Autism: Theory of Mind

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Autism is...

Defined by behavioral criteria

Some biological markers

Clinical presentation is varied:

education, temperament, ability

dynamic changes over development

Co-morbid with other disorders
Understanding autism: insights from mind and brain

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Autism is a developmental disorder characterized by impaired social interaction and communication as well as repetitive behaviours and restricted interests. The consequences of this disorder for everyday life adaptation are extremely variable. The general public is now more aware of the high prevalence of this lifelong disorder, with ca. 0.6% of the population being affected. However, the signs and symptoms of autism are still puzzling. Since a biological basis of autism was accepted, approaches from developmental cognitive neuroscience have been applied to further our understanding of the autism spectrum. The study of the behavioural and underlying cognitive deficits in autism has advanced ahead of the study of the underlying brain abnormalities and of the putative genetic mechanisms. However, advances in these fields are expected as methodological difficulties are overcome. In this paper, recent developments in the field of autism are outlined. In particular, we review the findings of the three main neuro-cognitive theories of autism: theory-of-mind deficit, weak central coherence and executive dysfunction.
Autism: Is the most severe childhood neuropsychiatric condition diagnosed today.

Abnormalities:
- Speech and communication
- Social functioning
- Imagination

Behaviors:
- Repetitive
- Restricted interests
- Complex behavioral disability

M:F ratio: 4:1
0.6% population
Appears during the first three years of life

American Psychiatric Association, *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.),
<table>
<thead>
<tr>
<th>Autistic Spectrum Disorders</th>
<th>Pervasive Developmental Disorder (PDD)</th>
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<tbody>
<tr>
<td><strong>Autistic Disorder</strong></td>
<td>Asperger's Syndrome</td>
</tr>
<tr>
<td></td>
<td>Less severe</td>
</tr>
<tr>
<td></td>
<td>No language delay</td>
</tr>
<tr>
<td></td>
<td>Deficient or absent social interactions</td>
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<tr>
<td><strong>Asperger's Syndrome</strong></td>
<td>Childhod Disintegrative Disorder (CDD)</td>
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<tr>
<td></td>
<td>Normal intellectual and social</td>
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<tr>
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<td>development then 2-10 years show</td>
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<tr>
<td></td>
<td>severe regression into autism.</td>
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<tr>
<td><strong>Childhood Disintegrative</strong></td>
<td>Rett's Disorder</td>
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<tr>
<td><strong>Disorder (CDD)</strong></td>
<td>Genetic neurological syndrome seen in</td>
</tr>
<tr>
<td></td>
<td>girls.</td>
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<tr>
<td></td>
<td>Arrest of normal brain development</td>
</tr>
<tr>
<td></td>
<td>that occurs during infancy.</td>
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<tr>
<td><strong>Rett's Disorder</strong></td>
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<tr>
<td><strong>PDD-Not Otherwise Specified</strong></td>
<td>(PDD-NOS)</td>
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</table>
• Insistence on sameness; resistance to change
• Difficulty in expressing needs; uses gestures or pointing instead of words
• Repeating words or phrases in place of normal, responsive language
• Laughing, crying, showing distress for reasons not apparent to others
• Prefers to be alone; aloof manner
• May not want to cuddle or be cuddled.
• Little or no eye contact.
Characteristics of Autism

- Unresponsive to normal teaching methods
- Sustained odd play
- Spins objects
- Inappropriate attachments to objects.
- Apparent over-sensitivity or under-sensitivity to pain.
- No real fears of danger
- Noticeable physical over-activity or extreme under-activity.
- Uneven gross/fine motor skills.
- Not responsive to verbal cues; acts as if deaf although hearing tests in normal range.
<table>
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<th>Language Development</th>
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<tbody>
<tr>
<td>delayed &amp; deviant</td>
</tr>
<tr>
<td>Peculiar use of sounds and words</td>
</tr>
<tr>
<td>echolalia</td>
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</table>
# Social Development

<table>
<thead>
<tr>
<th>Physical and emotional distance from others.</th>
<th>Failure to develop social attachments</th>
<th>Lack of cooperative group play</th>
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</thead>
<tbody>
<tr>
<td>Difficulties in reacting to or recognizing other people’s feelings.</td>
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## Intellectual Development

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<th>Poor on verbal ability</th>
<th>May perform above average on memory or spatial tasks</th>
<th>May be talented in music or drawing</th>
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<tbody>
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<td>25-35% have IQ &gt; 70</td>
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## Diagnosing Autism

### New tests:
- Childhood Autism rating scale (CARS) Questionnaire
- Two year old screening

### 5 behaviors:
- babbling (1 yr)
- gesturing (1 yr)
- Single words (16 mo)
- Two-word phrases (24 mo)
- Any loss of social skill (any age)
The savant is an individual with an islet of outstanding skill in one area, which can include calendar calculation, musical or artistic competence, often in the presence of modest or even low general intellectual ability.

Common reports of sensory abnormalities, which suggest heightened sensitivity to minute differences between stimuli, be they in sound, sight, taste or touch.
The term ‘autism’ is used to describe all individuals on the autistic spectrum. Behavioral findings are based on high-functioning individuals, while anatomical studies of the brain in autism are based on low-functioning individuals.
1st described

- Leo Kanner (1943)
- Hans Asperger (1944)

Explanation:

- “Refrigerator mother”
- Genetic
- Environment
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<th><strong>Brain pathology</strong></th>
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<td>10% of all cases of autism have definable biological causes – eg. Rubella, prenatal thalidomide and encephalitis.</td>
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<tr>
<td>Interference with a particular stage of prenatal development can cause autism.</td>
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**Herbert et al. (2004)** show white matter abnormalities in short-range v. long range axons.
The most consistent finding about the autistic brain to have emerged in recent years is that it is on average \textit{larger and heavier} than the normal brain.
Autistic brain is, on average slightly smaller at birth, it begins to grow abnormally quickly, and by two to three years of age it is about 10 percent larger than a normal brain.

Importantly, the increased size is not evident from birth, but from ca. 2–4 years. A reason for this increase could be a failure of the normal pruning process that occurs several times during development after an initial wave of proliferation of synapses.
• Differential growth pattern:
  • The frontal cortex and temporal cortex of the autistic brain grow quickly during the first two years of life but then show little or not increase in size during the next four years
  • The amygdala has an abnormal growth pattern:
    • At 4 years of age – it is larger
    • At adulthood – it is normal size – BUT fewer neurons

Growth pattern of lower order regions of the cerebral cortex – primary visual cortex and extra-striate cortex are relatively normal in the autistic brain.
White matter problems, too.

Volume of white matter containing short-range axons was increased.

Volume of white matter containing long-range axons lower.

Theory of Mind deficit: A fault in one component of the social brain can lead to the inability to understand certain basic aspects of communication.

mindblindness or mentalizing failure
Children were shown that Sally had a basket and Ann a box.

Sally puts a marble in her basket and goes outside.

While she is outside, naughty Ann moves Sally’s marble to her own basket.

Sally then comes back in and wants to play with her marble.

Children were asked, ‘where will Sally look for her marble?’

To a normally developing 4-year-old child, the answer is clear: Sally will look for her marble where she \textit{thinks it is and not where it really is now}. Furthermore, the normally developing child can reason that Sally will look in her basket because this is where she put it and she does not know that it has been moved.

80\% of children with autism, with a mental age equivalent to a 4 year-old or above, failed to answer this question correctly.

Does the autistic child have a ‘theory of mind’?
Individuals with autism do not activate the face area of the fusiform gyrus that is reliably activated by normal individuals when looking at faces as opposed to objects.
Brain imaging studies consistently find that fusiform region of the temporal lobe becomes active when people look at faces.

The patient sits on the bed, his head wrapped in thick gauze bandages. He looks his doctor in the eye and says, “You just turned into somebody else... You almost look like somebody I’ve seen before, but somebody different. That was a trip.”
Social intelligence in the normal and autistic brain: an fMRI study

Simon Baron-Cohen, Howard A. Ring, Sally Wheelwright, Edward T. Bullmore, Mick J. Brammer, Andrew Simmons and Steve C. R. Williams

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3Neuroimaging Research, Department of Clinical Neuroscience, Institute of Psychiatry, University of London, Denmark Hill, London SE5 8AF, UK
Task A: Male or Female?

Task B: What is mental state?

Results: High functioning autistic and AS adults could not perform the task. They also showed less extensive activation in frontal regions and no activation in the amygdala.
fMRI activation of the fusiform gyrus and amygdala to cartoon characters but not to faces in a boy with autism

David J. Grelotti\textsuperscript{a,1}, Ami J. Klin\textsuperscript{a}, Isabel Gauthier\textsuperscript{b}, Pawel Skudlarski\textsuperscript{c}, Donald J. Cohen\textsuperscript{a,2}, John C. Gore\textsuperscript{d}, Fred R. Volkmar\textsuperscript{a}, Robert T. Schultz\textsuperscript{a,c,*}

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\textsuperscript{b} Department of Psychology, Vanderbilt University, Wilson Hall, Nashville, TN 37203, USA
\textsuperscript{c} Department of Diagnostic Radiology, Yale University School of Medicine, Magnetic Resonance Research Center, 300 Cedar Street, New Haven, CT 06510, USA
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Received 10 June 2003; accepted 29 June 2004
The slices containing the FG are highlighted in green and amygdala in red.

Right and left are reversed by radiological convention.

Because of DD’s expertise for individuating Digimon and his deficit in individuating faces, there was hypoactivation of the FFA to familiar and unfamiliar faces (compared to objects) but Digimon elicited activity in the area of the FG that is normally recruited for faces. The middle region of DD’s FG responded more to Digimon and masked Digimon than to familiar and unfamiliar faces and nonface objects.
I am autistic, but that is not who I am. Take time to know me, before you judge me.
Oxytocin is...

- nine-amino-acid peptide
- synthesized in the hypothalamus
- released into the bloodstream
- receptor binding sites in the limbic system
Affiliative behaviors...

- Sexual behavior
- Mother-infant
- Adult-adult pairing
- Separation distress
- Feeding & Grooming
- Stress response
Research report

Endogenous oxytocin is involved in short-term olfactory memory in female rats

Mario Engelmann *, Karl Ebner, Carsten T. Wotjak, Rainer Landgraf

Max Planck Institute of Psychiatry, Kraepelinstrasse 2, D-80804 Munich, Germany

Received 24 January 1997; received in revised form 13 May 1997; accepted 13 May 1997
Oxytocin knock-out mice fail to recognize familiar conspecifics after repeated social exposures, despite normal olfactory and spatial learning abilities.

Oxytocin treatment fully restores social recognition. It was demonstrated that oxytocin acts in the medial amygdala during the initial exposure to facilitate social recognition.
Intranasal oxytocin or placebo was administered to male university students playing “the trust game,” in which participants make decisions about transferring money to an anonymous player; trusting the other player can lead to higher payoffs for both players because the money is tripled when transferred; but one runs the risk that the other player might violate one’s trust and not share his or her earnings.
Oxytocin increases eye contact during a real-time, naturalistic social interaction in males with and without autism

B Auyeung1,2, MV Lombardo2,3,4, M Heinrichs5,6, B Chakrabarti2,7, A Sule8, JB Deakin9,10, RAI Bethlehem2, L Dickens2, N Mooney2, JAN Sipple2, P Thiemann2 and S Baron-Cohen2,10

Autism spectrum conditions (autism) affect ~1% of the population and are characterized by deficits in social communication. Oxytocin has been widely reported to affect social-communicative function and its neural underpinnings. Here we report the first evidence that intranasal oxytocin administration improves a core problem that individuals with autism have in using eye contact appropriately in real-world social settings. A randomized double-blind, placebo-controlled, within-subjects design is used to examine how intranasal administration of 24 IU of oxytocin affects gaze behavior for 32 adult males with autism and 34 controls in a real-time interaction with a researcher. This interactive paradigm bypasses many of the limitations encountered with conventional static or computer-based stimuli. Eye movements are recorded using eye tracking, providing an objective measurement of looking patterns. The measure is shown to be sensitive to the reduced eye contact commonly reported in autism, with the autism group spending less time looking to the eye region of the face than controls. Oxytocin administration selectively enhanced gaze to the eyes in both the autism and control groups (transformed mean eye-fixation difference per second = 0.082; 95% CI: 0.025–0.14, P = 0.006). Within the autism group, oxytocin has the most effect on fixation duration in individuals with impaired levels of eye contact at baseline (Cohen’s $d = 0.86$). These findings demonstrate that the potential benefits of oxytocin in autism extend to a real-time interaction, providing evidence of a therapeutic effect in a key aspect of social communication.

Translational Psychiatry (2015) 5, e507; doi:10.1038/tp.2014.146; published online 10 February 2015
Participants
Males 18–56 years of age \((M = 34.23, \text{s.d.} = 9.18)\) were included in this study. The clinical group consisted of 37 males with a diagnosis of Autism or Asperger Syndrome based on strict DSM-IV criteria.\(^{34}\) Thirty-seven typically developing males were recruited from the University of Cambridge and the general population. Exclusion criteria included smoking; a diagnosis of major depression, bipolar, obsessive–compulsive, panic or psychotic disorder; use of any psychoactive medication within one year of the study; substance dependence; or epilepsy. Women were excluded to avoid sex differences in oxytocin response.\(^9,^{12}\)
Experimental setup and areas of interest (AOI).
(a) Depicts the study setup.
(b) Shows the AOIs drawn for the eyes, mouth and other non-eye-or-mouth regions.
Reduced eye contact that is frequently observed in autism.

Number of fixations for each AOI by group (normalized for interview length). AOI, area of interest.

Oxytocin significantly increased participant gaze to the eye region of the interviewer’s face in both the autism and control groups. Normalized number of fixations for each AOI by drug (data not transformed). (a) Shows fixations to the eyes for each AOI by drug for the control group. (b) Shows fixations to the eyes for each AOI by drug for the autism group. Error bars show ±1 s.e.d. for this within-subjects comparison. AOI, area of interest.
Difference scores in fixation time for the 'Low' versus 'High' looking groups in autism (groups identified using control group mean). CI, confidence interval.

Within the autism group, it was also found that oxytocin had a greater effect on looking time in individuals who exhibited lower eye contact in the placebo condition.