BROWN Alpert Medical School

Women & Infants

Behavior and Executive Function Problems in School Age Children with Prenatal Methamphetamine Exposure

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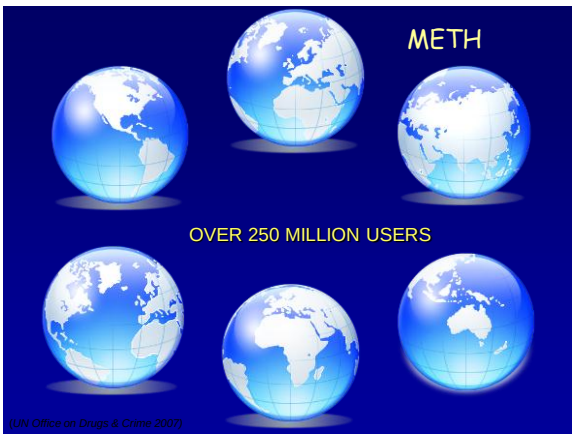
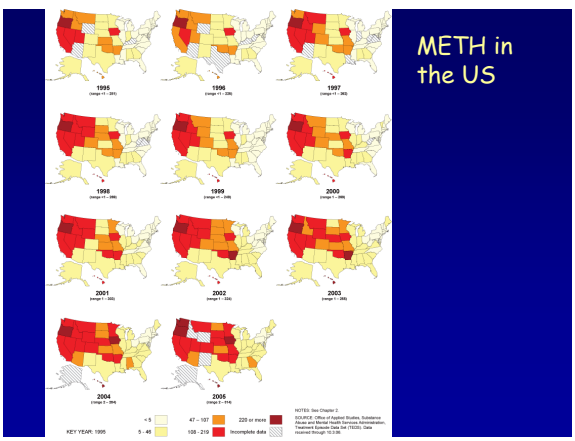
Drug Endangered Children Conference
Des Moines, IA Oct 23, 2012



(UN Office on Drugs & Crime 2007)



Infant Development Environment And Lifestyle Study

Brown

Oklahoma

California

Iowa

IDEAL

Hawaii

Auckland, NZ

IDEAL Recruitment

9/1/02 - 11/30/04

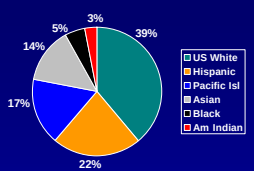
Screen births 7 hospitals → Postnatal consent → Enrolled At birth

- Postnatal sample: 3,708
- Follow up sample: **204** METH exposed **208** comparison
- Comparison mothers denied METH use / infants negative meconium tox
- Groups matched: race, birth weight, type of insurance, maternal education

Currently, completing the 7.5 year follow up

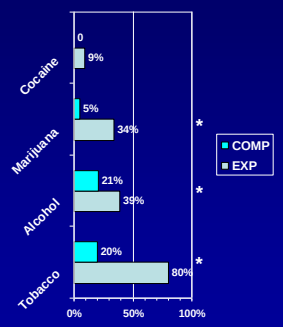
Demographic Characteristics

Race/Ethnicity

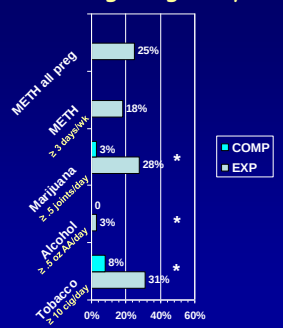


	EXP	COMP
Single, no partner	56%	34% *
Education <12th grade	46%	38%
Age (yr)	26	25
Low SES	34%	12% *

Prevalence of Alcohol and Other Substance Use During Pregnancy

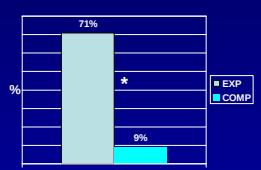


Heavy METH and Other Substance Use During Pregnancy



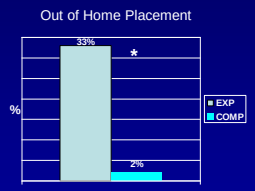
Substance Dependence Disorder-
SASSI (Substance Abuse Subtle Screening Inventory)

(biological mothers only)



Derauf et al Am J Drug Alc Abuse 2007

Child Protective Services at Discharge



Derauf et al Am J Drug Alc Abuse 2007

Early Effects of METH

Newborn medical outcomes

- poor suck — *Shah et al., Am J Perinatol 2012*
- require NICU admission
- poor growth (length)
- small for gestational age — *Nguyen et al., JPeds 2010*

Neurobehavior — *Smith et al., Neurotox & Terat 2008*

- (newborn) physiological and CNS stress
- (newborn) low arousal / more lethargy
- (3rd trim) poor quality of movement
- poor fine motor control ages 1-3 — *Smith et al., Neurotox & Terat 2011*

Growth

- decrement in length ages 1-3 — *Zabaneh et al., Am J Perinatol 2011*

Why Focus on Executive Function?

- **Adult meth abusers show deficits in EF because meth affects specific areas of the brain (from Rick Rawson based on imaging studies)**
  - prefrontal cortex *(working memory)*
  - anterior cingulate *(selective attention)*
  - temporal lobe *(episodic memory, depression)*
- **Meth affects the limbic prefrontal cortex which is involved in coding appetitive & aversive stimuli & conditioned cognition & behavior**
- **Prefrontal area is the site of action for other drugs of abuse (nicotine, alcohol, opiates, marijuana, cocaine) as well as mood disorders**

Deficits in Executive Function Associated with Meth Abuse

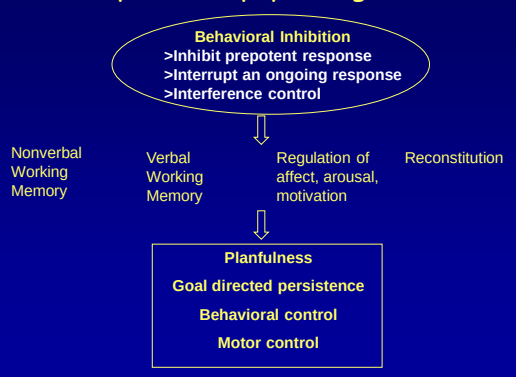
Poor judgment
Lack of insight
Poor strategy formation
Impulsivity
Unable to determine consequences of actions

- **Strategic planning**
- **Impulse control**
- **Organized search**
- **Flexibility in thought & action**
  - *Guy & Willis*

What is it ?

- **Goal-directed behavior**
- **Planning**
- **Organized searching**
- **Inhibition (impulse control)**
- **Self-correcting**
- **Flexible use of strategies**
  - *Welsh, Pennington & Groisser*

Barkley's Neuropsychological Model



Executive Function at 5.5 Years

Stroop Task. Hearts and Flowers

Rule:
- if heart, press key on the same side
- if flower, press key on the opposite site

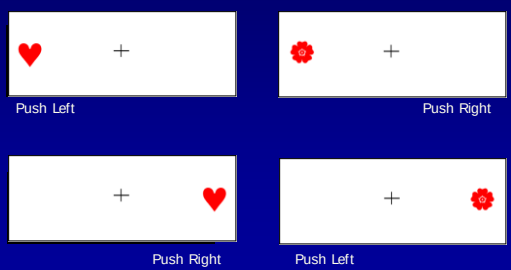
Conflict:
- Prepotent response: Press the key on the same side. Requires child to hold 'set' or rule that differs by picture

Measure:
- Errors
- Latency to press key (time)

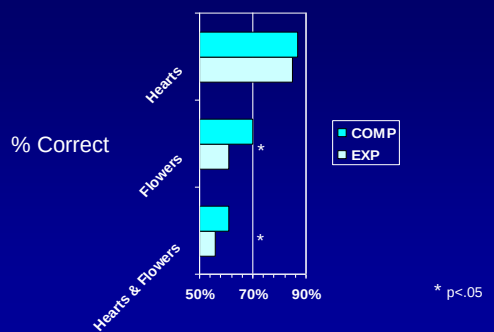
Inhibitory Control

HEARTS & FLOWERS

Congruent **Incongruent**



Inhibitory Control at 5.5 years



Derauf et al., JPEDS 2012

Executive Function at 5.5 Years

Continuous Performance Task

Rule:
- Press key when you see a picture
- EXCEPT when you see a ball, then don't press the key

Conflict:
- Prepotent response: Press the key for all pictures. Requires child to inhibit the key press for one picture

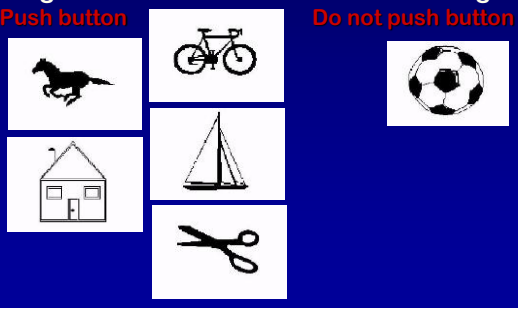
Measure:
- High probability of ADHD
- Hit reaction time increases over blocks
- Omission & commission errors

Impulsivity / Inattention

KIDDIE-CONNORS' CONTINUOUS PERFORMANCE TASK

Targets
Push button

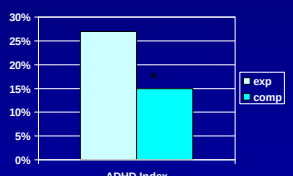
Nontarget
Do not push button



Impulsivity / Inattention at 5.5 Years

One picture presented on each of 200 trials in 5 blocks
With short and long interstimulus intervals

If target press button as fast as you can (75%)
If nontarget do not press button (25%)



* p<.01

Kiblawi et al., J Dev Beh Peds 2012

Behavior Problems at Years 3 to 5

Mean (SD)	Age 3		Age 5		P =	
	Exposed (n=141)	Comp (n=147)	Exposed (n=153	Comp (n=151)	Exp	Exp x Age
EXTERNALIZING	**53**	**52**	**53**	**50**	0.150	0.034
ADHD problems	5.3	5.2	5.5	4.6	0.259	0.029
INTERNALIZING	51	49	54	51	0.057	0.350
Emotionally reactive	3.2	2.3	3.7	2.5	0.006	0.363
Anxious/depressed	2.8	2.0	3.4	2.3	0.019	0.359
TOTAL PROBLEMS	52	51	53	50	0.119	0.134

Syndrome and DSM-Oriented scales are raw scores; Externalizing, Internalizing and Total are T scores

Summary of findings:
- Exposed children show more externalizing & ADHD problems at age 5
- Exposed children are more emotionally reactive & anxious/depressed at both ages

LaGasse et al., Pediatrics 2011

Odds of Clinical Cutpoint ≥60 for Behavior Problems at 5 Years

	Odds Ratio	95% Confidence Interval		p
		Lower	Upper	
INTERNALIZING BEHAVIORS				
Prenatal MA Exposure	1.258	0.642	2.462	0.504
EXTERNALIZING BEHAVIORS				
Prenatal MA Exposure	**2.390**	**1.161**	**4.918**	**0.018**
TOTAL BEHAVIOR PROBLEMS				
Prenatal MA Exposure	1.116	0.551	2.260	0.761

Summary of findings:
- Exposed children meet the clinical cutoff for externalizing

Twomey et al., Am J Orthopsy 2012

Executive Function at 6.5 Years

Attentional Network Task

Rule:
- Only feed the hungry fish in the middle
- Press the left button when the fish is facing left
- Press the right button when the fish is facing right

ALERTING
no cue double cue

ORIENTING
central cue spatial cue

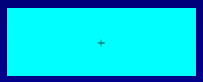
CONFLICT
congruent

incongruent

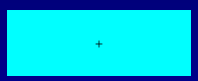
no conflict

Measure: RT

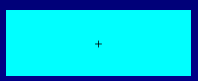
Alerting (no cue)
Orienting (spatial cue)
Conflict (congruent)



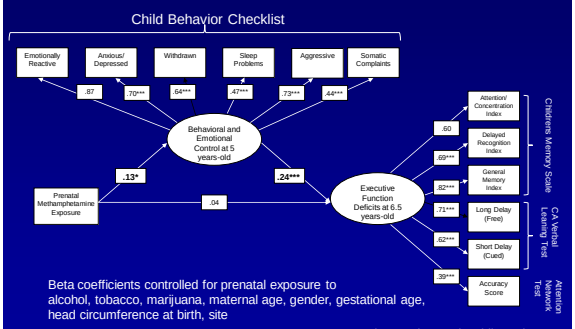
Alerting (no cue)
Orienting (central cue)
Conflict (incongruent)



Alerting (double cue)
Orienting (none)
Conflict (no flanker fish)



Behavioral & Emotion Control and EF



Beta coefficients controlled for prenatal exposure to alcohol, tobacco, marijuana, maternal age, gender, gestational age, head circumference at birth, site

Abar et al., Psych Addict Beh 2012

Science and Prenatal Drug Exposure

Are There Drug Effects?

YES, BUT:

They are smaller than initially feared during infancy

But - effects may increase with age

Science and Prenatal Drug Exposure

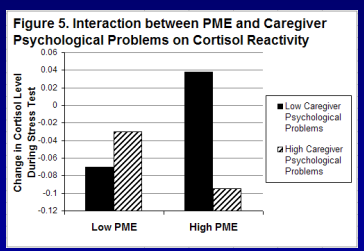
Not all methamphetamine exposed children show deficits in executive functioning

Why?

Environment

Poor Outcome

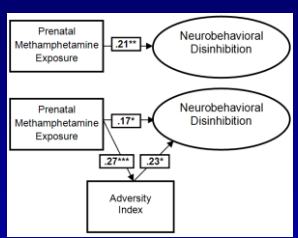
Cortisol Blunting – age 2



Adversity & Neurobehavior Disinhibition

ND at 6 ½ - 7 ½
- Memory impairment (CMS)
- Learning problems (CMS)
- Cognitive problems (CPRS)
- Hyperactivity (CPRS)
- Attention problems (CBCL)
- Aggressive behavior (CBCL)

Adversity Index (postnatal)
- Caregiver psychology problems
- Caregiver depression
- Low SES
- Caregiver substance use
- Poor quality of the home
- Poverty



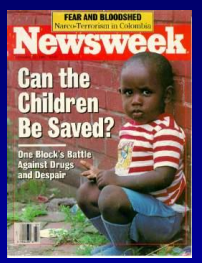
Final Thoughts…

The effects of prenatal METH exposure are milder than initially thought during infancy

But may emerge during childhood

A positive environment can help overcome drug effects

Need for intervention with families



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