E6 - Prenatal Alcohol Exposure and Social Behavior Function
Challenges Associated with Navigating the Social World with FASD

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Outline

• Provide an overview of how prenatal alcohol exposure (PAE) can alter social cognition and behavior development, with a particular focus on social problem solving skills and social perspective taking

• Discuss findings from an animal model of PAE, including potential neural mechanisms of social behavior dysfunction

• Examine the relationship between resilience, mental health, and social competence in adolescents with FASD
How do we define *Social Behavior*?

- “Social Skills”
  - Initiate and manage social interactions
  - Establish and maintain friendship(s)
  - Express and interpret emotions
  - Use interpersonal/communication skills
  - Inhibit inappropriate/negative social behaviors

Kully-Martens et al. 2012
How do we define **Social Behavior**?

- Executive Function
- Emotional Regulation
- Learning & Memory
- Perception
- Motivation
Social Behavior
Human Social Cognition

Self-regulation

- Coarse perceptual processing
  - Superior colliculus

- Motivational evaluation
  - Amygdala
  - Orbitofrontal cortex
  - Ventral striatum

- Emotional response in body
  - Visceral, autonomic, endocrine changes

- Representation of emotional response
  - Somatosensory-related cortices

- Detailed perceptual processing
  - Fusiform gyrus
  - Superior temporal gyrus

- Representation of perceived action
  - Left frontal operculum
  - Superior temporal gyrus

- Modulation of cognition (memory, attention)
  - Cingulate cortex
  - Hippocampus
  - Basal forebrain

- Social reasoning
  - Prefrontal cortex

Reappraisal

Adolphs 2003
Why study social behavior in FASD?

- Social behavior deficits are a pervasive feature across the entire continuum of FASD
- Deficits also observed in 'sub-clinical' alcohol-exposed groups ('PAE')
- Impact can become more pronounced with age (adolescence)

Why study social behavior in FASD?

• Impaired social behavior in individuals with FASD has widespread implications for other domains and may contribute to:

  • Difficulties in school
  • Social rejection
  • Trouble with the law
  • Later mental health problems
  • Independent living & work

  \[\text{“Secondary Disabilities”}\]  

Early environment shapes development of social behavior.

ALCOHOL

Mother

Infant

Attachment

Interpersonal Skills
Inappropriately Friendly (Boundaries)

- EXECUTIVE FUNCTION
- Memory & Learning
- Perception
- Impulse Control
- Decision-Making
- Flexibility & Fluency

What does this look like?
What does this look like?

- Learning/Deploying Social Rules and Conventions
- Flexibility & Fluency
- Impulse Control
- Decision-Making
- Executive Function
- Reading Social Cues
- Memory & Learning
- Perception?
What does this look like?

Difficulty with perspective-taking

Preferring younger peers

THEORY OF MIND

EMPATHY

GENERAL COGNITIVE DEVELOPM.
What does this look like?

Dysregulated emotional reactions to social situations/problems

EXECUTIVE FUNCTION

Problem Solving

Working Memory

Flexibility & Fluency

Impulse Control

EMOTIONAL SELF-REGULATION
Risky Social Behavior; Susceptibility to Peer Pressure

EXECUTIVE FUNCTION
- Decision-Making
- Impulse Control
- Flexibility & Fluency
- Problem Solving

Working Memory

MEMORY & LEARNING

Being Taken Advantage Of
Social Strengths

• Interest in others
  – Enjoy being social (Duquette et al., 2006)

• Caregivers have described their children with FASD as:
  – Being friendly, talkative, and charming (James et al., 2010)
  – Having a loving/caring personality and determination and energy (Breen & Burns, 2012)

• Mean scores in the normative average range on the SSRS: Communication, Assertion, Engagement (Regehr, 2015)
INAPPROPRIATE SOCIAL BEHAVIOR

SOCIAL INITIATION

SHARED AFFECT

NONVERBAL COMMUNICATION

RISKY BEHAVIOR

SOCIAL SUGGESTIBILITY

PEER DIFFICULTIES

Bishop et al., 2009
Children with FASD show changes in social behaviors across development

<table>
<thead>
<tr>
<th>Infancy</th>
<th>Periadolescence</th>
<th>Adolescence / Adulthood</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Disruption in Mother-Infant Dyad (O’Connor et al. 1992; 2006)</td>
<td>• Low scores on social behavior assessments (Thomas 1998; O’Connor et al. 2006; Regehr 2015; Stevens et al. 2015)</td>
<td>• Low scores on social behavior assessments (Moore &amp; Riley 2015)</td>
</tr>
<tr>
<td>• Disrupted sleeping/feeding rhythms; Increased irritability (Coles &amp; Platzman 1993)</td>
<td>• Impulsivity (McGee et al. 2008)</td>
<td>• Increased risk for interactions with criminal justice system (Streissguth et al. 1996; MacPherson &amp; Chudly 2007)</td>
</tr>
<tr>
<td>• Less “social monitoring” behaviors (Jirikowic et al. 2016)</td>
<td>• High scores on “problem behavior” assessments (Stevens et al. 2015)</td>
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</table>

Animal models corroborate clinical findings

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<tr>
<th>Infancy</th>
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<tbody>
<tr>
<td>• Increased latency to nipple attach</td>
<td>• Altered play behavior</td>
<td>• Reduced social interactions</td>
</tr>
<tr>
<td>(Subramanian 1992)</td>
<td>(Hamilton et al. 2010; Lawrence et al. 2008)</td>
<td>(Hellemans et al. 2010)</td>
</tr>
<tr>
<td>• Altered suckling behavior</td>
<td>• Decreased social investigation</td>
<td>• Sexually dimorphic effects of social memory encoding and duration</td>
</tr>
<tr>
<td>(Barron, Kelly, &amp; Riley 1991)</td>
<td>(Mooney &amp; Varlinskaya 2011)</td>
<td>(Kelly, Leggett, &amp; Cronise 2009)</td>
</tr>
<tr>
<td>• Inability to elicit retrieval by mother</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Ness &amp; Franchina 1990)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Altered pattern of ultrasonic vocalizations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Marino et al. 2002)</td>
<td></td>
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</tr>
</tbody>
</table>

For review, see Kelly, Day, & Streissguth 2000; Marquardt & Brigman 2016
Why use animal models?

• Control for many variables:
  • Dose of alcohol
  • Timing of alcohol exposure
  • Environmental factors
  • Sex of offspring

• Ability to look at mechanism
  • Investigate changes in behavior and correlate with changes in brain
Animal model of prenatal alcohol exposure

- Diets maintained throughout gestation (human 1\textsuperscript{st}- and 2\textsuperscript{nd}-trimester equivalent)
- Peak blood alcohol \(\approx 150\) mg/dL
- Offspring Ages at Testing:
  - Early Adolescence (\(\sim P30\))
  - Late Adolescence (\(\sim P45\))
Adolescence and Social Behavior Development

- Adolescence is a critical developmental period in which significant behavioral, cognitive, physiological and neurological changes occur, including sexual maturity (puberty)
  - Sex Hormones – Organize brain and behavior
- Maturational changes can have significant consequences for social behavior development, making adolescence a unique period of increased vulnerability to social behavior dysfunction
Effects of PAE on social behavior during pre-pubertal and pubertal periods of adolescent development

<table>
<thead>
<tr>
<th>Social Motivation</th>
<th>Social Play</th>
<th>Social Recognition</th>
<th>Social Discrimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habituation (5 min)</td>
<td><img src="image1" alt="Social Play Diagram" /></td>
<td><img src="image2" alt="Social Recognition Diagram" /></td>
<td><img src="image3" alt="Social Discrimination Diagram" /></td>
</tr>
<tr>
<td>Testing (10 min)</td>
<td><img src="image1" alt="Social Play Diagram" /></td>
<td><img src="image2" alt="Social Recognition Diagram" /></td>
<td><img src="image3" alt="Social Discrimination Diagram" /></td>
</tr>
<tr>
<td>Non-Social Chamber</td>
<td><img src="image1" alt="Social Play Diagram" /></td>
<td><img src="image2" alt="Social Recognition Diagram" /></td>
<td><img src="image3" alt="Social Discrimination Diagram" /></td>
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<td>Social Chamber</td>
<td><img src="image1" alt="Social Play Diagram" /></td>
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<td><img src="image3" alt="Social Discrimination Diagram" /></td>
</tr>
</tbody>
</table>

Learning Phase
- Familiar Social Stimulus
- Retention Period
  - 15 min

Testing Phase
- Novel Social Stimulus
Play behavior preferences in adolescent rats with or without prenatal alcohol exposure

Samantha Baglot
Erin Morgan
Play behavior preferences in adolescent rats with or without prenatal alcohol exposure

Play Behavior – Triads

PAE

Different

Control

Same

Samantha Baglot

Erin Morgan
Play behavior preferences in adolescent rats with or without prenatal alcohol exposure

Play Behavior – Triads

PAE

Different

Control

Same

Control

Samantha Baglot

Erin Morgan
Summary

• Social motivation **not** altered in animals follow prenatal alcohol exposure

• In play triads, control and PAE animals bias their play towards controls in sexually dimorphic ways

• Normal development of social recognition memory is delayed in PAE adolescent males

• Social discrimination is impaired in adolescent males
Social Behavior & Oxytocin

• Oxytocin
  • Uterine contractions
  • Lactation
  • Emotional feelings and responses
  • Social behaviors
  • Maternal behaviors and social bonds

Ostrowski 1998
Oxytocin and Prenatal Alcohol Exposure

• Adult rats show reduced OT receptor binding following PAE in amygdala

• Similar reductions in OT-IR cells observed in PVN & SON of adult female Mandarin voles following PAE
  (He, Zhang & Guo 2012)
Summary

• Prenatal alcohol exposure (PAE) produces long-term changes in social behavior
  • Delays social behavior development
  • Impairs social recognition memory
    • Particularly in complex social context

• PAE effects on social behavior are specific & sexually dimorphic

• PAE alters oxytocin system in the brain

• Next Steps
  • Investigate oxytocin’s potential to “rescue” social discrimination deficits following PAE
Questions???
Questions???
## Intervention

<table>
<thead>
<tr>
<th></th>
<th>Children’s Friendship Training Program (Keil et al., 2010; O’Connor et al., 2006; 2012)</th>
<th>Social Skills Intervention System (SSIS) (Regehr, 2015)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Adapted established protocol for FASD</td>
<td>Non-adapted but customized manualized intervention</td>
</tr>
<tr>
<td><strong>Target Age</strong></td>
<td>Elementary school</td>
<td>Elementary school</td>
</tr>
<tr>
<td><strong>Format</strong></td>
<td>Group (child or parent)</td>
<td>Individual (child only)</td>
</tr>
<tr>
<td><strong>Scope</strong></td>
<td>• Child-focused friendship training</td>
<td>• Direct skill teaching, role playing, video modeling for variety of social skills &amp; problem behaviors</td>
</tr>
<tr>
<td></td>
<td>• Caregiver education</td>
<td></td>
</tr>
<tr>
<td><strong>Research</strong></td>
<td>• Delayed treatment control</td>
<td>• Decrease in problem behaviors, but not dissimilar to contrast group</td>
</tr>
<tr>
<td></td>
<td>• Significant gains in social knowledge, skills, problem behavior</td>
<td></td>
</tr>
<tr>
<td><strong>Community Translation</strong></td>
<td>• More effective than a community-based social skills intervention</td>
<td>No</td>
</tr>
</tbody>
</table>
Intervention

• Identify risk factors: Universal and population-specific
• Universal and population-specific factors that lead to more positive outcomes
• How can adverse outcomes be prevented?
Risk & Resiliency

• Resiliency = *competent* development during the course of negotiating, adapting to, or managing significant sources of stress and trauma

• Requires exposure to *risk*

• **Protective factors**
  – Individual, relational, contextual assets that facilitate adaptation

• Two dominant models:
  – Ecological
  – Constructivist
Risk & Resiliency

Child

Environmental Adversity

Resilience Response

Protective Factors

Additional Risks
Key Protective Factors (Universal)

**INTERNAL**
- Social Competence
- Autonomy
- Problem Solving
- Sense of Purpose
- Self Regulation

**EXTERNAL**
- Caregiver Relationship
- Peer Relationships
- School Relationships
- High Expectations
- Opportunity
Resiliency: Key Points

- Requires exposure to risk
- Dynamic process, not outcome
  - Varies over lifespan
  - Not something that is necessarily ever ‘achieved’
    - Measurement?
    - Longitudinal research
- Primarily studied in the context of (otherwise) normative development
  - What about psychopathology?
Risk, Resiliency, & FASD

• “Double Jeopardy”

• Heterogeneity suggests resilience operating...
Social Protective Factors

RESILIENCE

- Social Competence
  - Friendliness, Communication, Assertion
  - Difficulty forming friendships, Social Judgment

- Positive Peer Relationships
  - Enjoy friendship, Socially motivated

- Bonds to Caregiver(s)
  - Loving
  - Instability
  - Behavioral/Cognitive Problems

- School Connectedness

Core deficit in social behavior

Caregiving Instability

Early Attachment
Key Protective Factors – FASD Specific

- Diagnosis of FAS (vs. FAE)
- Lower IQ
- Diagnosis before age 6
- Stable home environment
- Services for developmental disabilities
- No exposure to violence

Less Adverse Outcomes

Kully-Martens et al., in review; Streissguth et al., 2004
Conceptualizing Resilience in FASD

• Reconceptualization as a process
• Protective factors → resources (process-oriented)
• Outcomes
  – Point in time
  – What *is* competent development?
    • Within-group analysis of typical trajectories
    • Condition-specific vs. normative
  – Which domains should be considered?
Resilience & FASD

• Cohort of children, youth, and emerging adults assessed for FASD at the Glenrose Rehabilitation Clinic (Edmonton, AB)
• Tracking trajectories: mental health/behavior, adaptive behavior, executive function, working memory, etc.
• Child and Youth Resiliency Measure (CYRM)
From Research to Practice: Assessment

- Explicit consideration/quantification of resources
  - Resilience-informed assessment
- Hidden resilience in case conceptualization
- Consideration of strengths

Ungar, 2006; 2015
From Research to Practice: Intervention

• Carmichael Olson, 2015
  – Identify commonly occurring areas of impairment ✔
  – Adapt existing EBPs
  – Appropriate to developmental stage
    • Social skills intervention for adolescents?
  – Incorporate an understanding of risk and protective factors
From Research to Practice: Intervention

- **Key universal protective factor:** Peer relationships; School Connectedness
  - E.g., School-based peer-mediated intervention
  - Directly or indirectly target social skills

- **Key universal protective factor:** Caregiver relationships
  - Prioritizing stability
  - Modified Parent-Child Interaction Therapy?
  - Families Moving Forward
Guiding Questions

• What is ‘competent’ (social) functioning for an individual with FASD? Normative, or ‘better than expected?’ If you work directly with kids with FASD, what are you aiming for?

• If resilience is a process, when does it begin?

• What unanswered questions do you still have?