ADOLESCENT ADDICTION IN THE CONTEXT OF DEVELOPMENT

Sandra A. Brown, Ph.D.
Vice Chancellor for Research
Distinguished Professor
University of California, San Diego
NO CONFLICT OF INTEREST

UNIVERSITY OF CALIFORNIA, SAN DIEGO

GOALS FOR PRESENTATION

- Discuss adolescent development and alcohol/drug involvement.
- Highlight research on impact of alcohol/drugs on functioning during adolescence.
- Describe neurocognitive impact and long term recovery associated with alcohol/drug use.
- Suggest screening and intervention implications of recent clinical research findings.
ADOLESCENT AUDS/SUDS OCCUR IN THE CONTEXT OF DEVELOPMENTAL CHANGES

- Biological
  - (pubertal, neuroanatomical)
- Socioemotional
  - (family/peer/intimate relations, emotional lability and management)
- Cognitive
  - (information processing, executive functioning)
- Behavioral
  - (risk taking, self-regulation)

ADOLESCENT DEVELOPMENT: WHAT SHOULD WE EXPECT?

- Across species—accelerations in:
  - Activity level, Socialization, Experimentation and Risk Taking
  - Move to Independence & New Roles
- Development of Self-Regulation is Critical - Neurocognitive
  - Affect management
  - Behavioral choice & control
  - Requires new environments

BRAIN DEVELOPMENT

WHAT DO WE KNOW ABOUT ADDICTION AND DEVELOPMENT?

1. The earlier you start the faster you get addicted
2. Adolescent brains are ideal for drugs of abuse
   - resistant to sedative effects
   - rapid conditioning
   - maturational sequence is ideal
   - flexible for compensation
   - slow cumulative effects
3. Personality and expectancies (biology/environment) prime us for addiction
4. Addiction alters development

BRAIN REGULATORY SYSTEMS CRUCIAL TO ADOLESCENT SUCCESS BEGIN TO DEVELOP BEFORE AGE 11

- Emotional Control
- Social Regulation
- Behavioral Control and Attendance to Social Rules
- Regulation of Sleep and Activation Cycles
- Regulation of Stress Response

Zucker, 2006

NEURAL CIRCUITRY UNDERLIES THESE REGULATORY DEVELOPMENTS

- Suppress/inhibit prepotent responses
  - Right inferior frontal cortex to basal ganglia
- Suppress irrelevant information
  - Dorsolateral prefrontal cortex and association areas (working memory) and anterior cingulate
- Identify emotions and discriminate emotional facial expressions
  - Amygdala
- Differences in these areas are associated with early AUD/SUDs
TWO MAJOR DEVELOPMENTAL RISK PATHWAYS LINKED TO NEURAL SUBSTRATES

- Undercontrol-externalizing behaviors, impulsivity, high activity, aggressiveness, rule breaking
- Negative Affectivity- intense response to stimuli, internalizing behaviors, anxiety, depression, social inhibition
- Pathways demonstrated in 7 longitudinal studies
- Risks for MH disorders and alcohol/drug Dxs

ADOLESCENT BRAIN DEVELOPMENT

1. Expansion of the Cerebral Cortex
   - temporal, parietal, prefrontal

2. Maturation of Subcortical structure within the medial temporal lobe - hippocampus, amygdala- areas with high densities of sex steroid receptors

3. Reduction of Grey Matter/Increase in White Matter volume

4. Loss of 50% of neuronal connections

5. Repeated periods of Dendritic Pruning

6. Regional Response Changes – (eg, prefrontal, limbic regions) reflect changes & subserve emerging Cortical

4. Myelination proceeds posterior to anterior
STRUCTURE AND FUNCTION CHANGES AS BRAIN MATURATION CONTINUES INTO THE EARLY TO MID 20s

SELF REGULATION = ACQUIRED SKILLS FOR MATURE DECISION MAKING AND BEHAVIOR

· REQUIREMENTS:
  · Cortical Control
  · Affective Arousal/Motivation
  · Behavioral Competence

· COGNITIVE PROCESSES:
  · Bottom up: affect alters information processing
  · Top down: cortical control of affective responses
  · Inhibition: initial/primary response
  · Reappraisal: evaluate own response

ADOLESCENT BRAIN DEVELOPMENT: DECISION MAKING AND RISKY BEHAVIOR

· Incomplete neural development leads to risky decisions
· Presence of peers alters decisional process
· Strong emotions may override rational decision-making
· Risk-taking can be good – facilitates transitions, necessary exploration and autonomy
ALCOHOL'S UNIQUE ROLE IN SOCIETY: PREFERRED DRUG OF YOUTH

Source: Monitoring the Future, 2007

- Use less often
- Greater intensity

YOUTH DRINK MORE DANGEROUSLY THAN ADULTS: LESS OFTEN BUT TWICE AS MUCH

Source: SAMHSA National Survey on Drug Use and Health

- 38% of 12-17 year olds who drank last year
- 1 or more alcohol related problems (National Household Survey on Drug Abuse, SAMHSA)

- 53% of HS seniors drank 10 or more times last year
  - 2/3 had at least 1 alcohol problem
  - 1/3 had 3 or more problems

Monitoring The Future, O'Malley, Johnston & Bachman
HIGHEST AUD/SUD PREVALENCE IS LATE ADOLESCENCE

Behavioral Milestones:
Progress Through School

Enter and Complete High School

1 in 3 report alcohol hurt grades

Academic Problems
Low Involvement

Behavioral Milestones:
Independence / Drivers License

Permit
License

1 in 5 unsafe driving ½ single vehicle crashes related

Alcohol: Accidents
Injuries
Deaths
### WHY BE CONCERNED ABOUT ALCOHOL / DRUGS DURING ADOLESCENCE: ENHANCED RISK

- Depression
- Anxiety
- Legal problems
- Education
- Adult relations

### BEHAVIORAL MILESTONES: NEW TYPES OF RELATIONSHIPS

- Stable Friendships
- Romance
- Sex
- Children

1 in 2 regret behavior
1 in 5 relationship problem

### WHY BE CONCERNED ABOUT ALCOHOL/DRUG USE DURING ADOLESCENCE? MORTALITY

Linked to or the cause of the top 3 causes of death among adolescents:
1. Accidents
2. Suicides
3. Homicides

+ Hereditary Developmental Pathways (Cumulative & Cascading Effect)
## WHY BE CONCERNED ABOUT ALCOHOL/DRUGS DURING ADOLESCENCE? ANIMAL STUDIES

- **Compared to Adults**, Adolescent animals are:
  - Less sensitive to acute sedative effects
  - More sensitive to disruption of memory, impairment of neurotransmission in hippocampus and cortex, and social facilitation
  - **Binges** produce long-lasting memory effects, damage frontal-anterior cortical regions and reduce neuronal repair
  - Prolonged ethanol exposure enhances withdrawal and produces long term changes in cortex and hippocampus.

## QUESTIONS?

## GOALS FOR PRESENTATION

- Discuss adolescent development and alcohol/drug involvement
- Highlight research on impact of alcohol/drugs on functioning during adolescence
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- Suggest screening and intervention implications of recent clinical research findings
NEURODEVELOPMENTAL MODELS FOR ADOLESCENT ALCOHOL PROBLEMS

- Neurodevelopmental Delay
  (Benegal et al, 2007)
- Generalized Disinhibitory Complex
  (Begleiter & Porjesz, 1999)
- Psychological Disregulation
  (Clark, Thatcher & Tapert, 2008)

FOCUS ON: FRONTAL, LIMBIC AND REWARD CIRCUIT DEVELOPMENT
MANY THEORIES WITH FEW REPLICATIONS

NEUROCOGNITIVE IMPACT OF ALCOHOL ON YOUTH: > 100 DRINKING EPISODES

- Middle Adolescence
  - Fewer Learning Strategies
  - Memory Impairment
- Late Adolescence
  - Attention Decrement
  - Visuospatial Impairment
- Withdrawal May Impact Different Abilities than Use

AUD YOUTH RETAIN 10% LESS 20 MINUTES AFTER LEARNING RELATIVE TO COMMUNITY TEENS

- Alcohol Dependent
- Nonabusing Comparisons

- Age
- Grade
- SES
- FH
- Gender
- 3 weeks abstinence
- 20 minute delay test
NEUROCOGNITIVE FUNCTIONING DETERIORATES WITH CONTINUED USE AFTER TREATMENT

Tapert & Brown (1999)

ALCOHOL AND REDUCED LEFT HIPPOCAMPAL VOLUME

Nagel et al., 2005, PRN; Medina et al., 2007, NTT

PREFRONTAL CORTEX VOLUME

Medina et al., 2009, ACER
TEEN DRINKING & BRAIN ACTIVITY DURING SPATIAL WORKING MEMORY: COMPENSATION TO DEACTIVATION HYPOTHESIS?

<table>
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ALCOHOL CUE REACTIVITY OF AUD ADOLESCENTS COMPARED TO CONTROLS

Alcohol

Non-Alcohol

Matched:
Color
Light
Content
Valence


HEAVY USE = GREATER RESPONSE TO CUES WHICH DIMINISHES WITH ABSTINENCE

LEFT

Posterior cingulate/Precuneous

Emotion
Interest
Craving
Reward

Anterior Cingulate & NAc

Orbital/Prefrontal

• Orange: AUD teens had greater increase in response to alcohol pictures relative to other beverages

EARLY LIFE RISK FACTORS ARE LINKED TO NEURAL RESPONSE, EXPECTANCIES & ADOLESCENT DRINKING

**Neural Activation**
- Working Memory
- Cue Reactivity
- Response Inhibition

**Personality**
- Trait Disinhibition
- RI linked to:
  - Sustained/selective attention
  - Inhibitory control of habitual behavior
  - Risk taking decisions

**Cognitions**
- Expectancies
  - Positive Social Activating

**Alcohol/Drug Use**

(Anderson et al, 2006)

CONCERNED FOR ALCOHOL/DRUG EXPOSURE DURING ADOLESCENCE:

Alcohol/Drug use disorders develop early

Effects are more pronounced and dangerous for adolescents

Heavy use changes brain response and cognitive functioning.

Source: Masten et al, 2008 Pediatrics

HOW SUCCESSFUL ARE TEENS AFTER TREATMENT?

- As good as adults
- Comorbidity = Poorer Outcome
- Multiple patterns with developmental changes
- Use related to life success
- Hidden Risks (Cognitive Impact)
ADOLESCENTS RELAPSE AFTER ALCOHOL/DRUG TREATMENT AT RATES AS HIGH AS ADULTS

Highest risk in the first 3 months
1/3 of teens who have serious relapse in first 3 months subsequently abstain

Relapse risks:
- Social/positive mood
- Social/relief from stress

SUD ADOLESCENTS WITH MH DISORDERS DO MORE POORLY AFTER TREATMENT THAN OTHER ADOLESCENTS AND ADULTS

Co-morbidity
• Disruptive Disorders
• Depression & Anxiety
• Reduces Success
• Influences Relapse
  ▲ negative affect
  △ cog/beh symptoms
  ▼ relapse alone
2/3 report worse MH symptoms after relapse

FOR ALCOHOL/DRUG ABUSING YOUTH IN TREATMENT: ALCOHOL CONTINUES AS TOP DRUG

10 YEAR ALCOHOL/DRUG USE TRAJECTORIES OF TREATED YOUTH

1. Abstainers-infrequent use (30%)
2. Late Adolescent Resurgence (18%)
3. Early 20's Resurgence (14%)
4. Heavy Drinkers—no drugs (16%)
5. Heavy Drinkers/Drug Dependent (16%)
6. Chronic Severe (6%)

Long Term Course Varies Markedly:
Abstention, Regular use, Age Dependent Problems and Chronic Problems

ALCOHOL AND DRUG TRAJECTORIES FROM ADOLESCENCE TO MID-TWENTIES
MEMORY PERFORMANCE OVER 10-YEARS: CONCERN FOR HEAVY DRINKERS & DRUG USERS

ATTENTION PERFORMANCE OVER 10-YEARS: CONCERN FOR LATE TEEN YEARS

DRINKING BEFORE AND AFTER TRANSITION TO INDEPENDENT LIVING

* Exposure & SS Use Predict  * M > F
PROTRACTED USE IMPACTS DEVELOPMENT

- Socioemotional
- Cognitive
- Behavioral
- Biological

INTERVENTIONS NEEDED BEFORE YOUTH PROGRESS TO AUDs OR SUDs

- Prevention
- Secondary Prevention
- Secondary Intervention
- Treatment

Abuse/Dependence
Hazardous Use
Many adolescents not screened
No Use

<10% of AUD youth receive Treatment

DEVELOPMENT: IMPLICATIONS FOR SCREENING AND INTERVENTION

- Earlier is Better
- Skills are Learned - experience & practice (Planning, Evaluate Consequences, Control Impulses)
- Tailor Approach & Content to Teen Needs/Preferecess (Novelty, Emotions, Peers, Motivation, Structure & Consequences)
BRAIN DEVELOPMENT: IMPLICATIONS FOR TREATMENT AND PREVENTION

- The earlier the intervention or treatment, the better.
- Youth is a particularly vulnerable period for developing an alcohol/drug use disorder
- Every year use of alcohol/drug is delayed, the risk of developing an alcohol/drug use disorder is reduced.

SCREENING IS A CRITICAL LINK IN THE PREVENTION AND EARLY INTERVENTION OF ALCOHOL, DRUG AND MH PROBLEMS
MD/COUNSELORS/TEACHERS

- Sends a message of concern
- Is an opportunity for youth to ask knowledgeable adults about alcohol
- Is an opportunity to intervene before or after problems develop
- Should be routine in multiple settings

SCREENING WITH BRIEF INTERVENTION WORKS

★ Youth expect and are open to discussing alcohol and drug use (Steiner, 1996. Stern, 2006)

★ Screening and brief interventions can reduce alcohol, tobacco and marijuana use. (Knight, 2005, McCambridge, 2004, Oze et al., 2003)

★ Brief Interventions in Primary Care, ER and schools can reduce both use and problems (Monti, et al., 2004; Knight et al., 2009, Brown at al, 2008)
Developmental Neuroscience and Behavioral Science Suggests Such “SCAFFOLDING” Approaches May Protect and Facilitate Skill Development as the Brain Matures

BRAIN DEVELOPMENT: IMPLICATIONS FOR TREATMENT & PREVENTION

The youthful brain is not likely to exhibit optimal . . .

- Planning (second thought)
- Weighing negative consequences
- Impulse control
- THESE SKILLS ARE LEARNED through experience and practice

BUILDING DEVELOPMENTALLY INFORMED PREVENTIVE INTERVENTIONS

<table>
<thead>
<tr>
<th>Youth Preferences</th>
<th>Formats</th>
<th>Enhance</th>
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<tr>
<td></td>
<td>Context</td>
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<td>MET &amp; CBT</td>
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<td></td>
<td>Facilitators / Barriers</td>
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<th>Development issues</th>
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<td>Support autonomy &amp; Decision Making</td>
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PROJECT OPTIONS GOALS

1. Design a developmentally sensitive intervention appealing to youth
   - Motivational Enhancement
   - Alter Perceived Norms and Expectancies for Use/Non-Use
   - Cognitive Behavioral Skills

2. Market to attract youth with diversified alcohol involvement histories
   - Facilitators and Barriers
   - Multiple Formats and Topics

3. Tested intervention
   - Voluntary Engagement
   - Mediators and Proximal Outcomes
   - Distal Alcohol Outcomes

EARLY INTERVENTION MODEL: DEVELOPMENTAL SOCIAL INFORMATION PROCESSING

DECISION MAKING INFLUENCES ARE CHANGED: PERCEIVED NORMS

OVERESTIMATION
BINGE DRINKERS MAKE MORE QUIT ATTEMPTS & REDUCE PROBLEMS IF THEY ATTEND PROJECT OPTIONS

[Bar chart showing significant reductions in alcohol problems (physical, school, relationships)]

THIS DEVELOPMENTALLY FOCUSED MODEL OF PREVENTIVE INTERVENTION DESIGN MAY FIT FOR HIGH RISK POPULATIONS AND EMERGENT MENTAL HEALTH PROBLEMS OF ADOLESCENCE

- Minorities in greater proportion than at the schools
- Youth in Project Options reflect base rates of depression (20-25% of students)
- Higher rates of bullying and harassment are reported in Project Options sample than school samples
- Advertising focuses on issues salient to youth at risk for other drug and mental health problems

SCREENING WITH BRIEF INTERVENTION

Questions to Ask
Friends:
- Elementary- friend who drank
- Middle School- close friends who drink?
- High School – If friends drink, how much?
  - (≥5 is the RED FLAG)

Yourself:
- Elementary- Ever drink, smoke, MJ
- Middle School- How many times in the last year
- High School- How many times in the last year?
  - (≥6 is the RED FLAG)
If positive, continue – CRAFFT
AUDIT-C
WHAT DO YOUTH PREFER?

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<tr>
<th>PREFERENCE</th>
<th>COMFORTABLE</th>
<th>HONESTY</th>
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<tr>
<td>(1 = Most)</td>
<td>(%) Screen</td>
<td>(%) Likely</td>
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SAMPLE: N=2,133 12-18 Year Olds from Primary Care pediatrics clinics, school based health clinic (43% Lifetime alcohol use, 15% 2+ on CRAFFT)

POSITIVE SCREENS: Higher rates with paper and computer,
Lower comfort (same order),
Computer screen improves comfort

Knight, 2007

CRAFFT SCREENING:

- CRAFFT (Yes/No  Cutoff=2)
- Car- ever ridden in automobile with someone who had been drinking or was high
- Relax- ever drank to relax
- Alone- ever drank/used alone
- Forget- ever forgot what you did when you were drinking/using
- Family/Friends- wanted you to cut down or stop
- Trouble- ever got into trouble
- AUDIT-How often ( Score 1-4: Cutoff =3)
  - Average when you drink (>3)
  - Days drank 6 or more

POSITIVE SCREENING: BRIEF INTERVENTION

- MOTIVATIONAL INTERVIEWING
  - most effective with adolescents
- Screen Positive: Elementary
  - Advise to stop
  - Discuss with Parents
- CHECK PROBLEMS:
  - Friends, Sick/Blackouts, School work Parents, Law
- Middle School- 6+ Listen, Norms and Advise to stop
- High School- 6+ Listen, Share Norms and Risks
- No Problems- Personal Goal,Reduce Risk, Guidance, Flag for next visit
- Problems- Share Norms, Advise Stop or Refer for Assess, Return One Month

NIAAA Workgroup on Adolescent Screening, 2010
YOUNGER BOYS ACHIEVE HIGHER ALCOHOL BLOOD LEVELS

YOUNGER GIRLS ACHIEVE HIGHER BALS WITH LESS ALCOHOL

BRIEF INTERVENTION: RESOURCES

Booklets:  NIAAA, NIDA, AAP
Websites:  thecoolspot.gov
collegedrinkingprevention-
high school and parent versions
School/Community
Specialists
Treatment Programs

WHAT ABOUT TREATMENT??????
"SCAFFOLDING“ Approaches to Protect and Facilitate Skill Development as the Brain Matures

Fig. 3. Right lateral and top views of the dynamic sequence of GM maturation over the cortical surface.


ADOLESCENT DEVELOPMENT: WHAT SHOULD WE EXPECT?

- Accelerations in:
  - Activity level, Socialization, Experimentation, and Risk Taking
  - Move to Independence & New Roles
- Need for Self-Regulation
  - Cognitive Skills
  - Affect Management
  - Behavioral Choice & Control
  - New Environments

COGNITIVE BEHAVIORAL MODEL OF RELAPSE FOR ADULTS

Marlatt and Gordon
DEVELOPMENTAL MODEL OF RELAPSE

High Risk Situation

Coping Response

Initiation of Substance

Decreased Self-efficacy

Increased Probability of Relapse

Increased Motivation

Positive Use Expectancies

Abstinence Violation Effects

Increased Probability of Relapse

No Coping Response

Decreased Self-efficacy

Positive Use Expectancies

Abstinence Violation Effects

Increased Probability of Relapse

Brown & Ramo (2005)

Motivation

• abstinence

• problems

• drug specificity

Neurocognitive Development

• vigilance

• cue reactivity

• anticipation

Psychiatric Co-morbidity

• negative affect

• risk appraisal

• coping resources

Social Information Processing

• less differentiation

• perceived norms

Environment/Culture

• age dependent

• gender specific

Abstinence Expectancies

• 12-Step Participation maintains motivation

12-STEP PARTICIPATION MAINTAINS MOTIVATION

Treatment Intake

1-3 Month Follow-up

Days Abstinent

Abstinence-Focused Coping

Self-Efficacy

Motivation for Abstinence

Kelly, Myers & Brown 2000; Kelly et al 2008

12-STEP PARTICIPATION: WHAT CLINICIANS SHOULD KNOW ABOUT YOUTH

Any attendance helps (number first year sessions predicts long term outcomes)

Teens prefer to go to groups with teens

Perception of "someone like me" enhances AA/NA return rates

The closer - the better

Girls like girls- guys like girls

Kelly, Brown, et al 2009
### BRAIN DEVELOPMENT: IMPLICATIONS FOR TREATMENT & PREVENTION

The youthful brain is not likely to exhibit optimal...  
- Planning (second thought)  
- Weighing negative consequences  
- Impulse control  
- **THESE SKILLS ARE LEARNED through experience and practice**

### BRAIN DEVELOPMENT: IMPLICATIONS FOR TREATMENT & PREVENTION

Shape treatment to accommodate the youthful brain...  
- Responds to novelty  
- Influenced by peer issues  
- Influenced by emotion before logic  
- Primed for physical and sensory activities  
- Impose structure ("Be the frontal lobe")

### NEUROCOGNITIVE IMPLICATIONS FOR ADOLESCENT INTERVENTION

NP AREAS MOST AFFECTED:  
- Attention  
- Memory  
- Problem Solving

DEVELOPMENTAL CHANGES:  
- Activity level  
- Risk Taking  
- Socialization  
- New Environments  
- Experimentation  
- New Roles
NEUROCOGNITIVE IMPLICATIONS FOR ADOLESCENT INTERVENTION

PERSONALIZED FEEDBACK
- Expect improvement
- 2-5 weeks (preliminary)
- Measure in treatment to demonstrate

DEVELOPMENTAL NEEDS:
- Activity level
- Risk Taking
- Socialization
- New Environments
- Experimentation
- New Roles

NEUROCOGNITIVE IMPLICATIONS FOR ADOLESCENT INTERVENTION

Attention
- build skills and plan
- shorter sessions
- social/interactional approach
- focus on target (risks & rewards)

DEVELOPMENTAL NEEDS:
- Activity level
- Risk Taking
- Socialization
- New Environments
- Experimentation
- New Roles

NEUROCOGNITIVE IMPLICATIONS FOR ADOLESCENT INTERVENTION

- repetition
- compensatory approach
- monitor improvement

DEVELOPMENTAL NEEDS:
- Activity level
- Risk Taking
- Socialization
- New Environments
- Experimentation
- New Roles
NEUROCOGNITIVE IMPLICATIONS FOR ADOLESCENT INTERVENTION

Executive functioning
- Problem solving - real situations/affect
- Planning - social/affect
- Working Memory - Active Process

DEVELOPMENTAL NEEDS:
- Activity level
- Risk Taking
- Socialization
- New Environments
- Experimentation
- New Roles

ADOLESCENT ALCOHOL/DRUG TREATMENT TO SUPPORT DEVELOPMENT

P -> Promote activities that capitalize on the strengths of the developing brain
A -> Assist youth with challenges that require planning.
R -> Reinforce seeking advice/discussion for big decisions; teach decision making
E -> Encourage personal choice to facilitate motivation.
N -> Never underestimate the effects of substance use on the developing brain – protracted and subtle effects
T -> Tolerate the “oops” behaviors due to an immature brain.

HOW DO TEENS SUCCEED? MULTIPLE PATHWAYS OUT OF ADDICTION

1. Traditional
   - Support groups
   - Perceive as helpful
   - Half of Teens Do Not Attend Support Groups

2. Family Focused
   - Younger
   - Less exposure
   - Lower FH
   - Higher family participation

3. Early Individuation
   - Older Youth
   - Greater FH
   - Activities Helpful
   - More Anxiety
CONCLUSIONS:

1. AUD/SUDs Develop and Resolve in the Context of Adolescent Development
2. Multiple Pathways Into and Out of Alcohol & Drug Problems
3. Heterogeneity Affects Clinical Course
4. Youth Display a Remarkably Varied Course Following Treatment
   - Development Specific Challenges
   - Multiple Pathways to Success
5. Treatment should help Development

INTEGRATED MODELS OF ADDICTION RELAPSE: ADDITIVE AND TEMPORAL DYNAMICS

- Deal with all risks (social and affect risks shift over time)
- Subgroups—FH more W/D—more NP
- Temporal Dynamics—booster
- Use New Technologies—monitors

QUESTIONS?