IT'S NEVER TOO LATE: NEUROPLASTICITY, SOCIAL DEVELOPMENT, AND MENTAL HEALTH IN ASD ACROSS THE LIFESPAN

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Outline

- Review of brain development in Autism Spectrum Disorder (ASD)
- Review of social development in adolescence
- How does increasing social opportunities affect the brain?
  - Intervention overview: PEERS®
  - PEERS®: Research on adolescents with ASD
- Future Directions
- Resources: other treatments with research evidence for affecting the brain

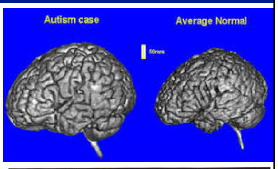
Autism Spectrum Disorder (ASD)

- Pervasive developmental disorder, likely rooted in genetics and environment, that affects brain development, social behavior, communication, sensory processing, and interests
- Autism, Asperger, PDD-NOS = ASD now
- 1 in 68 individuals (CDC, 2014)
- 4x more commonly identified in males

Brain development in ASD

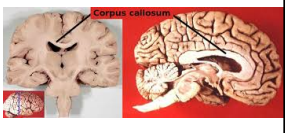
Brain Development in Autism in Infancy and Childhood

- Smaller head circumference (HC) at birth
- Larger head circumference at 2 yrs.: Brain volume10% larger
- Disregulation of growth of new nerve cells or malfunction in programmed cell death in frontal and temporal lobes, amygdala (Social brain)
- Higher heart rates, esp. to unfamiliar people



Brain Development in Autism in Adolescence and Young Adulthood

- White matter (connective tissue) atrophy- corpus callosum (CC), plus other long-range fiber tracts
- Cortical thinning of grey matter (cell bodies) in frontal and temporal lobes
- White matter and gray matter atrophy through adulthood
- Higher heart rates: fight/ flight



Differences in Brain Specialization: Neural Asymmetry and Social Approach

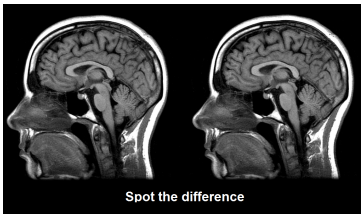
- Our brains are not identical in structure or function on each side (hemisphere): lateralization and asymmetry that supports specialization
- Asymmetry linked to cognitive function, but also emotion and temperament
  - Left: language; social approach and well-being; Right: detail-oriented and spatial processing; avoidance and depression
- In ASD, we see differences in both structure and function of lateralization, and connections to symptoms: language, face processing, emotion regulation
  - Direction in ASD: ↓ left hemisphere, ↑right hemisphere
- Earlier concerns of autism in children with stronger right-dominant patterns

Social Approach: Physiological Connections

- Parasympathetic system in ASD:
  - Lower regulation of heart rate (respiratory sinus arrhythmia) in older children and teens with ASD, at baseline and in response to social stimuli (but different findings in younger children)
- Sympathetic system in ASD:
  - Heightened electrodermal activity to social interaction
  - Decreased pupil dilation to social visual stimuli
  - Increased heart rate/decreased heart period
  - Blunted cortisol response to social stress

However….some caveats

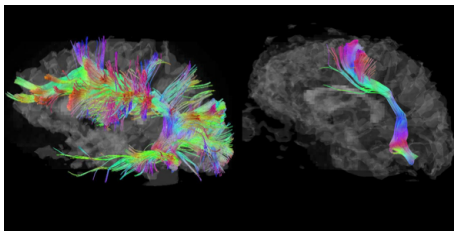
- Consider "use it or lose it"
- The "new infancy" of adolescence
- Consider individual differences



Haar, Berman, Behrman, & Dinstein (2014). Cerebral Cortex.

Caveats (cont).

- Consider strengths



Temple Grandin Not Temple Grandin

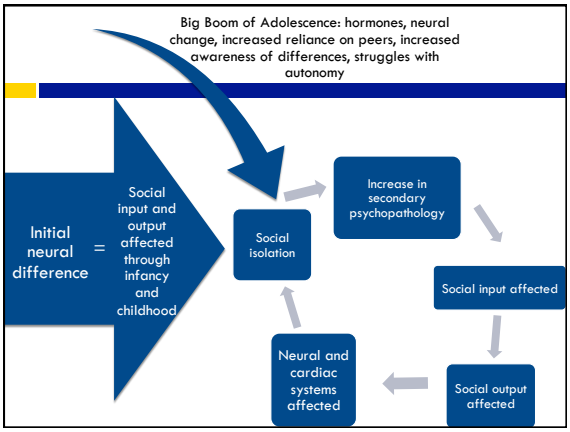
Social development in adolescence and young adulthood

Importance of Friendships

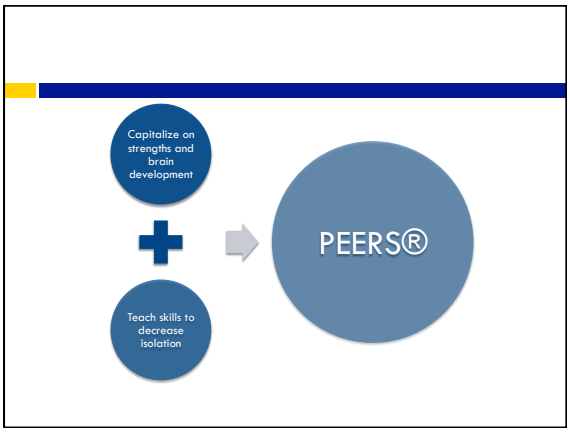
- Having one or two close friends is predictive of later adjustment
  - Buffers impact of stressful life events
  - Improves self-esteem
  - Increases independence
  - Relates to less depression and anxiety
- Peer rejection is one of the strongest predictors of:
  - Mental health problems
  - Juvenile delinquency
  - Early withdrawal from school

Challenges of Adolescence

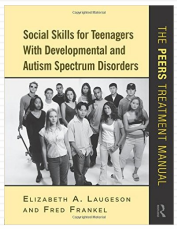
- Shift from playing to complex relationships
- Adolescents with ASD:
  - Poor friendship quality, bullied
  - More isolated
  - Many are aware of differences and difficulty
  - Mental health challenges: depression, anxiety, suicidality

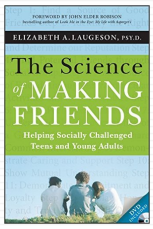


Overview of the PEERS® intervention



Manuals available on Amazon and Routledge





PEERS® Intervention

- 14-week intervention with publicly available manual and parent guide (Routledge: Laugeson & Frankel, 2010; Laugeson, 2013)
- Caregivers included
- Teaches social skills needed to make and keep friends

PEERS® Evidence Base

- Adolescents Laugeson et al., 2009; Laugeson et al., 2011; Schohl et al., 2014; Mandelberg et al., 2013; Karst et al., 2015
  - Social skills knowledge
    - Contact with other teens
    - Friendship quality
    - Family function and parenting efficacy
    - Effects last at least 3-5 years
- Adolescent Adaptation Yoo et al., 2014
  - Culturally validated and translated into Korean
  - Similar effects
- Young adults Gantman et al., 2013; Laugeson et al., 2015
- School-based version Laugeson et al., 2014

PEERS® Sessions: Evidence-Based Methods of Instruction

- Direct instruction
  - Structured lessons
  - Concrete rules/steps of social etiquette
  - Valid social skills → what ***works in the real world***
- Role-playing/modeling
  - Appropriate and inappropriate demonstrations
- Behavioral practice
  - Accompanied by in-class coaching and performance feedback
- Homework assignments → so skills carryover to new settings
- Caregivers as social coaches

PEERS® Sessions

- 1. Conversational Skills Part I: Trading information
  - Ask open-ended questions
  - Ask on topic, follow-up questions
- 2. Conversational Skills Part II: Two-way conversations
  - Share the conversation (reciprocity)
- 3. Conversational Skills Part III: Electronic communication
  - Beginning and ending phone calls
  - Leaving a voicemail
  - Two-message rule
- 4. Choosing appropriate friends
  - Friendship is a *choice*
  - What makes a good friend?

PEERS® Sessions

- 5. Appropriate use of humor
  - Are you a *joke teller* or *joke receiver*?
- 6. Peer Entry Part I: Entering a conversation
  - Watch, listen, wait for a pause, make an on topic comment
- 7. Peer Entry Part II: Exiting a conversation
  - How to handle rejection if not accepted in the conversation
- 8. Get-togethers and being a good sport
  - Etiquette while hosting and/or hanging out with friends

PEERS® Sessions

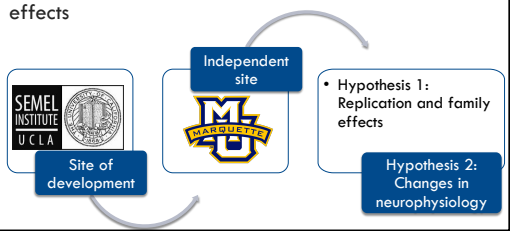
- 9. Being a Good Sport
- 10. Teasing and embarrassing feedback
  - Short, sweet teasing comebacks: "Whatever" or "Yeah, and?"
- 11. Chronic bullying
- 12. Rumors and gossip
  - Don't be friends with the gossip or gossip about the gossip
- 13. Handling arguments and disagreements
  - Listen to their side, repeat what they said, say you're sorry, solve the problem
- 14. Graduation and termination

PEERS® Video Role Play Examples

- Entering Group Conversations
- http://www.routledgetextbooks.com/textbooks/9781138238718/videos.php

Teen Study Objectives & Hypotheses

- Needed a study to replicate effects of PEERS® outside of UCLA and examine effects on anxiety
- Needed a study to examine neurophysiological effects



MU PEERS Video Overview

- Clay's Story
- http://www.marquette.edu/psyc/about_PEERS_video.shtml

Method: Design of Study

- Randomized Controlled Trial
  - Experimental ASD group (EXP)
  - Waitlist Control ASD group (WL)
  - Typically developing group (TYP)
  - All ASD groups seen at Pre and Post (with either PEERS Tx or a 14-week wait in between assessments)
- Multiple baseline design
  - Selection of teens measured for physiology at every intervention session

Participants

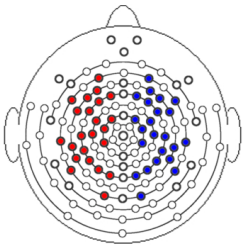
	Experimental (EXP)	Waitlist Control (WL)	Non-ASD
N	22 male/ 6 female	23 male/ 6 female	28 male/ 2 female
Race	92% Caucasian	89% Caucasian	96% Caucasian
Mean Age	14.1	13.3	13.3
Mean Kbit IQ	99.4	102.2	107.1
Mean ADOS Total Score	11.29	10.83	NA
Income	84% 50k +	76% 50k +	89% 50k +
Parent Education	70% univ +	74% univ+	75% univ +
Medications	65% on meds		0% on meds

Measures: Behavioral

- *Kaufman Brief Intelligence Test-Second (K-BIT)*
- *Autism Diagnostic Observation Schedule (ADOS)*
- *Vineland Behavior Scales*
- *Contextual Assessment of Social Skills (CASS) during 10-min in vivo interaction*
- *Adolescent:*
  - *Test of Adolescent Social Skills Knowledge (TASSK)*
  - *Quality of Socialization Questionnaire – Adolescent (QSQ-A-R)*
  - *Friendship Qualities Scale (FQS)*
  - *Social Interaction Anxiety Scale (SIAS)*
  - *Social Anxiety Scale-Adolescent (SAS-A)*
- *Parent:*
  - *Social Responsiveness Scale (SRS)*
  - *Social Skills Rating System (SSRS)*
  - *Social Anxiety Scale- Parent (SAS-P)*
- *Teacher:*
  - *Social Skills Rating System (SSRS)*

Measures: Neurophysiology

- 64-lead resting EEG
  - Average gamma (30-50 Hz) power
  - EEG Asymmetry= Right Hemisphere- Left Hemisphere
    - More negative scores= relatively more left hemisphere activation (positive emotion, social approach)
- Cardiac function
  - Concurrent with EEG
  - Heart period: milliseconds between beats (larger numbers = slower heart rate
  - Regulation of arousal and fight/flight



Measures: Multiple Baseline (MB)

Jain et al., (2017) in preparation

- Self-report ratings of anxiety before and after each of the 14 intervention sessions (State Trait Anxiety Inventory-Brief)
- Electrodermal activity (EDA) measured during each session using Q-Sensor wireless bracelets
  - Index of sympathetic nervous system/arousal/fight or flight
- Faces videotaped during each session
  - Still facial image during max EDA and min EDA extracted
  - Do emotion expressions on faces match the EDA arousal?

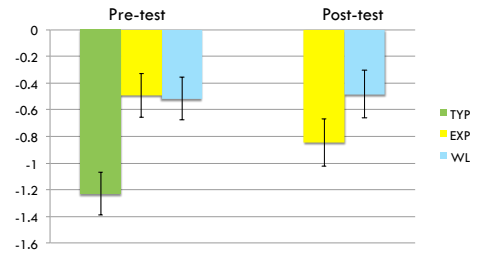
Results: Behavioral

Schohl et al., 2014, Journal of Autism and Developmental Disorders
Dolan et al., 2016, Journal of Autism and Developmental Disorders

- Significant effects:
  - Social skills: EXP ↑
  - Hosted and invited get-togethers: EXP ↑
  - Anxiety: EXP ↓
  - ASD symptoms: EXP ↓
  - Problem Behaviors (parent- & teacher-report): EXP ↓
- Live video interaction coding: effects in:
  - Expressivity EXP ↑
  - Rapport EXP ↑

Results: EEG Asymmetry

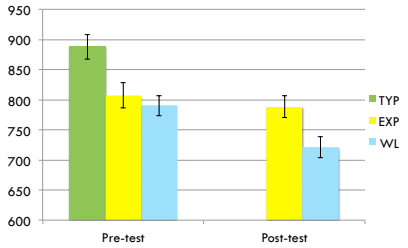
Vaughan Van Hecke et al., 2015, Journal of Autism and Developmental Disorders



Note. EXP = Experimental ASD(treatment), WL = Waitlist control ASD, TYP = Non-ASD group. Y axis is mean Gamma asymmetry = Right ln power-Left ln power, more negative scores = more relative left hemisphere activation. Time x Group Interaction for ASD: $F(1,220) = 7.68$, $p<.01$

Results: Heart Period (HP)

Vaughan Van Hecke et al., (2017) in preparation



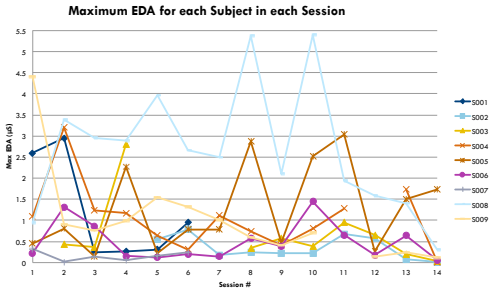
Note. EXP = Experimental (treatment), WL = waitlist control, TYP= Non-ASD control group. Y axis is mean heart period in milliseconds. ASD lower than TYP at Pre: F (2,130) =6.0, p < .05; All groups different from each other at Post: F (2,122) =16.95, p < .001. Time main effect in ASD mixed ANOVA: F (1,86) = 10.40, p < .005.

Results: Physiology

Jain et al., (2017) in preparation

- Average anxiety from self-reports significantly predicted physiological anxiety (EDA) at each session
- But computers unable to use facial expressions to predict physiological anxiety EDA- at about 50% or chance level
- Humans unable to do this, as well

Results: Physiology



Conclusions: Behavioral and EEG

- Replicated UCLA's positive effects, plus:
  - Teachers report less problem behavior in PEERS participants
  - PEERS participants decrease in social anxiety
- Experimental ASD group:
  - Shift to stronger left-dominant asymmetry, more similar to typically developing group
  - PEERS intervention resulted in relatively more neural activity in left hemisphere, perhaps indicative of higher social approach orientation, happiness
- Waitlist ASD group did not show these changes
- Degree of asymmetry change was related to amount of social contact, intervention knowledge, and decreases in autism symptoms

Conclusions: Heart Period

- Results for heart period more mixed:
  - ASD group strongly less well-regulated than non-ASD groups, replicating prior research.
  - Slightly hopeful: the ASD group that got PEERS seems to deteriorate more slowly/less
  - Very little/no evidence of treatment effects.
  - Evidence of predictive relations amongst heart rate variables and treatment outcomes.
  - Needs further study: what happens during intervention, after intervention, and at long-term; what is "adaptive" for ASD? For teens?

Conclusions: Physiology, Facial Expressions, and Arousal

- "Have it": EDA is indicating that many of teens are aroused/anxious
- "Know it": self-report indicates that they are cognitively aware of this fact
- "Show it": BUT their faces do not match their physiological state
- Implications for intervention

Future Directions

- Examine how anxiety affects response to PEERS® treatment
- Examine changes in brain structure (white matter development) due to PEERS®
- Long-term EEG neurological follow-up
- Develop wireless iPad Physiology monitoring app
- Preschool PEERS

Resources: Other evidence-based treatments affecting the brain for individuals with ASD

Evidence For Neurological Effects

- Early Start Denver Model: Dawson, G., Jones, E. J., Merkle, K., Venema, K., Lowy, R., Faja, S., ... & Smith, M. (2012). Early behavioral intervention is associated with normalized brain activity in young children with autism. *Journal of the American Academy of Child & Adolescent Psychiatry*, *51*(11), 1150-1159.
- Pivotal Response Therapy: Ventola, P., Yang, D. Y., Friedman, H. E., Oosting, D., Wolf, J., Sukhodolsky, D. G., & Pelphrey, K. A. (2015). Heterogeneity of neural mechanisms of response to pivotal response treatment. *Brain imaging and behavior*, *9*(1), 74-88.
- Computerized Face Affect Recognition Training: Bölte, S., Ciaramidaro, A., Schlitt, S., Hainz, D., Kliemann, D., Beyer, A., ... & Walter, H. (2015). Training-induced plasticity of the social brain in autism spectrum disorder. *The British Journal of Psychiatry*, bjp-bp.
- Visualizing and Verbalizing Reading Intervention: Murdaugh, D. L., Deshpande, H. D., & Kana, R. K. (2015). The impact of reading intervention on brain responses underlying language in children with autism. *Autism Research*.
- Theatre Intervention: Corbett, B. A., Key, A. P., Qualls, L., Fecteau, S., Newsom, C., Coke, C., & Yoder, P. (2015). Improvement in Social Competence Using a Randomized Trial of a Theatre Intervention for Children with Autism Spectrum Disorder. *Journal of autism and developmental disorders*, 1-15.

Doing your research

- This is a Wisconsin website, but findings regarding these therapies apply everywhere
- https://tiac.wisconsin.gov/summary-determinations-regarding-level-evidence.htm
- Click on the blue dot for the review and evidence base for a therapy

Treatment	*Click on bullets for supporting documentation.					Funding Decision
	1	2	3	4	5	
Applied Behavior Analysis (ABA)	•					Yes
Aromatherapy				•		No
Art Therapy				•		No
Auditory Integration Training (AIT)					•	No
Auditory Verbal Therapy				•		No
Brain Balance				•		No
BrainBeat					•	No
Chelation Therapy					•	No
Connector RX					•	No
Cognitive Behavioral Therapy	•					Yes
Craniosacral Therapy				•		No
Dance and Movement Therapy				•		No
DIR/Floortime				•		No
Early Start Denver Model (ESDM)		•				Yes
Equine-Assisted Psychotherapy			•			Yes
Feldenkrais Therapy				•		No
GemIIni Systems	•					Yes

How to determine if a therapy has an evidence base

- If the therapy has the word "brain" in it, and is expensive, it is unlikely to have a published evidence base.
- If a therapy has a website that only has anecdotal "testimonials," it is unlikely to have a published evidence base.
- New evidence is being published all the time.
  - Search Google Scholar for terms "brain," "autism," "intervention," and/or "therapy"
  - Reputable scholarly journals include: Journal of Autism and Developmental Disorders, Autism Research, Child Development, Journal of the American Academy of Child and Adolescent Psychology and Psychiatry, among others.

Overarching Conclusions

- The brain changes every moment we are alive
- Showing that a therapy affects the brain means seeing large changes, in a large group, versus a comparison group
  - These changes should last over time
  - And should be related to intervention concepts or therapy benefit
- Effective treatments that address social isolation also change the activity of the brain and physiology
  - Related to improvements in mental health and well-being
  - Shift from focusing on symptoms of ASD, to considering well-being and quality of life
  - How much of "Autism" is isolation and poor mental health?
  - How risky is this situation in individuals that are aware of their struggles?
- Effective therapies continue to be important across the lifespan in ASD

How does assisting those with autism connect to our Catholic mission?

- *Cura Personalis*
- Helping each person reach their full potential
- Servants for and with others in need
- Integrating those that are isolated
- Acceptance of differences: Modeling empathy and kindness for students without autism

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Thank you for your attention!