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Special Thanks to our collaborators and students who made this work possible

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Wednesday, October 12, 2011
Autism Spectrum Disorder (ASD): Background

Currently diagnosed through behavioral deficits in:

- Social interaction
- Communication
- Repetitive or stereotyped behaviors

Deficits in social interaction are considered the hallmark feature of ASD.

- These have generally been examined using subjective observation techniques.
- Advances in technology provided researchers with tools to observe and quantify this deficit using more objective methodology.
- For example: Klin et al and Pelphrey et al in 2002 used eye-tracking technology and found adults with ASD to spend less time looking at the faces than typically developing peers.
Presented 2 stimuli from each of the four categories, separated by a blank slide to obtain a pupil measure.

Children (2-5 years of age) with ASD looked at the faces for similar amounts of time as controls.

Children with ASD did have a significant decrease in pupil size to human faces only.

Implicating that although they are looking at the stimulus they are not gaining any information from it.
Larger Tonic Pupil Size in Young Children with ASD

(Anderson & Colombo, 2009)

Used data from our previous study to examine the resting or the tonic size of the pupil.

- Averaged pupil size across all baselines (9 slides total) 5.1 lx

Wednesday, October 12, 2011
Specific Goals of our Research Program:  

**Neurocognitive Development of Autism**

1. Replicate previous findings phasic and tonic responses with larger samples, under a variety of conditions.

2. Extend these findings by examining neurological systems that are likely to produce atypical pupil responses.

3. Examine the practical application of these pupil and scanning measures in assessment and intervention practices.
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Pupil and Scanning Responses to Dynamic and Multimodal Stimuli in 2-5 year old children with ASD

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Pupil and Scanning Responses to Dynamic and Multimodal Stimuli in 2-5 year old children with ASD

**RESULTS:**

- **Scanning Responses**
  
  \[ p = .219 \]

- **Proportion of time scanning in each Lookzone**
  
<table>
<thead>
<tr>
<th>Social LookZone</th>
<th>Internal</th>
<th>External</th>
<th>Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASD</td>
<td>0.2500</td>
<td>0.5000</td>
<td>0.7500</td>
</tr>
<tr>
<td>DS</td>
<td>-1.0000</td>
<td>-0.7500</td>
<td>-0.5000</td>
</tr>
<tr>
<td>TD</td>
<td>-0.2500</td>
<td>0.2500</td>
<td>0.5000</td>
</tr>
</tbody>
</table>

- **Pupil Responses**
  
  \[ *p = .005 \]

- Similar scanning responses for all groups.

- Distinct pupil responses for the ASD group.

- Increase in ecological validity did not change the outcome of the results, indicating that scanning differences, found in other laboratories, may be due to some other variable such as age.
Age-related Effects of Scanning?

**Hypothesis:** Does lack of social processing, beginning at age 2, eventually affect behaviors leading to active avoidance (decreased looking) by 8 years-of-age?

- 8 – 12 year old children with high-functioning autism

### Proportion of time scanning in each lookzone

<table>
<thead>
<tr>
<th>Lookzone</th>
<th>ASD</th>
<th>TD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye</td>
<td>0.5000</td>
<td>0.4500</td>
</tr>
<tr>
<td>Nose/Mouth</td>
<td>0.3750</td>
<td>0.2500</td>
</tr>
<tr>
<td>Head</td>
<td>0.2500</td>
<td>0.1250</td>
</tr>
</tbody>
</table>

\[ p = .045 \quad *p = .002 \quad p = ns \]

- All p’s < .01

### Change in Pupil Size from baseline

<table>
<thead>
<tr>
<th>Lookzone</th>
<th>ASD</th>
<th>TD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye</td>
<td>-0.3000</td>
<td>-0.2250</td>
</tr>
<tr>
<td>Nose/Mouth</td>
<td>-0.1500</td>
<td>-0.0750</td>
</tr>
<tr>
<td>Head</td>
<td>0.0750</td>
<td>0.1500</td>
</tr>
</tbody>
</table>

\[ n = 11 \quad n = 17 \]
Tonic/Baseline Pupil Size

- Measured while looking at a blank slide at different luminance levels.

2-5 year old children

**p = .006, η² = .333

8-12 year old children

**p < .0001, η² = .401

ASD (n = 11)
TD (n = 16)
Specific Goals of our Research Program:

Neurocognitive Development of Autism

2. Extend these findings by examining neurological systems that are likely to produce atypical pupil responses.
Neuroanatomical Components of the Pupillary System

- Examine the central components of the pupillary system.
  - Central components help to balance the ratio activity in this system.
  - Altered balance would result in atypical responses, such as pupil responses.
What underlies the altered pupil responses in ASD?

- Examine salivary correlates of norepinephrine (salivary alpha-amylase; AA)

2-5 years of age

- ASD ($n = 12$)
- DS ($n = 9$)
- TD ($n = 11$)

ASD ($n = 15$)
- TD ($n = 19$)
Specific Goals of our Research Program:

*Neurocognitive Development of Autism*

3. Examine the practical application of these pupil and scanning measures in assessment and intervention practices.
Eye-tracking as a measure of Verbal Comprehension

- 2-5 year old children with ASD and typically-developing controls.
- Scores from a receptive language test were acquired:
  - List of 12 known and 12 unknown words

Reading-Known_fiat ions. avi

Dripping-Unknown_fiat ions. avi
SUMMARY AND CONCLUSIONS

• Replication of baseline pupil and sAA results:
  • Need larger sample size and validation measures
  • Can we use these measures as early biomarkers of ASD?

• Our data suggest that there may be a developmental effect to the visual scanning.
  • Need to examine responses from 2 to 12 years of age
    • Determine where the looking stops
    • Design interventions to prevent its occurrence

• NE system possibly plays a role in the atypical pupil responses
  • Imaging data to examine the central brainstem structures is underway
  • Blood measures

• Eye-tracking may be a technique that we can use in children who are typically deemed “untestable” using traditional techniques.
  • Explore use of the measure for assessment and intervention

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