

Autism 203

The Visual Pathway in ASD: Explicit Teaching Methods to Promote Social Communication

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Overview of the Topic

- Core social deficits early in development foundational to understanding how the visual system affects response to interventions
- Brain development and “underconnectivity” in ASD
- The visual pathway as a mechanism for understanding aspects of physiology affecting social responsiveness: eye-tracking and pupillometry
- Integrating modalities: strategies to support building blocks of language and advanced social language skills



Core Social Deficits

Interventions-Early Childhood:

Pivotal Response Treatment (PRT)

Enhanced Milieu Teaching (EMT)

Early Start Denver Model (ESDM)

Joint Attention Symbolic Play Recognition (JASPER)

Interventions-Later Development:

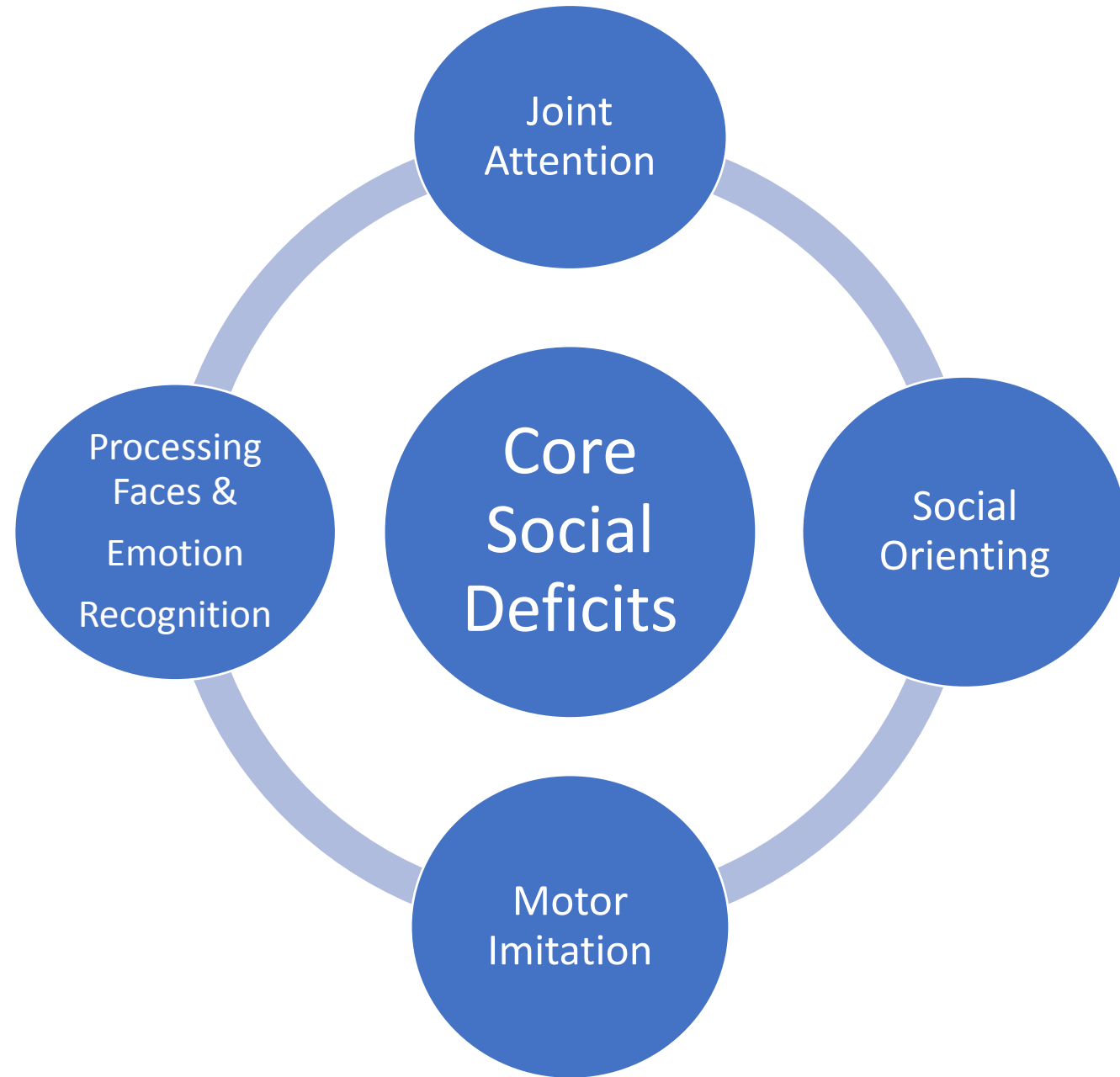
Functional Behavior Plans/Discrete Trial Training (DTT)

Program for the Educational Enrichment of Relational Skills (PEERS)

Social Skills Training Programs

Social Skills Training Programs

We are missing fundamental, intensive focus on core deficits later in development



Research Models to Inform Treatment— Impact all Aspects of Language Development

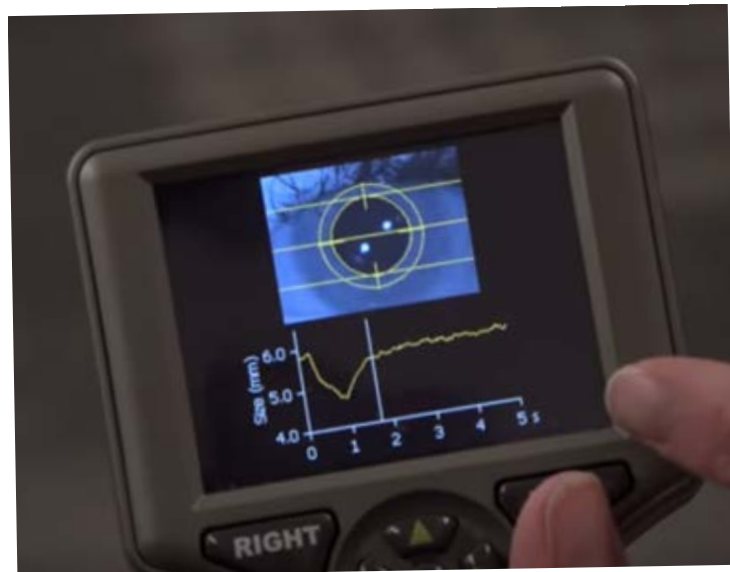
- **Underconnectivity Hypothesis**—disruption in development of pyramidal neurons, axons and dendrites; reduced projections between regions; failure to “prune” neurons efficiently result in some areas of the brain over-connected and some under-connected (Courchesne & Pierce, 2005)
- **Neural circuits disrupted**—intensive behavioral interventions may help “shape” these due to brain plasticity; circuits “adapt” in relation to treatment and become more efficient and functional (Dawson, 2008)
- **The superior temporal sulcus (STS)--the “Social Part of the Brain”**—this area supports perceptual processing of social information, and affects subcortical regions driving behavioral responses related to expression of emotion---hypervigilant responding or lack of responding---STS is important for processing *biological motion*—*hands, face, eyes, body* and processing *intentional inference* (Pelphrey & Morris, 2006; Alaerts et al., 2014)

The Visual Pathway as a Mechanism for Examining Socialization & Arousal

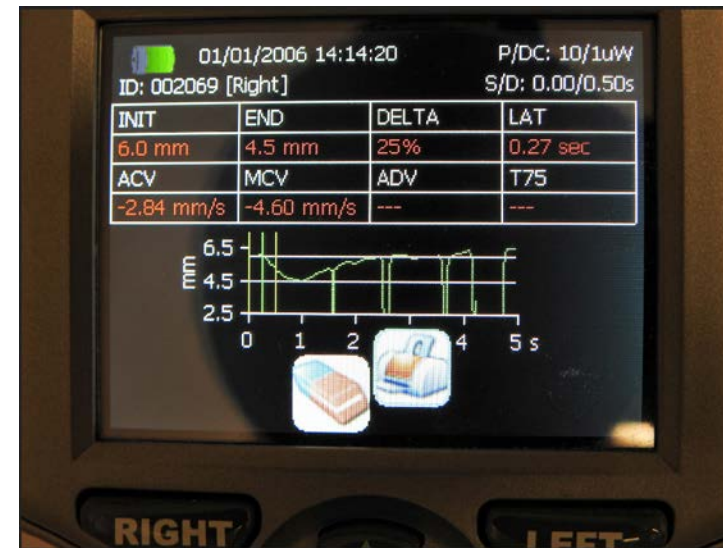
- The pupillary light reflex (PLR) tells us about “fight or flight” responding
- The PLR has been shown to be atypical in ASD (Daluwatte et al., 2013; Lynch, 2018)
- May serve as a marker for dysregulation of the autonomic nervous system
- Dysregulation affects attention to visual stimuli and subserves RRBs



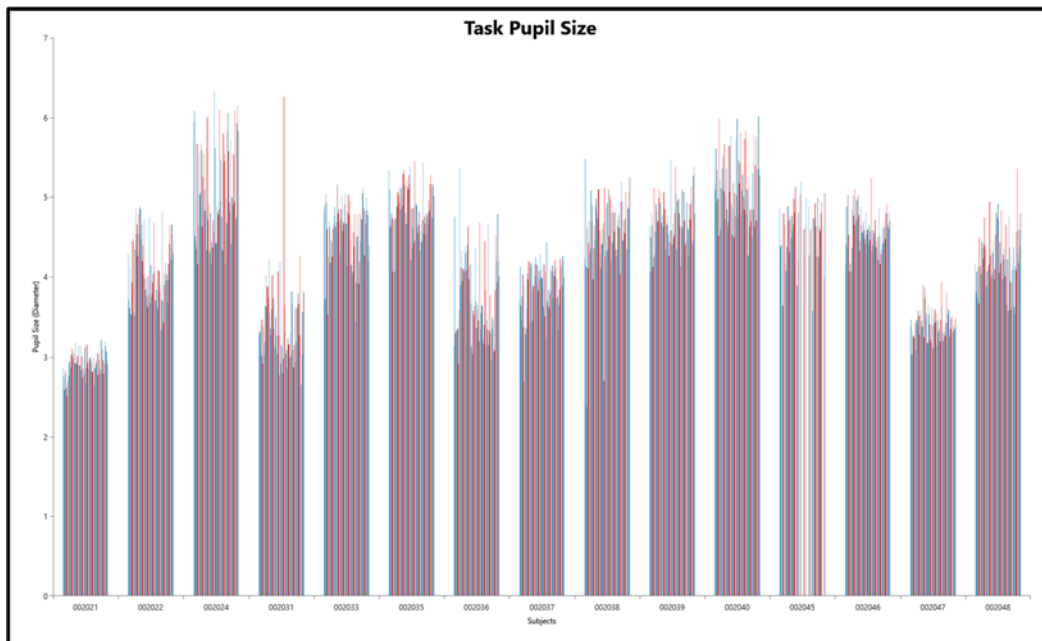
TYPICAL PLR



ATYPICAL PLR: ASD



Eye-tracking Technology to Examine Core Social Deficits in ASD



Advances in Technology Inform Clinical Practice

- Eye-tracking methodology has been used in many empirical studies
- Objective, quantifiable way to measure visual attention
- Allows us to “see what the individual with ASD sees”
- Can inform science about underlying neurology AND directly inform clinical practice

What Do Eye-tracking Studies Tell Us?

Published in final edited form as:

Nature. 2013 December 19; 504(7480): 427–431. doi:10.1038/nature12715.

Attention to Eyes is Present But in Decline in 2–6 Month-Olds Later Diagnosed with Autism

Warren Jones^{1,2,3} and **Ami Klin**^{1,2,3}

¹Marcus Autism Center, Children's Healthcare of Atlanta, Atlanta, Georgia 30329, USA

²Division of Autism & Related Disabilities, Department of Pediatrics, Emory University School of Medicine, Atlanta, Georgia 30022, USA

³Center for Translational Social Neuroscience, Emory University, Atlanta, Georgia 30022, USA

***Take-away: Eye-gaze patterns in ASD are similar to typical development at birth, then change.
Deficits in Social Orienting is a primary concern as a result of this change in the visual neural pathway.***

Can Visually-based Interventions Change Brain Activity?

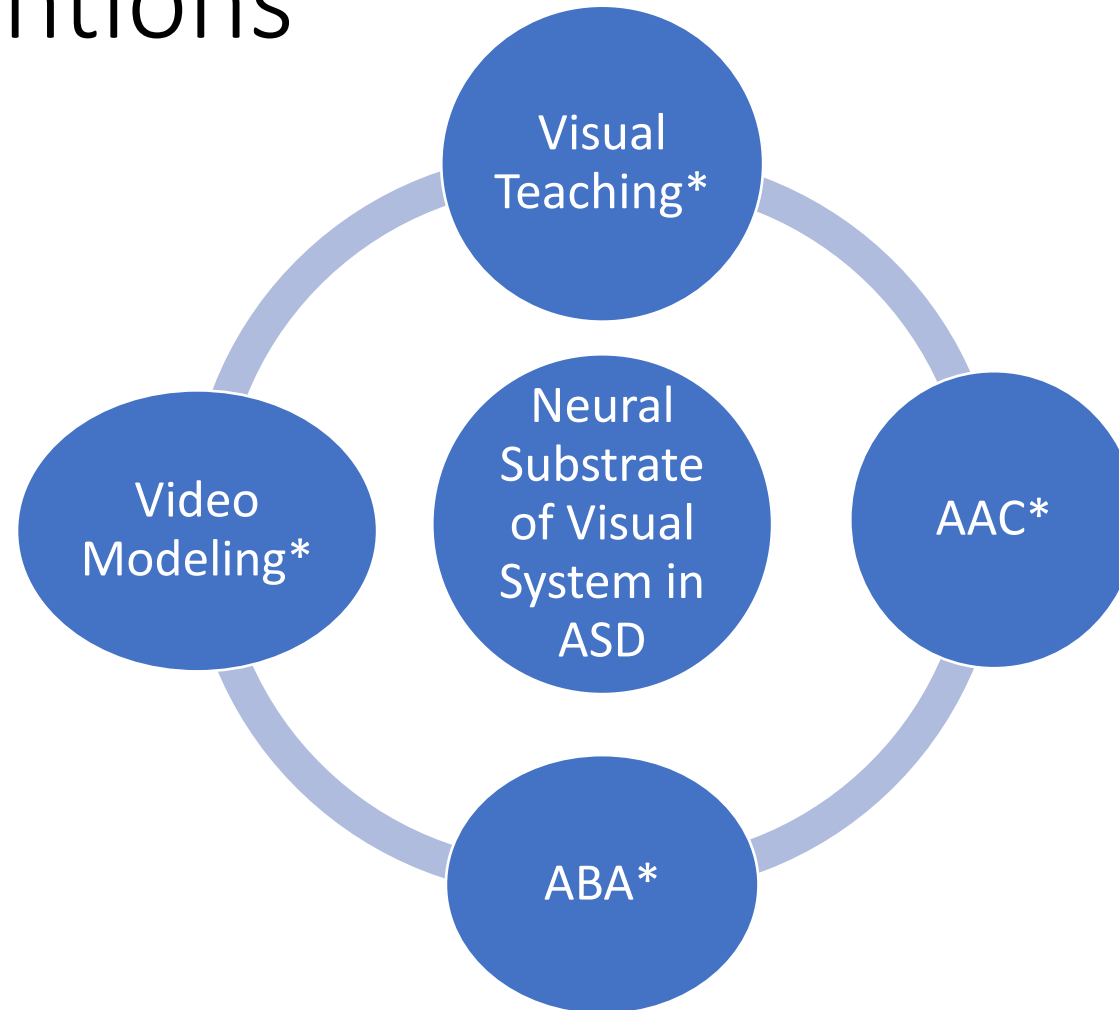
J Am Acad Child Adolesc Psychiatry. 2012 November ; 51(11): 1150–1159. doi:10.1016/j.jaac.2012.08.018.

Early Behavioral Intervention Is Associated With Normalized Brain Activity in Young Children With Autism

Geraldine Dawson, Ph.D., Emily J.H. Jones, Ph.D., Kristen Merkle, B.S., Kaitlin Venema, B.S., Rachel Lowy, B.S., Susan Faja, Ph.D., Dana Kamara, B.S., Michael Murias, Ph.D., Jessica Greenson, Ph.D., Jamie Winter, Ph.D., Milani Smith, Ph.D., Sally J. Rogers, Ph.D., and Sara J. Webb, Ph.D.

Take away: Brain activity measured using EEG indicated greater activation in children receiving intensive behavioral early intervention (ESDM) with an emphasis on joint attention, social reciprocity, social orientation, and imitation to address core social deficits in comparison to children receiving commonly available community-based interventions.

Influence of the Visual System in Response to ASD Interventions



* "Established" or "Emerging" evidence-based intervention for ASD (*Findings and Conclusions: National Standards Project-Phase 2, 2015*)

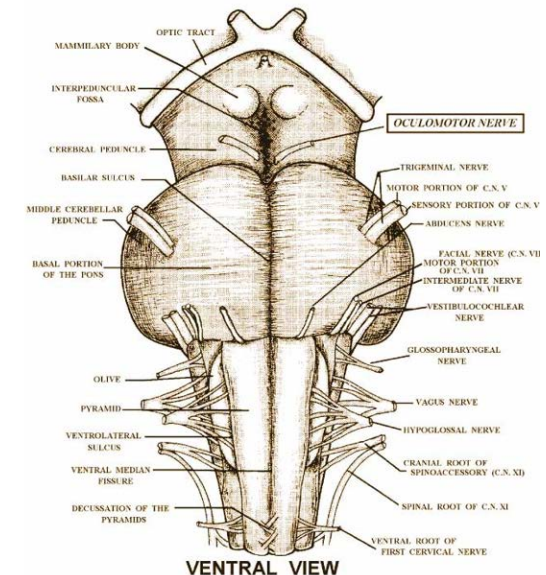
Primary Process Systems Affecting Speech and Language

- “Primary Sensory Systems” are fundamental neural systems which subserve higher-order processes in the brain---*auditory, motor, touch, visual*
- Cranial nerves in the brainstem are modulated by norepinephrine, which activate physical processes for sensory perception; higher order association cortex processes this information making meaning from the sensory experience
- The LC-NE system affects release of norepinephrine, and has projections throughout the cortex, affecting cognitive processes and modulation of behavior

CN II & III
CN V, VII
CN VIII
CN XII

Observed in ASD:

- Atypical Pupillary Light Reflex (PLR)
- Atypical Auditory Brainstem Response (ABR)
- Atypical Diadochokinetic Rate (DDK)



How Do Eye-Tracking Studies Inform Language Development in ASD?

Biol Psychiatry. 2014 February 1; 75(3): . doi:10.1016/j.biopsych.2013.07.009.

Speech Disturbs Face Scanning in 6-Month Olds who Develop Autism Spectrum Disorder

Frederick Shic¹, Suzanne Macari¹, and Katarzyna Chawarska¹

Take away: There may be “competing” signals making it difficult for the child with ASD to visually attend to complex stimuli and dynamic social interactions. Infants later diagnosed with ASD spent less time attending to scenes---and less time attending to inner features of the face when speaking was added.

Interventions Targeting Visual Processes to Promote Social Communication and Language

- The primary goal is to **INTEGRATE** primary process systems using a “**bottom up**” approach and provide a great deal of opportunities to practice the skill
- This is why interventions rooted in **principles of applied behavior analysis** have a positive outcome----especially when used in naturalistic behavioral paradigms
- We are **REDUCING competing signals** and pairing stimuli to promote visual attention to objects, faces, contexts, and cues

What are Visual Teaching Methods (VTM)?

Umbrella Term to Describe:

Methods incorporating evidence-based practices capitalizing on visual supports, video modeling, and visually-based behavioral approaches which focus on the visual pathway

A Way of Thinking About Intervention:

“What are the competing signals---how can I reduce complexity of stimuli to help focus visual attention and integrate language in this process?”

Focus of VTM in Relation to Developmental Needs

Young Children & Complex Communication Needs

- AAC Use
- Visual supports
- Schedules
- Multiple repetition pairing objects with words
- “Less is more”--remove competing auditory and visual signals

Older Children & Adolescents with Verbal Language

- “Bottom Up”
- Non-verbal Cues
- Visual supports
- Mnemonics
- Video modeling
- Less focus on “in-vivo” dynamic interactions--focused, intentional visual attention to social cues

Common to both: Addressing core social deficits/addressing joint attention, social orienting, processing faces, imitation

Incorporating Visual Teaching Methods-Example from an Early Intervention Setting



Examining Competing Signals:

“Less Is More”----Adult Verbal Directions Contributed to Ambient Noise Levels

Ambient Noise During Active Routines:

Min dB= 50; Max dB= 80

ANSI Standards: 35dB

Increased Visual Supports Within Instruction:

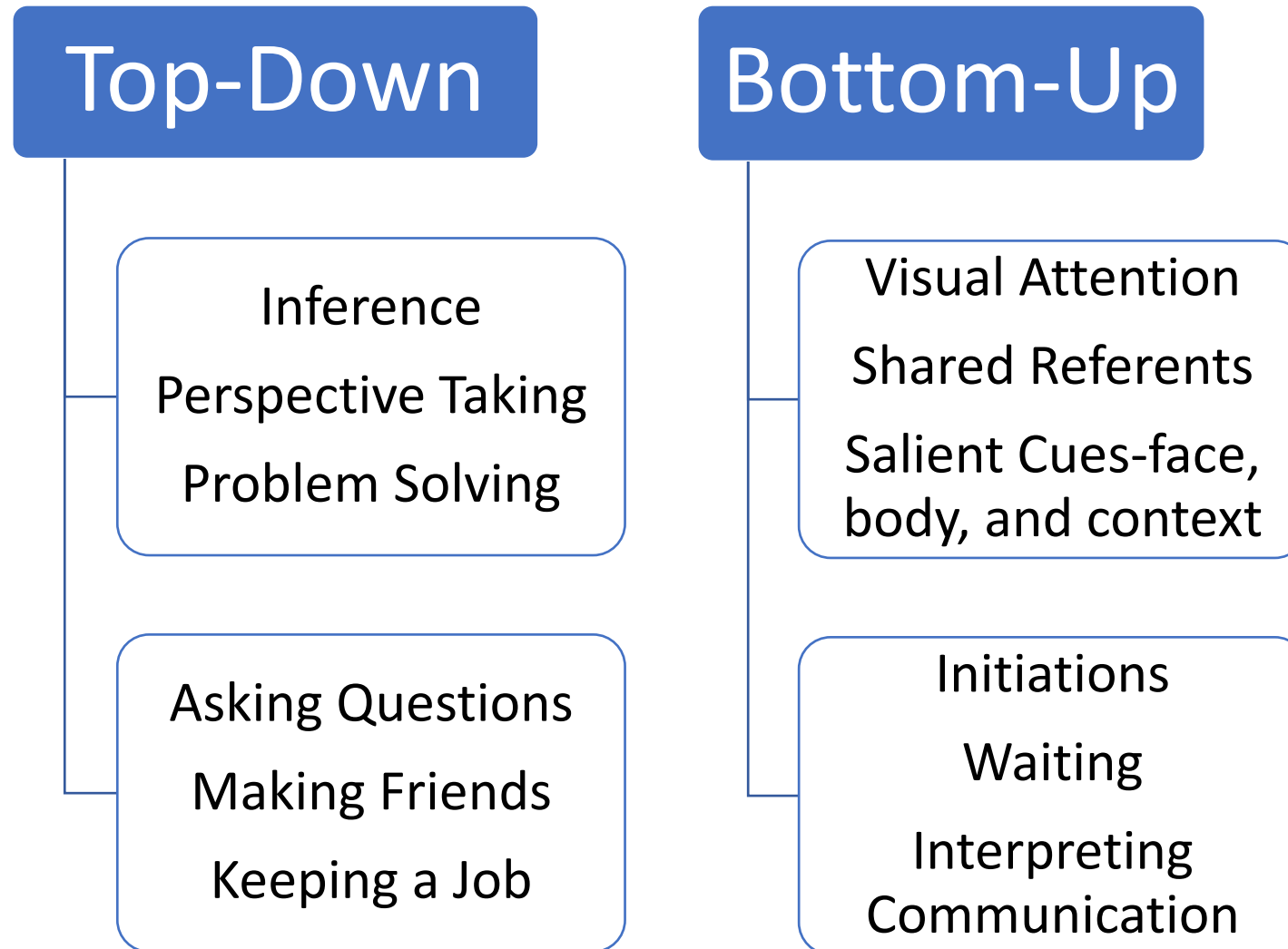
Decreased Ambient Noise <40dB

Increased on-task and adaptive behaviors

Decreased #of adult-assisted prompts



Current Social Language Intervention Models Rest Heavily in the “Expressive Language Domain” & Require Higher-Order Skills



The “VTM Approach” Visual Teaching Methods— Older Kids with ASD

- VTM are considered EBP for individuals with ASD between ages 3-22yrs*
- VTM can be used to support intervention from “bottom-up” to “top-down” processes
- VTM includes:
 - Visual schedules
 - Use of visual symbols/cues
 - Visually based reinforcements
 - Use of static photos
 - Video modeling

**Wong et al., (2014) Evidence-based practices for children, youth, and young adults with Autism Spectrum Disorder. Chapel Hill: The University of North Carolina, Frank Porter Graham Child Development Institute, Autism Evidence-Based Practice Review Group.*

**National Autism Center (2015) Findings and conclusions: National standards project, phase 2. Randolph, MA: Author.*



VTM Study—Based on EBP for ASD- Visual Attention to Socially Relevant Stimuli



Eye-tracker
Captures:
Range of
Interest (ROI)

Pre- Post Test:
% of visual
attention to
those salient
cues

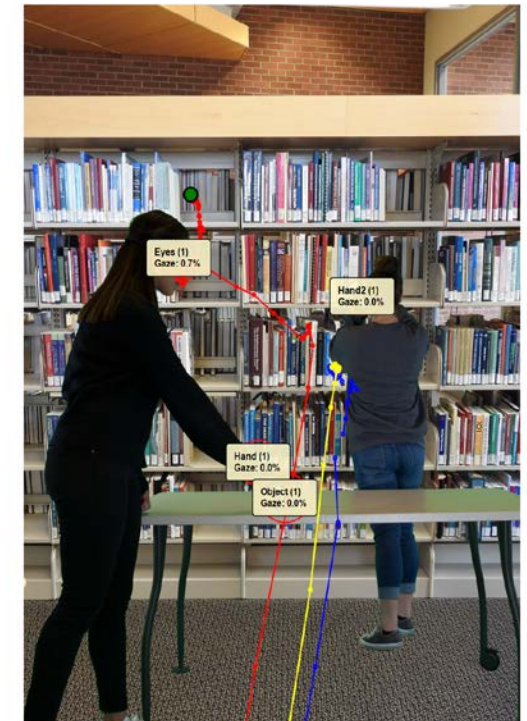
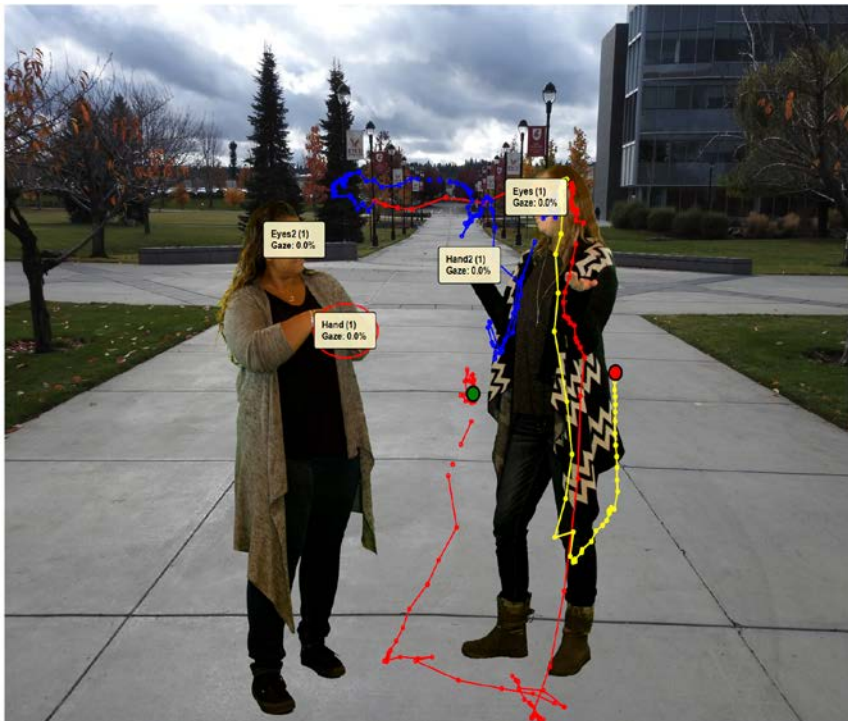
Competing Signals & Visual Distraction

Interactions Depicted in Static Photos: One- vs. Two-Person Contexts

Visual Attention= <10% of the range of interest (ROI)

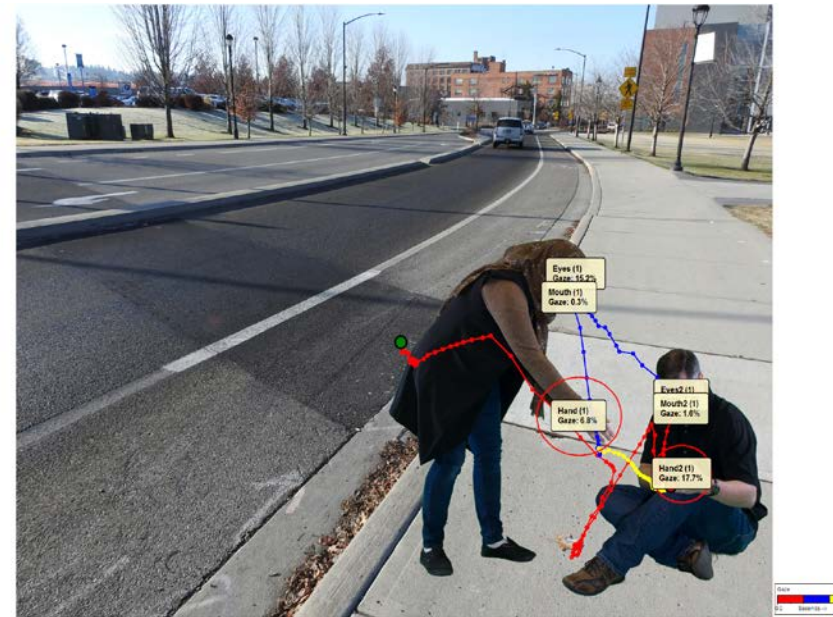
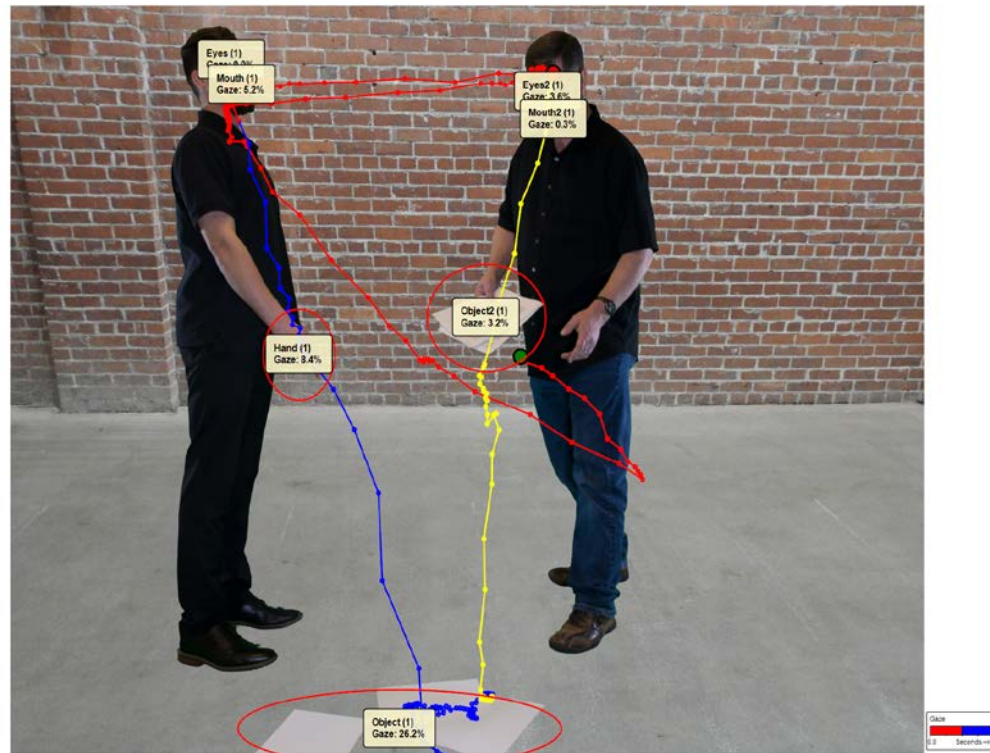


Examining Visual Attention to Salient vs. Non-salient Cues VTM & “Treatment As Usual” (TAU) Pre-Assessment

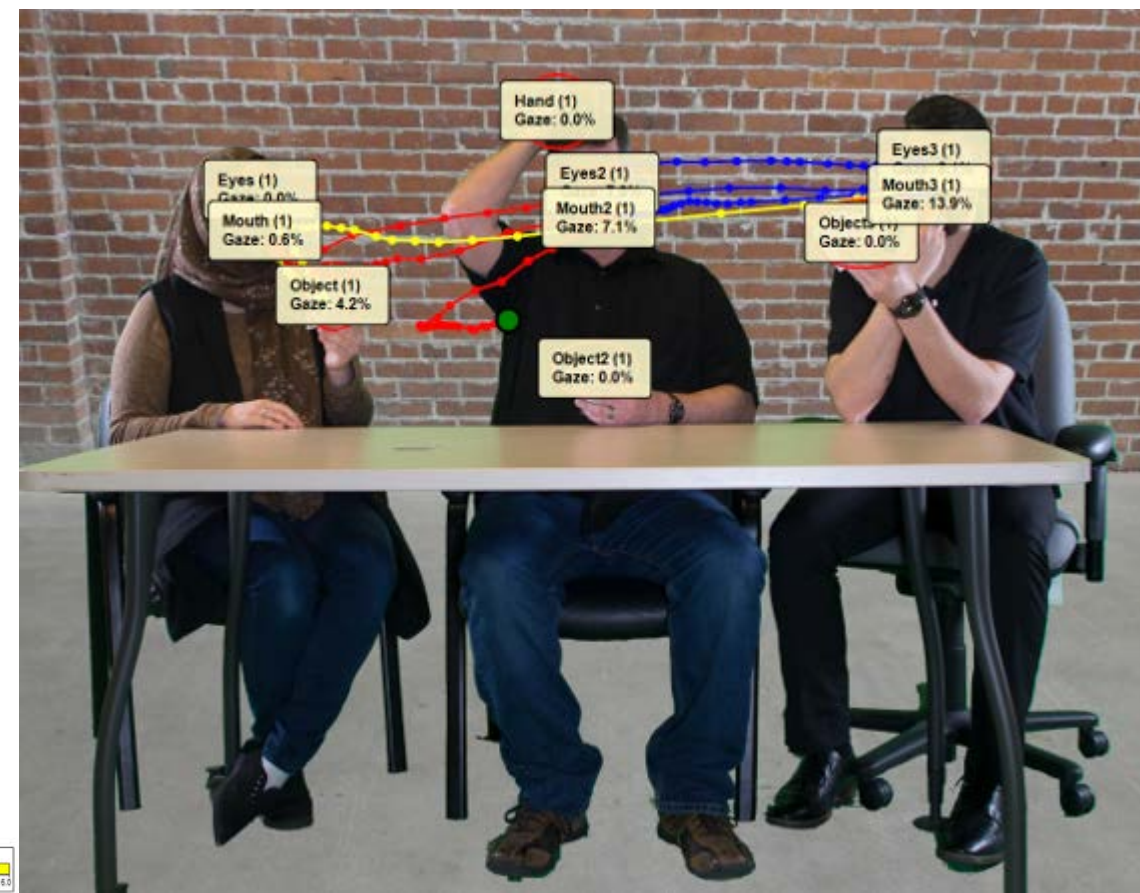
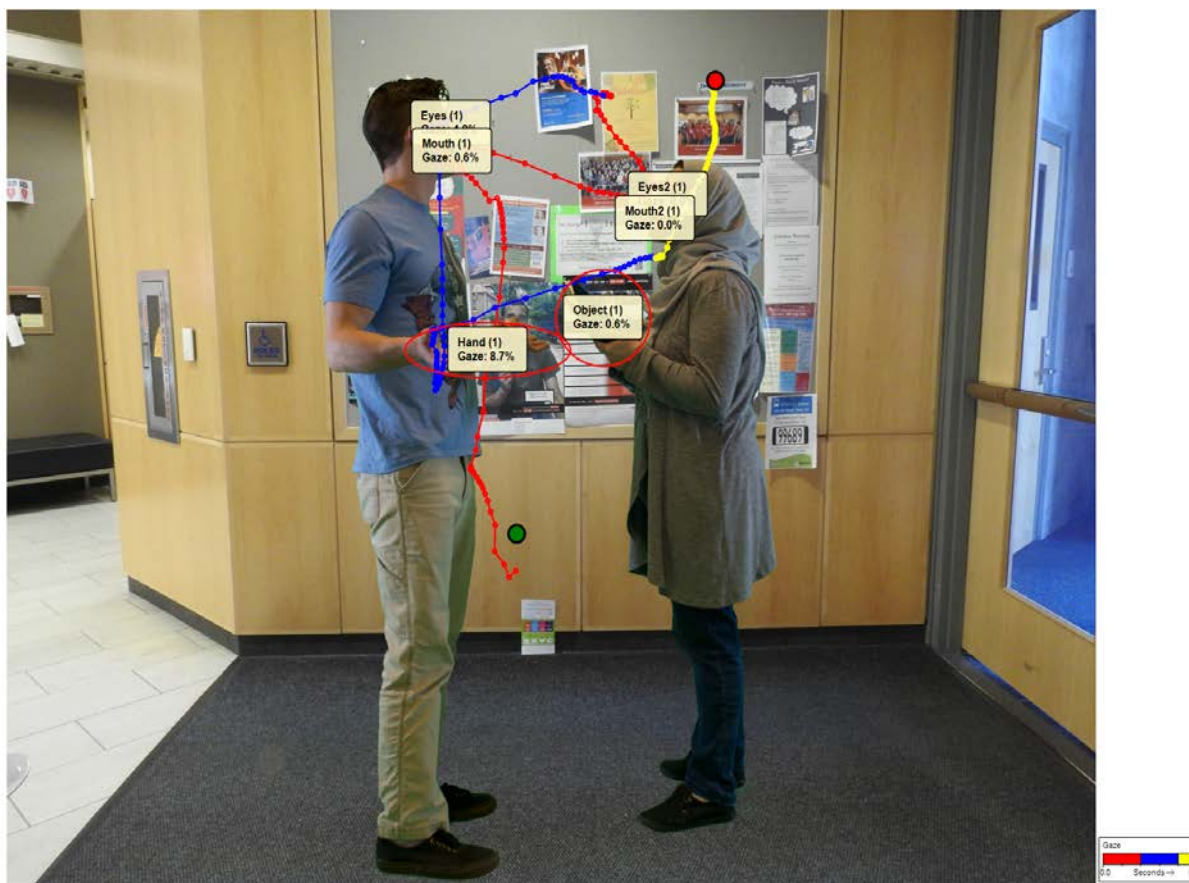


Post-VTM Attention to Salient Cues

Increased attention to shared referents, eyes, hands



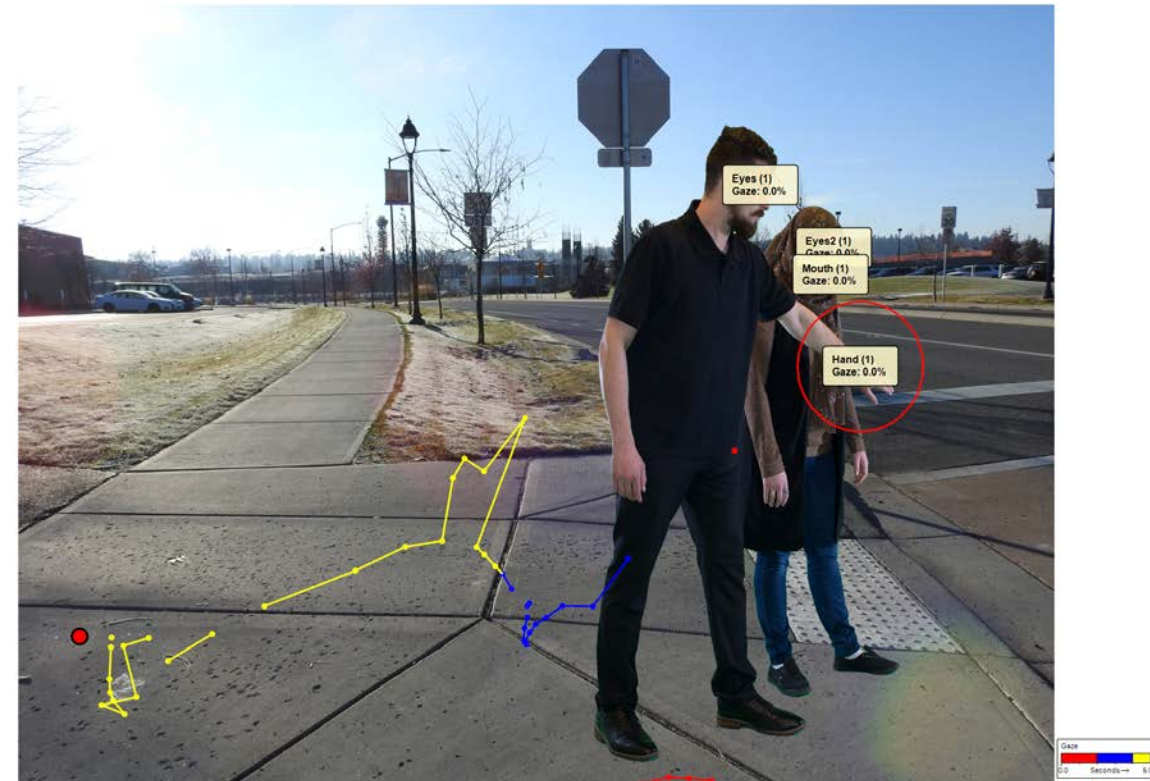
Post VTM-shared referents, eyes, hands



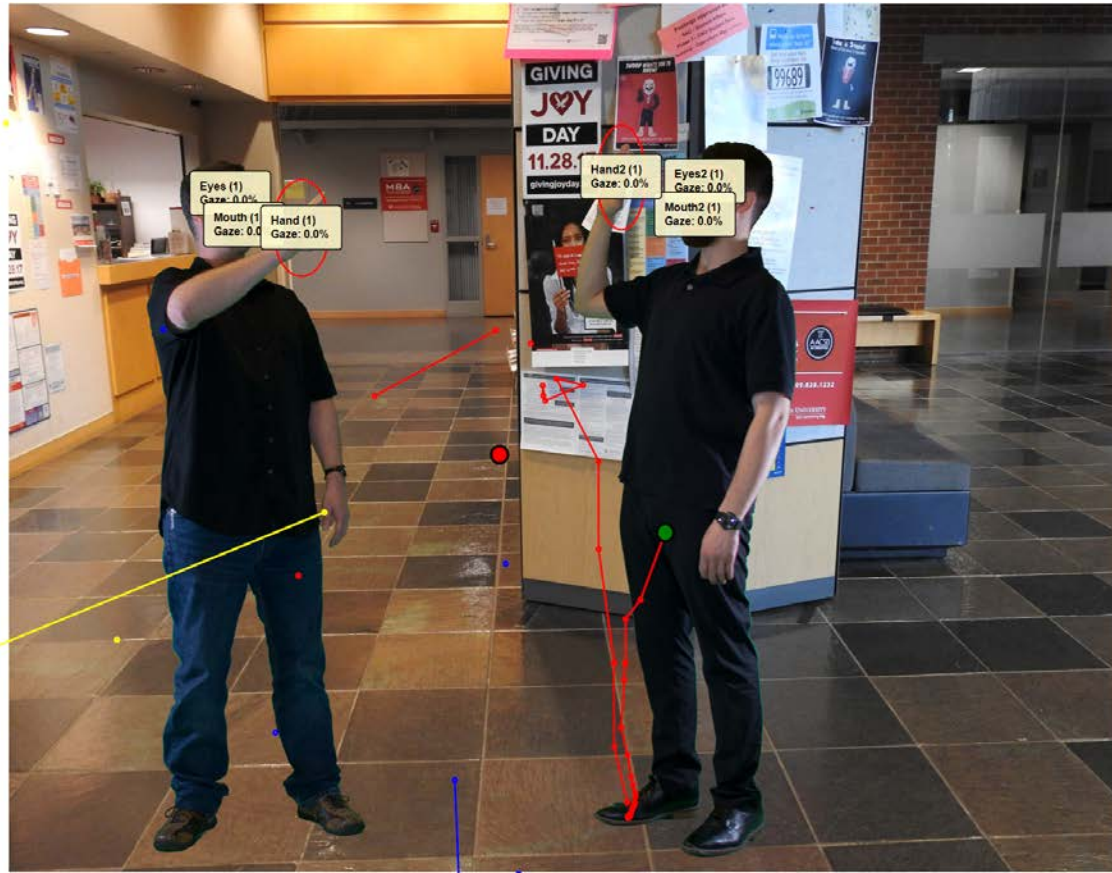
Post-Assessment: TAU

Attention to Salient Cues/Eyes, Hands

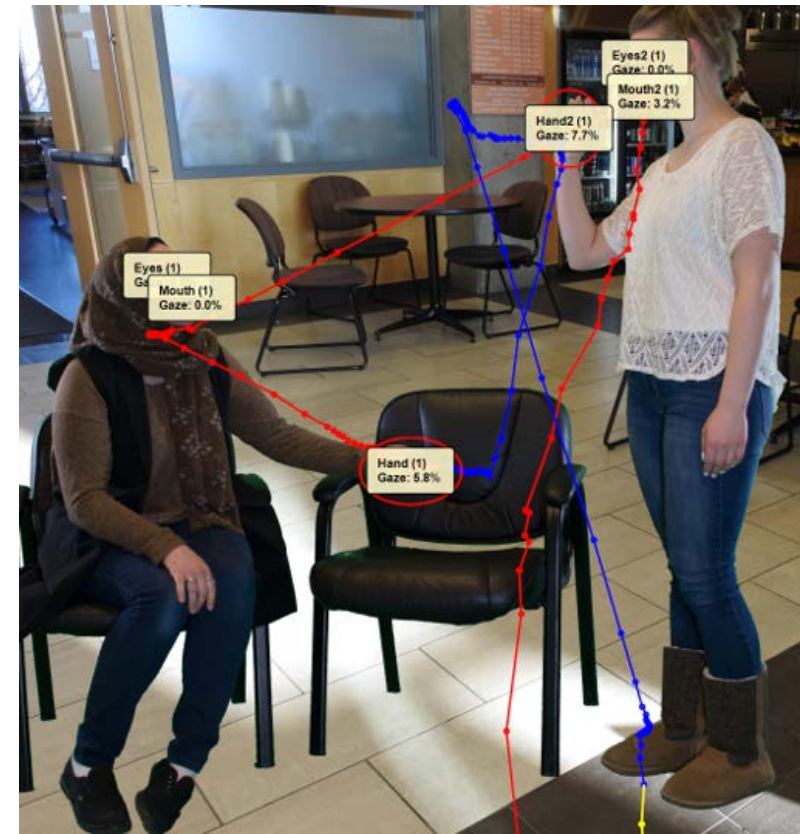
Little Change



Gesture Use & Eyes-Post Assessment

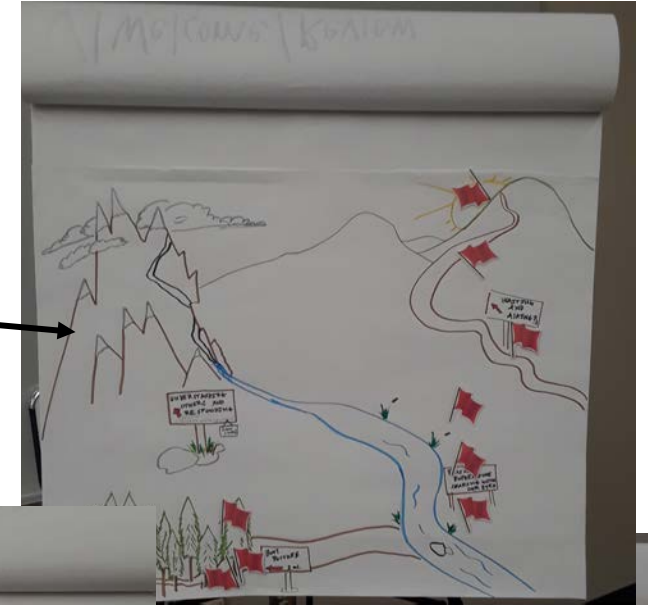
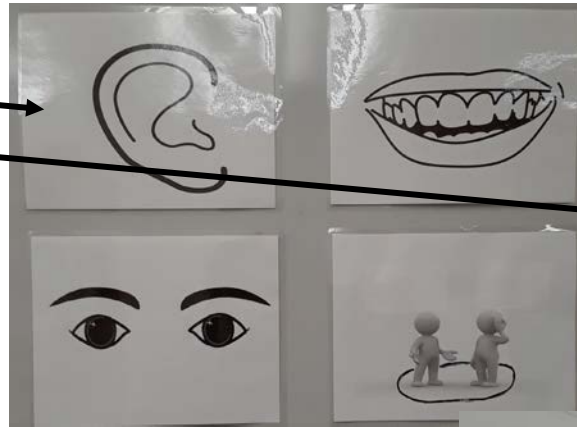


TAU

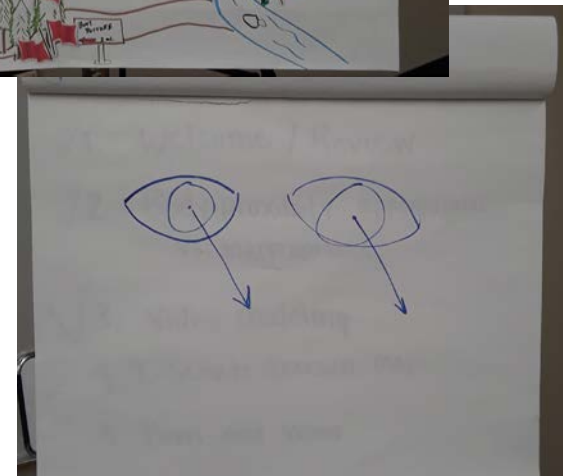


VTM

Examples of VTM Supports Used in Treatment



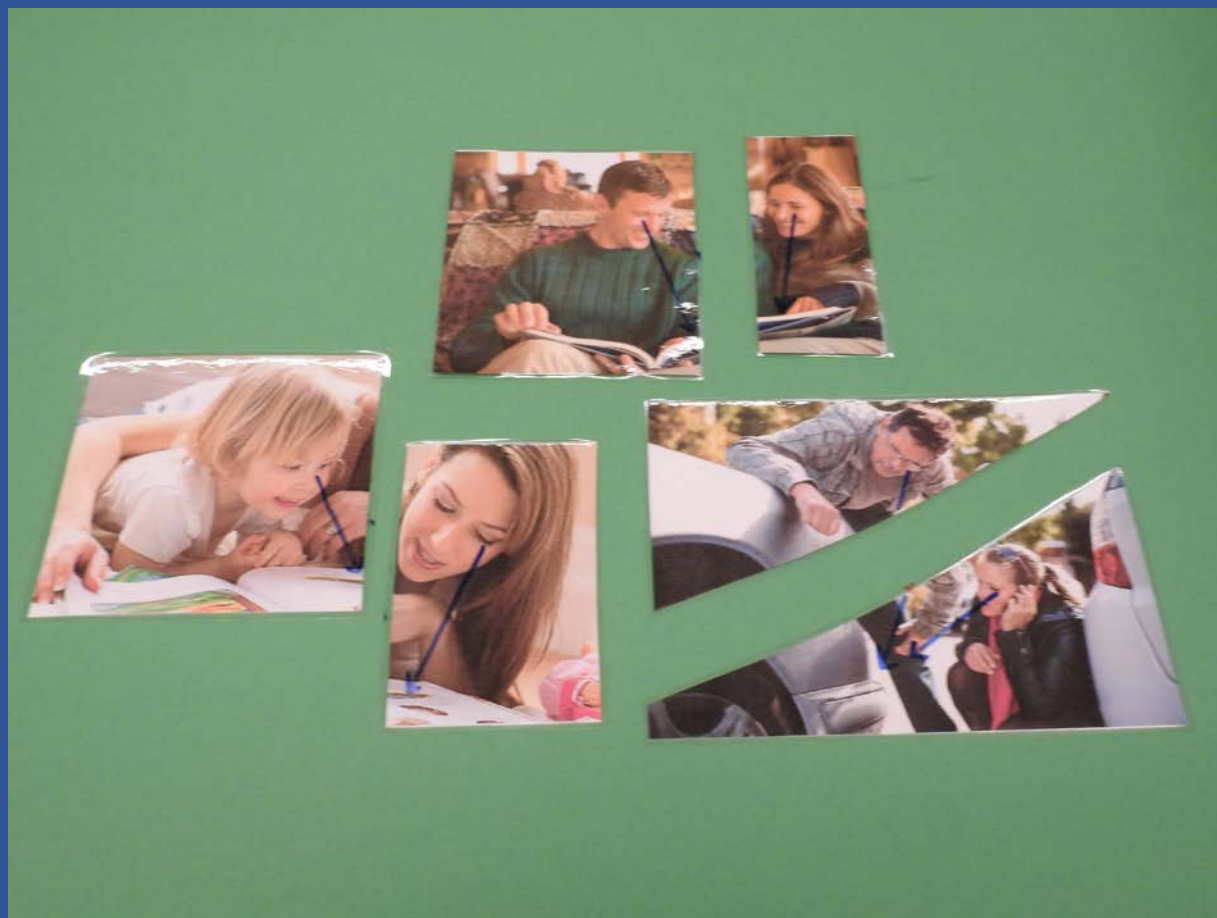
- ✓ 1. Welcome / Review
- ✓ 2. Body proximity: appropriate vs. inappropriate
- ✓ 3. Video modeling
- 4. I-Scouts Terrain map
- 5. Pows and Wows



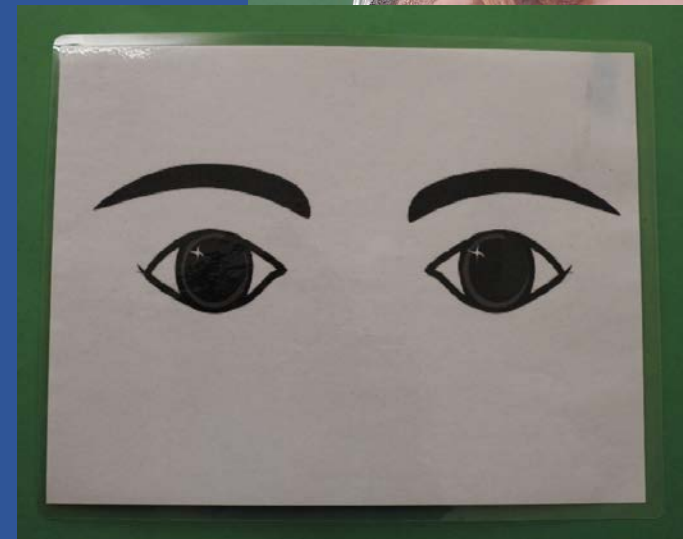
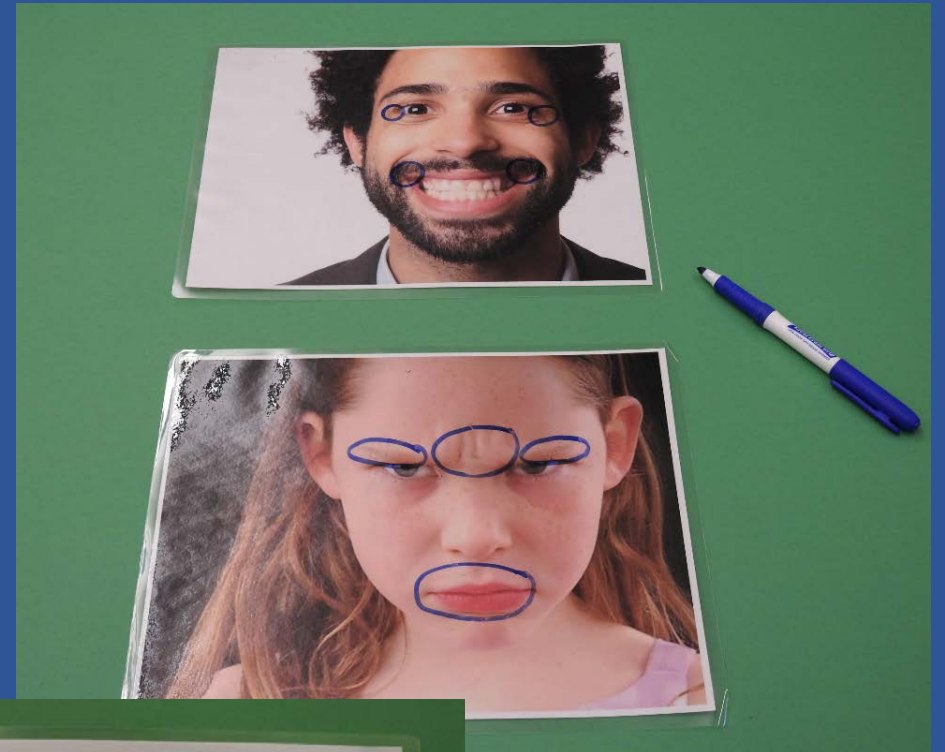
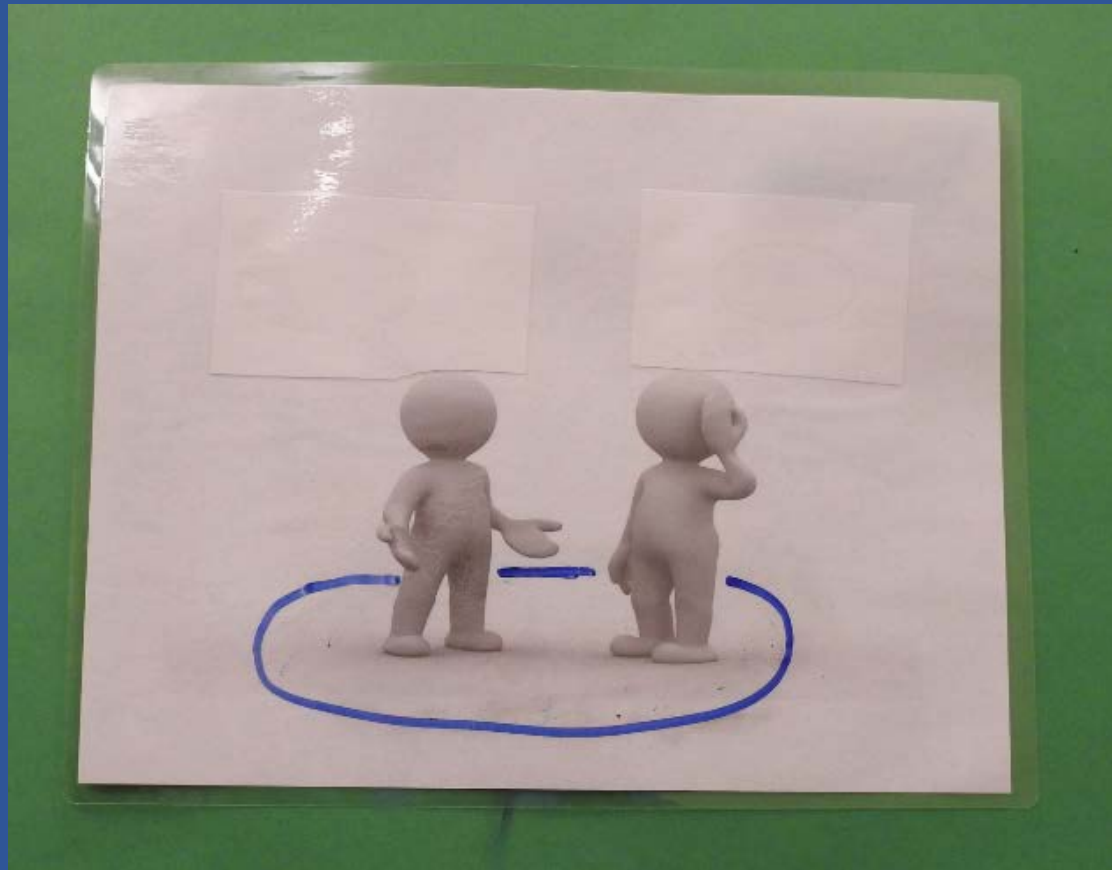
Hierarchy: VTM Intervention for Non-verbal Skills

Non-verbal Cue	Environmental Cue	Stimuli	Method
I. Facial Expression	<ol style="list-style-type: none"> Face alone Face in a given context 	Static Photos	Identify, recognize, and explain—in terms of faces as “objects”
II. Body Proximity	Body position in various contexts-home, school, outdoors	Static Photos Visual Mnemonic Video Modeling	Recognize, explain, and demonstrate; in-vivo modeling with playback & debrief
III. Line of Regard	Relevant background stimuli Salient vs. non-salient	Static Photos Video Modeling	Recognize, explain, and demonstrate; identify features/objects in environment within stimuli
IV. Shared Referent	Objects Relevant contextual Referent	Static Photo Visual Mnemonic Video Modeling	Recognize, explain, and demonstrate within photos and in video debrief; identify salient features of scene
V. Inference	Facial Expression Body Proximity Shared Referents Contextual Stimuli	Static Photos Visual Mnemonic Video Modeling	Recognize and explain visual “clues” to support inferential guess as to perspective of each person

Stimuli



Mnemonics & Cues



Appropriate vs. Inappropriate Body Proximity



Behavioral Reinforcement-Tangible Cues



In Summary

- Core social deficits in ASD are fundamentally impacted by deficiency in the visual pathway across levels of severity
- Eye-tracking holds promise for better understanding nuances of the visual system in ASD
- Interventions incorporating focused visual attention and reducing complex stimuli may show greater impact due to challenges with “competing signals” and underconnectivity
- Intervention targeting visual attention and using behavioral reinforcement result in significant shifts in visual search for relevant cues

Biggest Take Away

Less is More!

Less talking while teaching:

Speaking with intentional messages paired with VTM help “slow down” the rate of incoming dynamic social information---greatly affects one’s ability to develop language once basic skills are in place

Focused, explicit visual instruction is needed AT ALL LEVELS of development and all levels of language along the spectrum!

Resources

For more on evidence-based practices and ASD:

National Professional Development Center:

Evidence Based Practices & Tutorial Modules:

<https://autismpdc.fpg.unc.edu/evidence-based-practices>

National Autism Center National Standards Project

<https://www.nationalautismcenter.org/resources/>



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