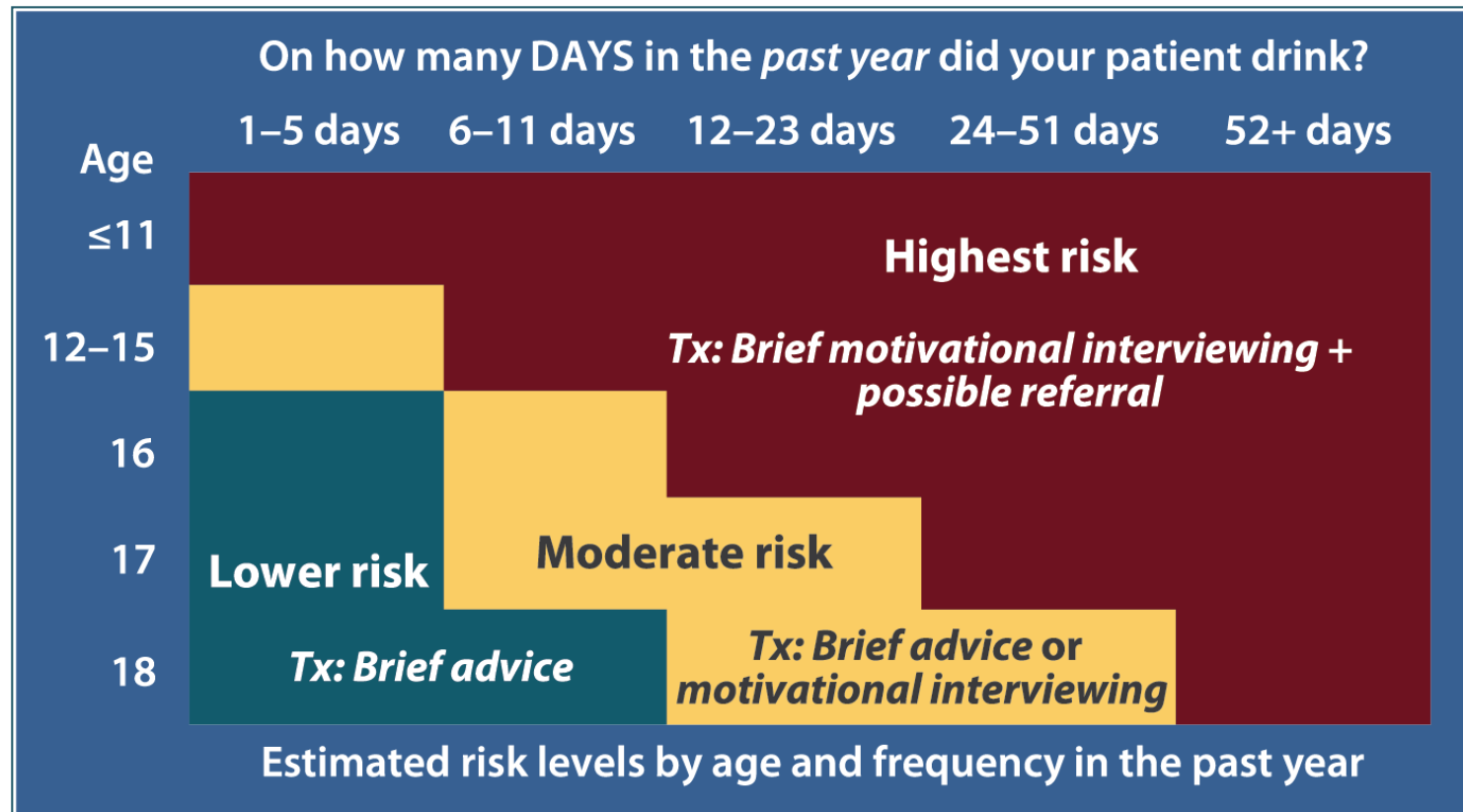
PRO-SACCADE

ANTI-SACCADE

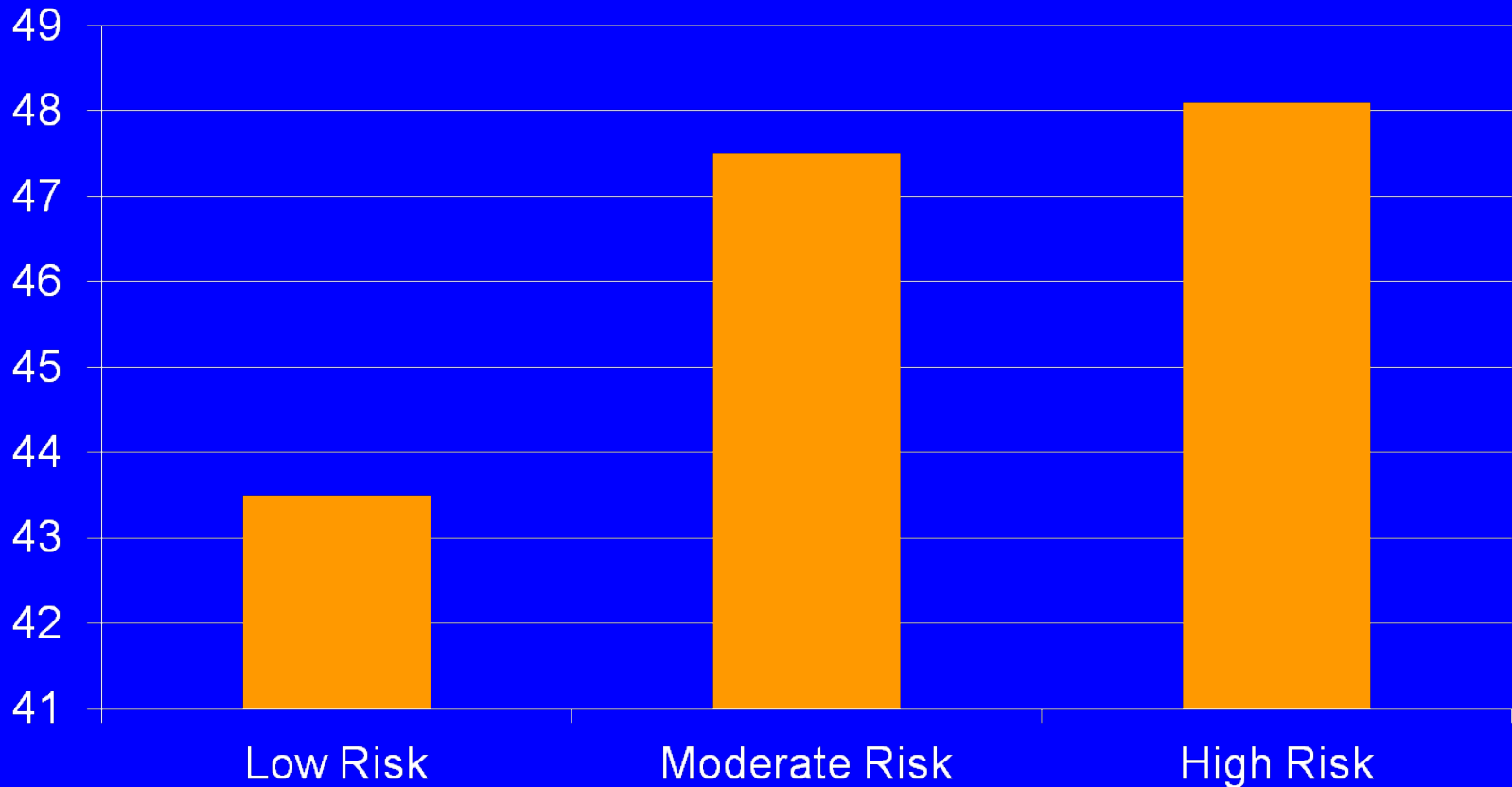


Participants in the externalizing risk group had significantly lower antisaccade accuracy at baseline ($p < .05$). Behavioral differences were accompanied by reduced activation in the anterior- and posterior cingulate cortices (ACC, PCC; $p < .05$, corrected) during the response period at baseline.

AUD Risk by # Days Alcohol Use in Past Year



AUD Risk Alcohol Use Frequency x BRIEF



F=7.0, d.f. 2,723; p<.01; covariates: sex, age, SES

Age Defined Binge Alcohol Use

Widmark equation to estimate BAC

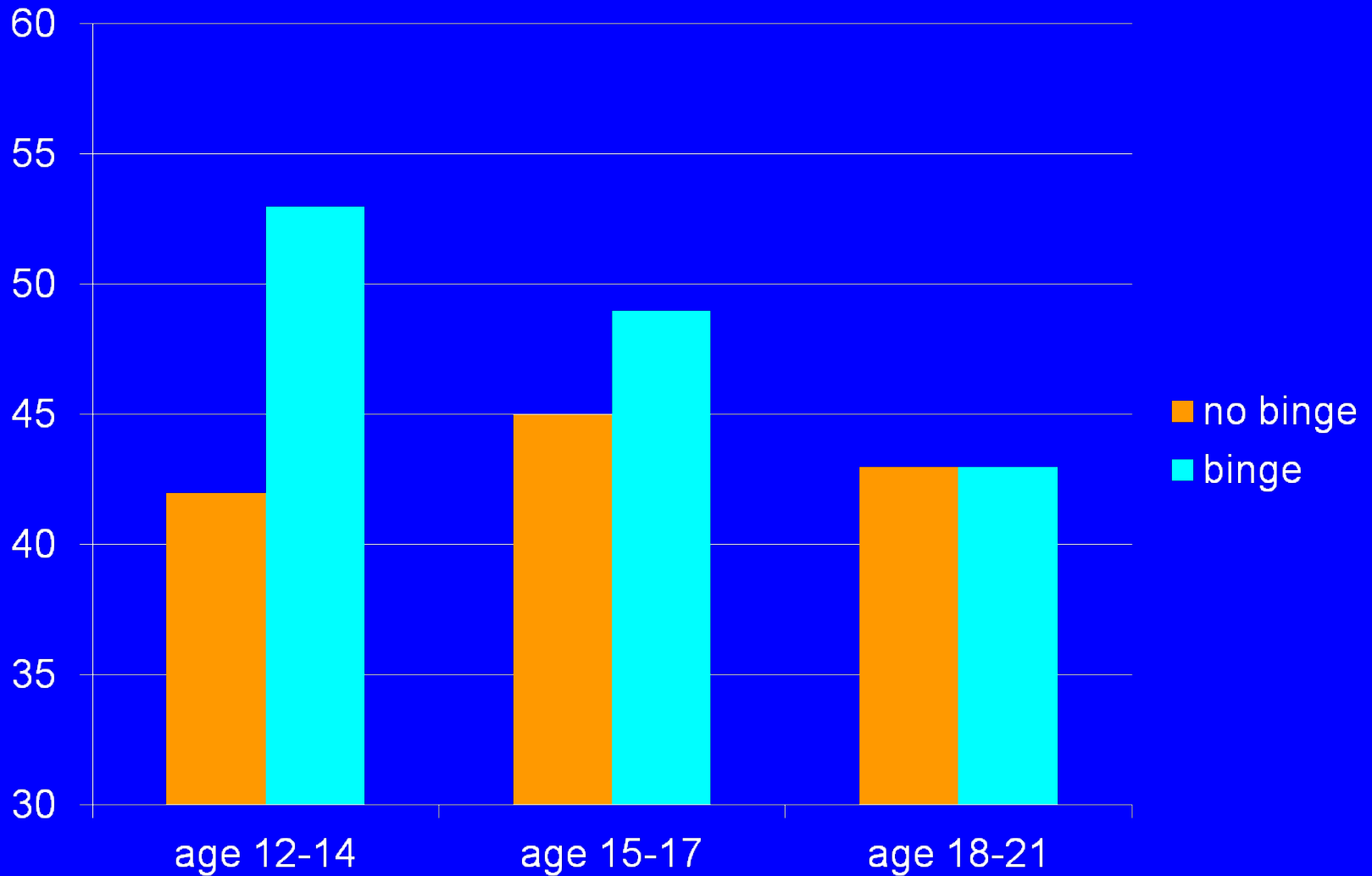
Children differ by age and gender on

- body composition [total body water]
- alcohol elimination rate [accelerated]

Binge definitions

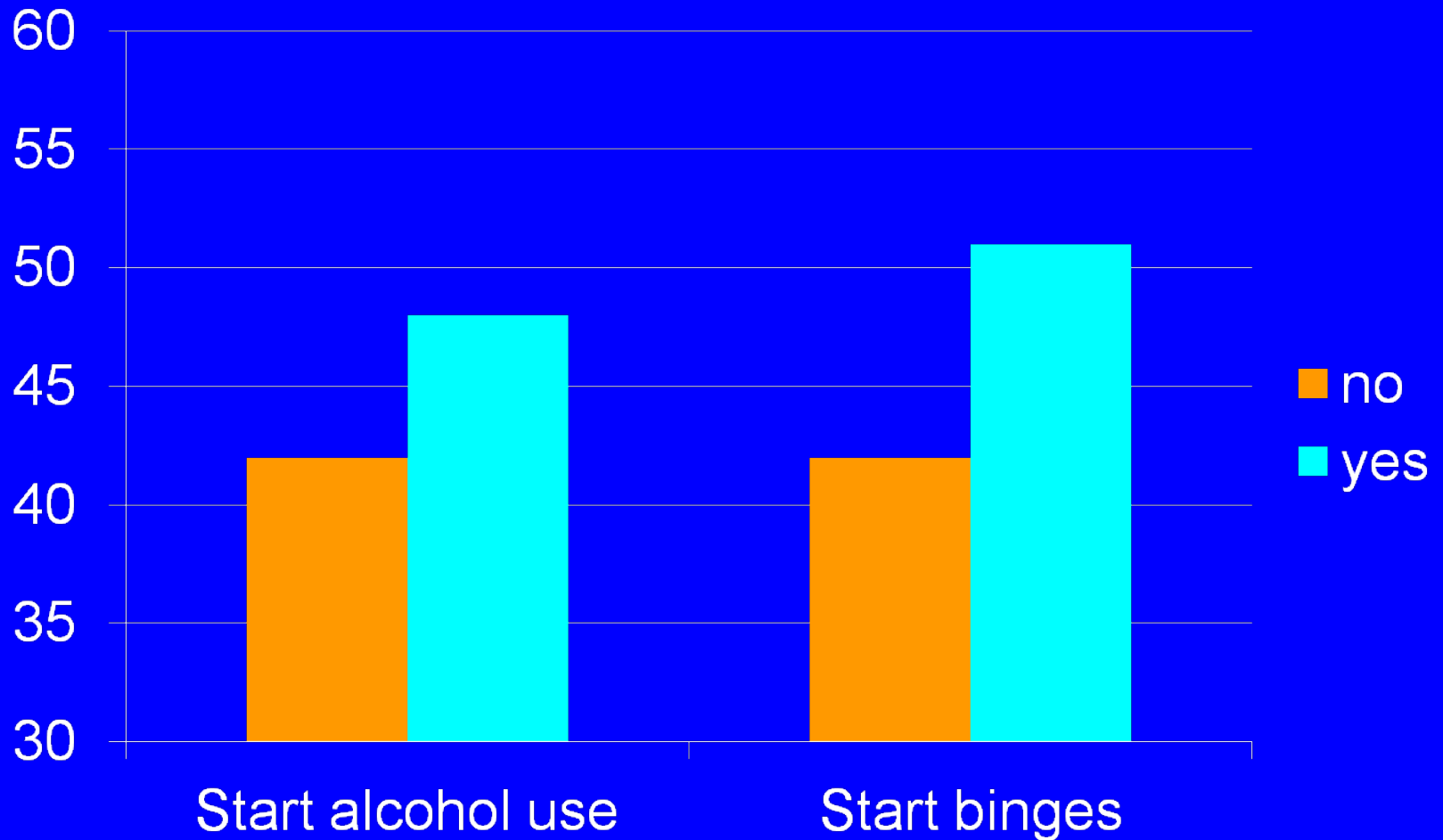
| age | males | females |
|-------------|----------|----------|
| 9-13 | ≥ 3 | ≥ 3 |
| 14-15 | ≥ 4 | ≥ 3 |
| 16-17 | ≥ 5 | ≥ 3 |
| 18 or older | ≥ 5 | ≥ 4 |

BRIEF GEC x past year binge [baseline]



binge x age: $F=3.1$, $df\ 2,810$, $p<.05$

At ages 12 -14, worse BRIEF predicts initiation of alcohol use and binges at 1 year FU



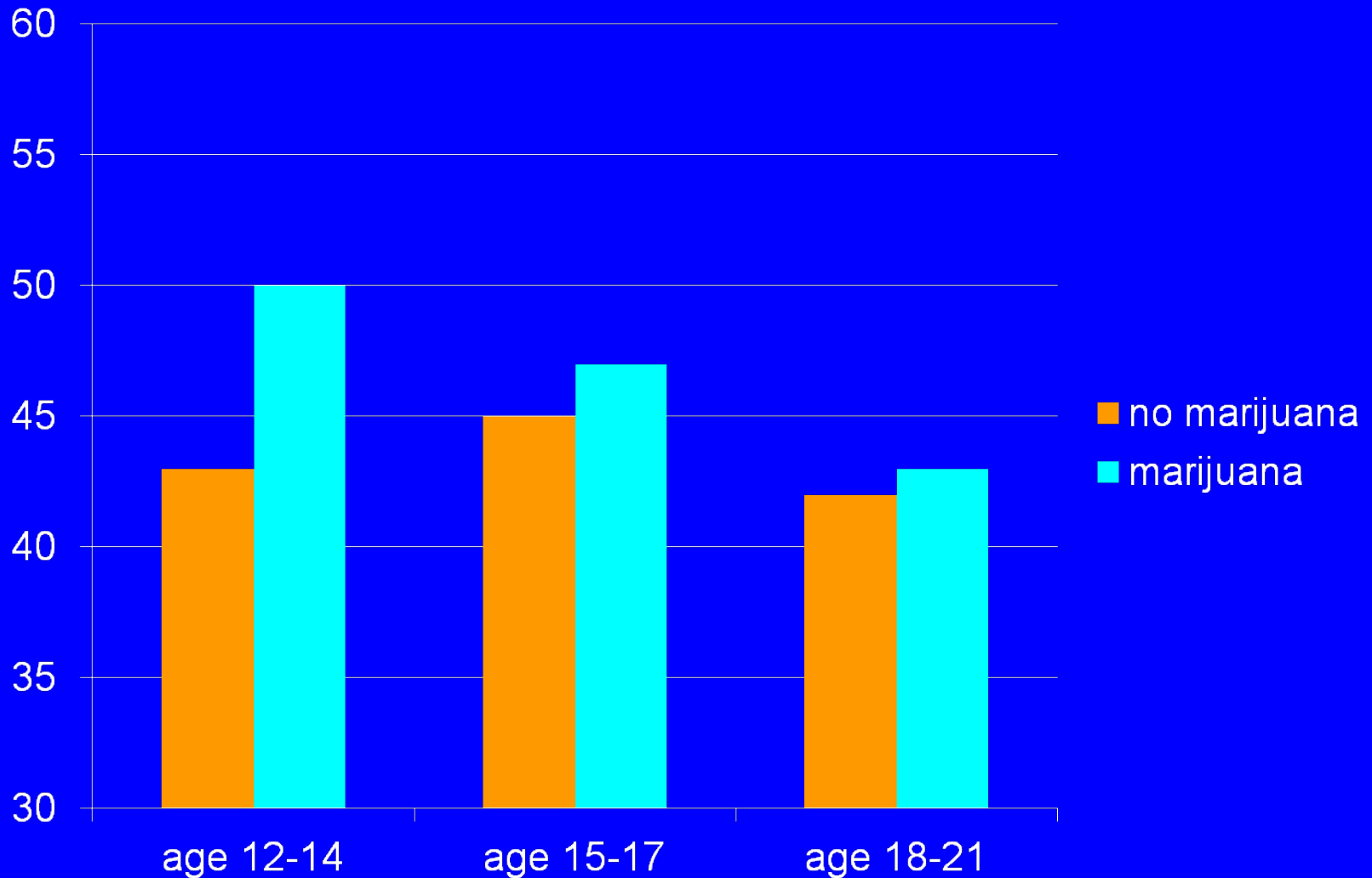
F=6.3; F=5.1, $p \leq .02$: covariate: sex, age

BRIEF @ BL predicts # binge days 1 yr FU

| | F | d.f. | p |
|-------------|------|-------|-------|
| Age 12-14.9 | 12.8 | 1,280 | <.001 |
| Age 15-17.9 | 1.5 | 1,280 | ns |
| Age 18-21.9 | 2.9 | 1,164 | ns |

covariates: age, sex, # binge days @ BL

BRIEF GEC x any lifetime marijuana use [baseline]



marijuana; sex & SES: $F=8.6$, $df\ 2,717$, $p<.05$; age: $F=1.7$

BRIEF @ BL x # marijuana days past year

| | F | d.f. | p |
|-------------|-----|-------|------|
| Age 12-14.9 | 1.0 | 1,295 | ns |
| Age 15-17.9 | 5.0 | 1,306 | <.05 |
| Age 18-21.9 | 8.8 | 1,199 | <.01 |

covariates: age, sex

NCANDA EF: Summary

- **BRIEF validity measures EF construct**
- **EF problems in everyday life distinct from EF skills assessed by cognitive testing**
- **Correlated with other risk variables**
 - **Risk Density, Sleep Quality, Adverse Life Events**
- **BRIEF not sig. correlated with cortical gray volume, thickness, surface area; DTI indices**
- **Predicted initiation of alcohol use and binges in young adolescent period; marijuana use**
- **BRIEF compliments other measured constructs important for understanding adolescent substance use risks and outcomes**