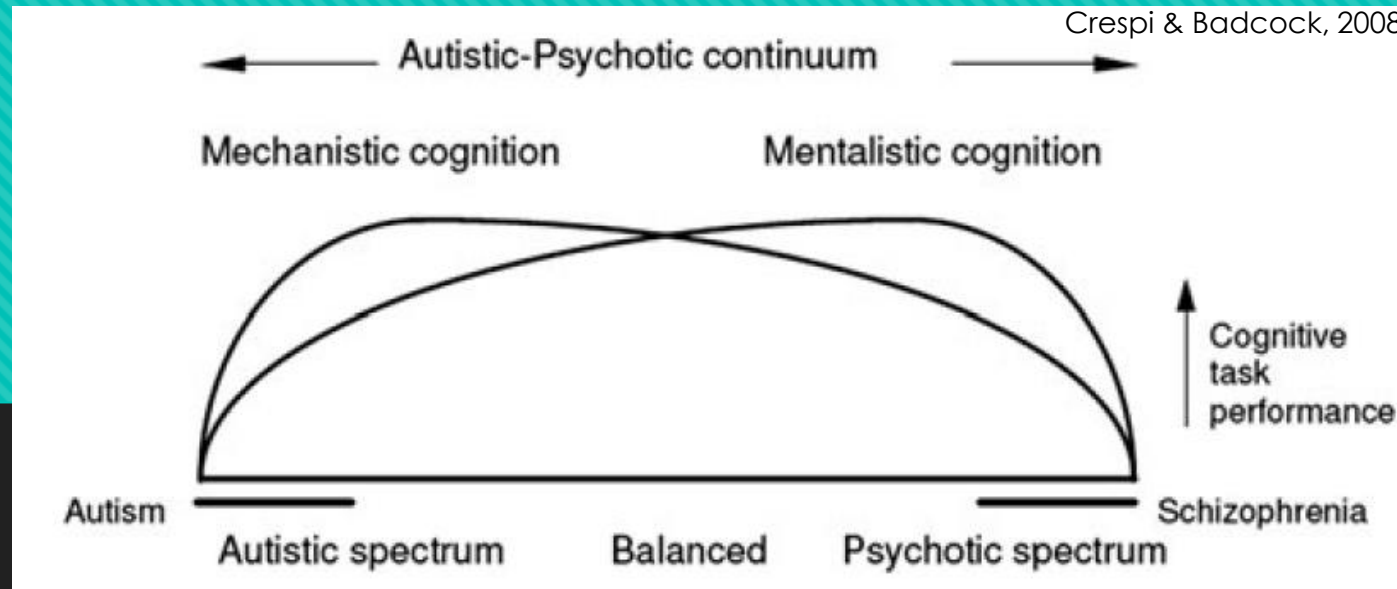


Is there an autist–neurotypical–schizophrenic continuum in social cognition? A critical review of theories and evidence



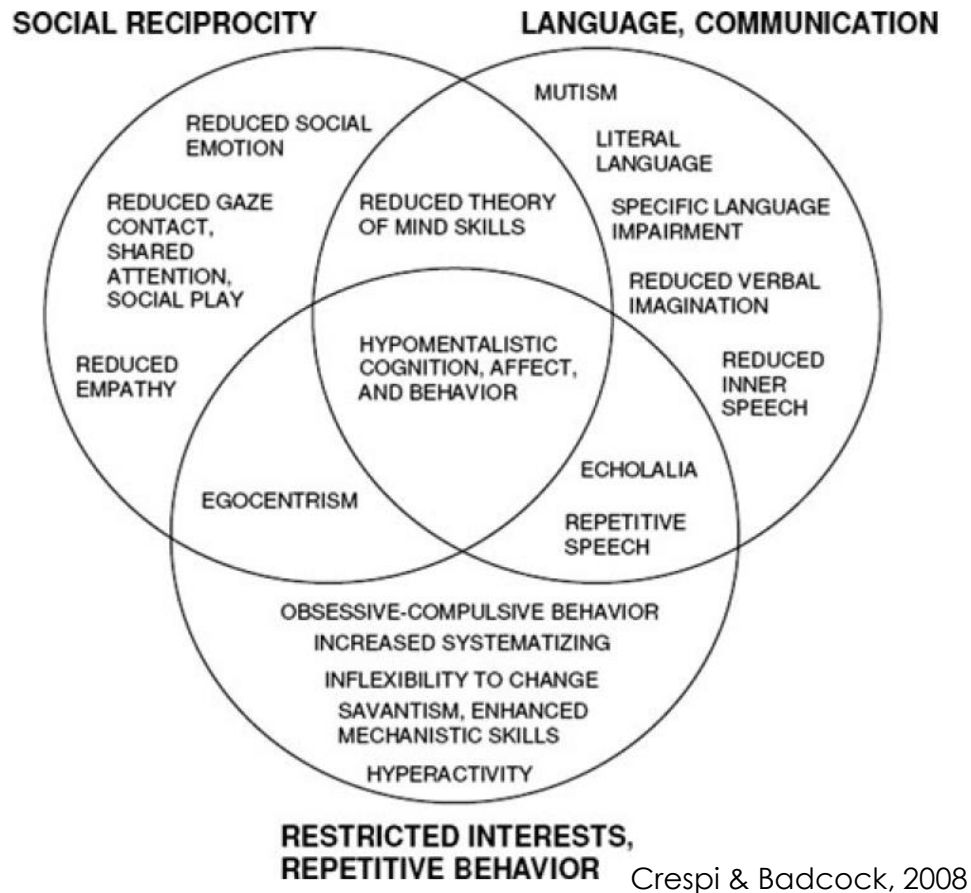
Henryk Bukowski, postdoc at UCLouvain

Autism & Schizophrenia, two spectrums

INTRO:

- Both disorders are caused by multiple genes.
- Individuals express to varying degrees a fraction of the symptoms
- Problems of social cognition in both schizophrenia & autism
- Same problems?
 - Diametrical opposite hypothesis (Part 1)
 - Opposite social cognition impairments? (Part 2)
 - Another diametrical distinction? (Part 3)

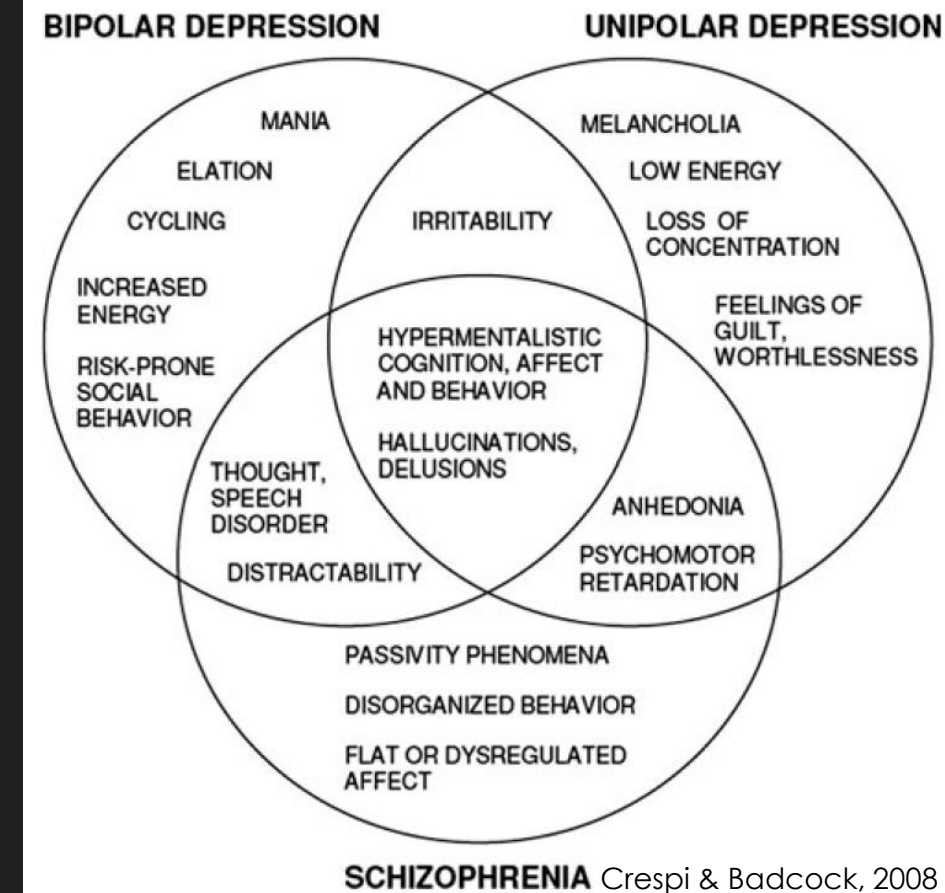
Part 1: Diametrical opposites hypothesis



← Autism spectrum

Psychosis spectrum →

Degree of overlap =
magnitude of autism /
psychosis



Part 1: Diametrical opposites hypothesis

- **Crespi & Badcock** (2008) argued that :
- Social brain development...
 - Gaze, Agency, Social cognition, Global/local processing, Language, Behavior
- ... is underdeveloped in autism
- ... is hyper-developed in psychosis
- Concretely, social inferences are **poor in autism** and **excessive in psychosis**.

BEHAVIORAL AND BRAIN SCIENCES (2008) **31**, 241–320

Printed in the United States of America

doi:10.1017/S0140525X08004214

Psychosis and autism as diametrical disorders of the social brain

Bernard Crespi

Killam Research Professor, Department of Biosciences, Simon Fraser University, Burnaby, BC V5A 1S6, Canada

crespi@sfu.ca <http://www.sfu.ca/biology/faculty/crespi/>

Christopher Badcock

Part 1: Diametrical opposites hypothesis

- **Autism:** body & brain overgrown but deficits in social cognition.
- **Psychosis:** body & brain undergrown but excessive social cognition (delusions = non adaptive because disconnected from reality)

Trait	Autistic Spectrum	Psychotic Spectrum
Placentation	Placental inclusions, associated with overgrowth (1)	Intrauterine growth restriction, placental undergrowth and fetal hypoxia (2,3)
Growth, anatomy	High or same birth weight, length (mixed) (4–6) Faster body growth in childhood (5,10,11)	Low birth weight, length (mixed) (7–9) Slow growth, small size in childhood (mixed) (2,12,13)
Neuroanatomy and neurological function	Lower 2 : 4 digit ratio (14,15) High levels of BDNF, IGF2 and other growth factors (18,19)	Higher 2 : 4 digit ratio (16,17) Low levels of BDNF and other growth factors (20–22)
	Larger brain size, more gray and white matter, thicker cortex (23–25) Lack of gray matter loss (31)	Smaller brain size, less gray and white matter thinner cortex (26–30) Accelerated gray matter loss (32)
	Larger amygdala (early development), more reactive (33,34) Smaller corpus callosum (34,36) Anomalous lateralization (39,40) Relative right-hemisphere dysfunction (43) Mirror neuron system underdeveloped (46,47)	Smaller amygdala, less reactive (mixed) (35,36) Larger corpus callosum (mixed) (37,38) Less lateralized (41,42) Relative left-hemisphere dysfunction (44,45) Mirror neuron system dysregulated (48)
Cognition	Deficits related to gaze (49) Deficits in interpreting intention (52) Deficits in shared attention (55) Deficits in personal agency (56,57) Theory of mind underdeveloped (58,59)	High gaze sensitivity, paranoia (50,51) Delusions of persecution, erotomania (53,54) Delusions of conspiracy (53) Delusions of reference, megalomania (53) Theory of mind overdeveloped in schizophrenia (60); enhanced theory of mind in healthy schizotypy (61–63)

Part 1: Diametrical opposites hypothesis

Autism

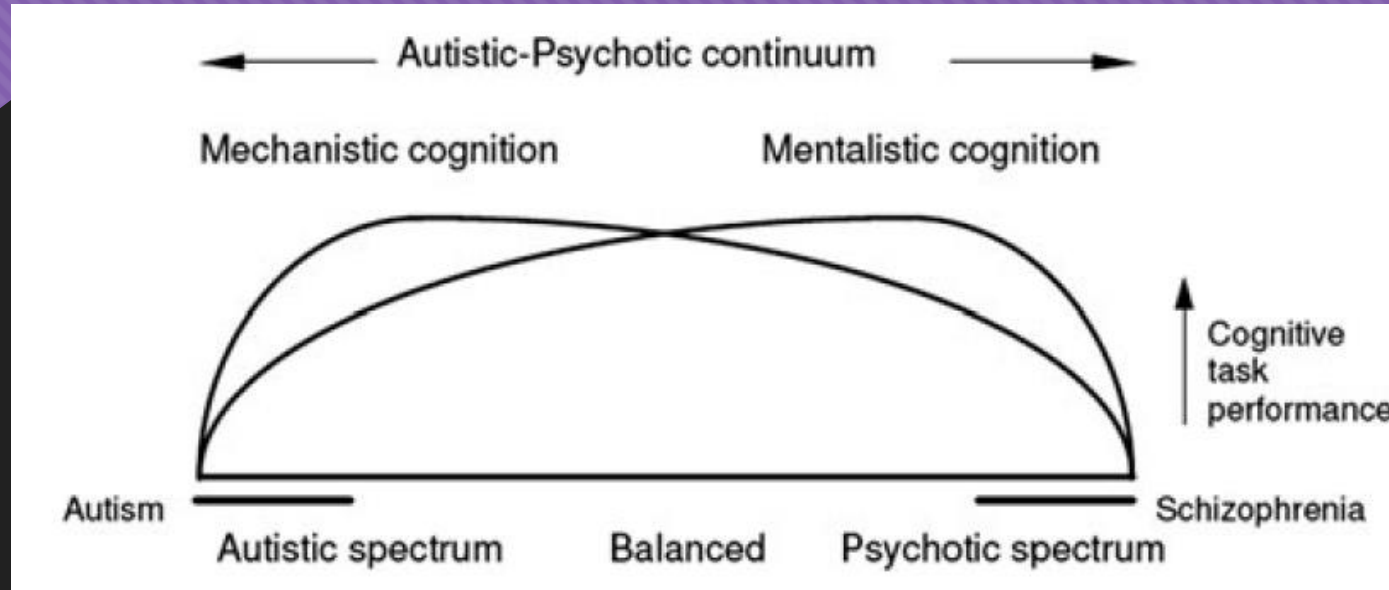
- **Avoidance of direct gaze** (amygdala and oxytocin dysfunction) leads to impaired development of social cognition.
- **Low self-consciousness** (events interpreted in mechanistic terms).

Psychosis

- **Hypersensitivity to gaze** leads to extreme inferences of social cues and over-attribution of intentionality.
- **High self-consciousness** (events interpreted as self-related).

Part 1: Diametrical opposites hypothesis:

What about healthy individuals?



Association with autism

- (+) High proportions of fathers of autistic children in physics, engineering, computer science, and mathematics
- (+) High-functioning autism have better and more impervious memory, better embedded figures detection, better sentence comprehension

Association with psychosis (positive symptoms)

- (+) higher affective empathy, subtle social cues detection, socio-emotional imagination.
- (-) low social functioning, low ToM (Hinting task, sequencing False-Belief, open responses), low visual perspective taking,

Part 1: Diametrical opposites hypothesis: What about healthy individuals?

PROCEEDINGS B

rsob.royalsocietypublishing.org

Research

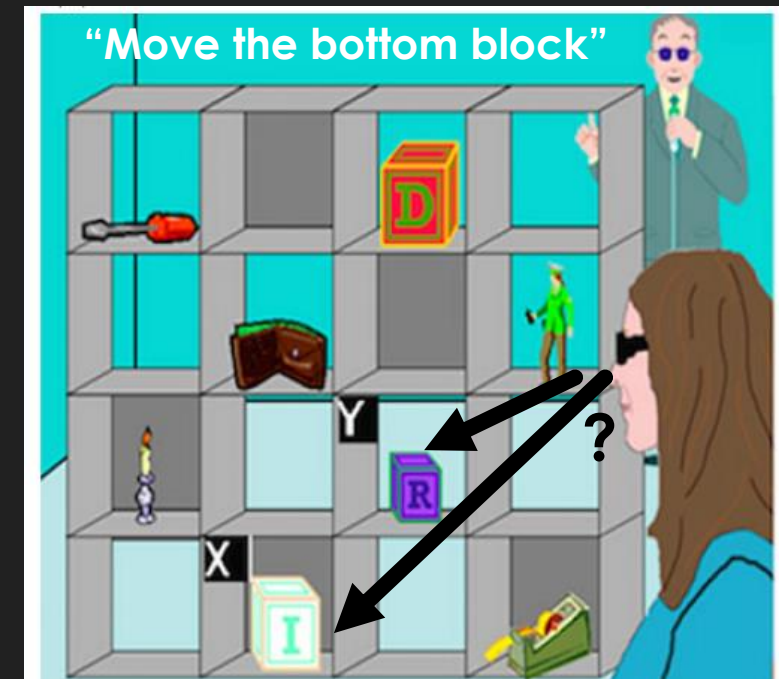
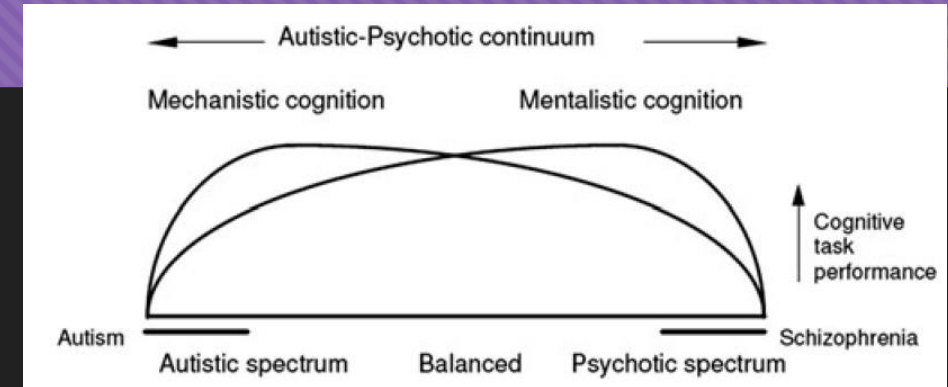


Perspective-taking abilities in the balance between autism tendencies and psychosis proneness

Ahmad M. Abu-Akel¹, Stephen J. Wood^{1,2}, Peter C. Hansen¹ and Ian A. Apperly¹

Association with both autism and positive psychotic symptoms = **BALANCED ?**

- Autism and positive symp. psychosis independantly predict perspective taking errors
- Their interaction (both high) reduced errors → balancing!
- New! Autism/Psychosis interaction for excitatory and inhibitory neurotransmitter concentrations in the superior temporal cortex (Ford, Abu-Akel, & Crewther, 2019)



Part 2: Opposite social cognition impairments?

PROCEEDINGS B

rspb.royalsocietypublishing.org



Perspective-taking abilities in the balance between autism tendencies and psychosis proneness

Ahmad M. Abu-Akel¹, Stephen J. Wood^{1,2}, Peter C. Hansen¹ and Ian A. Apperly¹

- Errors predicted by autism & psychosis
- Different errors? Cannot tell with this task.

A Meta-Analysis of Mentalizing Impairments in Adults With Schizophrenia and Autism Spectrum Disorder

Yu Sun Chung^{*,1}, Deanna Barch^{1,2}, and Michael Strube¹

- 32 studies analyzed:
- Both impaired in ToM to similar extent
- Schizo more impaired for verbal > visual tasks.
- → could not distinguish autism vs. schizo errors

Part 2: Opposite social cognition impairments?

- **Clinical descriptions :**
 - Autism = poor, non-spontaneous ToM (low self-consciousness)
 - Schizophrenia = excessive ToM (delusions, intrusive inner speech, over-attributions)
- **Cognitive tasks:**
 - Different tasks for different populations (Implicit mentalizing vs. Hinting task)
 - Errors in both population, no distinction (e.g., False Beliefs, RMET, Strange stories)
 - ➔ Very few tasks can distinguish autism from schizophrenia errors
 - ➔ Because there is little theory of what the errors should be
- **One notable exception:** multiple choices to explain social stories
 - Schizo : excessive mentalizing answer "She wants her friend out because she realized her friend doesn't actually like her"
 - Normal : appropriate mentalizing "She opens the door to her friend who leaves the party"
 - Autism : poor/absent mentalizing answer: "She opens the door to make some air".
 - Limit: Can be used only with autist with normal QI and language!

Another diametrical distinction?

Predictive coding

- **Brain = predictive machine**
- Information processing is strongly shaped by predictions of :
 - What will happen
 - How things should look/sound like
 - Ambiguous stimuli are particularly interpreted according to predictions.
- Predicted stimuli = business as usual = filtered out of our attentional focus
- Unpredicted stimuli = prediction error = something wrong/new
- If strong error (because prediction was strong or deviation is high):
 - Gets our attention
 - Lead to re-interpret/revise the prediction, hence the nature of the unpredicted stimulus
- **Social cognition** in all that? 2 examples : **self-agency** and **self-body ownership**
 - When I execute an action, I expect sensory consequences.
 - If sensory consequences are unexpected, the action is interpreted as not performed by myself or the executing hand as not belonging to me.

Another diametrical distinction?

Predictive coding



The computational anatomy of psychosis

Rick A. Adams^{1}, Klaas Enno Stephan^{1,2,3}, Harriet R. Brown¹, Christopher D. Frith¹ and Karl J. Friston¹*

Psychosis:

- Too weak predictions for low-level cognition
 - ➔ Aberrant perceptions of events caused by oneself and others (hallucinations, over-attributions of intentionality)
 - ➔ Over-estimation of changes in environment for decision making ➔ decisions are hasty, based on too few evidence
- Compensation hypothesis: Too strong influence of high-level predictions (e.g., beliefs)
 - ➔ Delusions

Precise minds in uncertain worlds: Predictive coding in autism

Sander Van de Cruys¹, Kris Evers^{1,2,3}, Ruth Van der Hallen^{1,2,3}, Lien Van Eylen^{2,4}, Bart Boets^{2,3},
Lee de-Wit¹, Johan Wagemans^{1,2}

¹Laboratory of Experimental Psychology, KU Leuven, Belgium; ²Leuven Autism Research (LAuRes), KU Leuven, Belgium; ³Department of Child Psychiatry, UPC-KU Leuven, Belgium; ⁴Parenting and Special Education Research Unit, KU Leuven, Belgium

Autism

- Too strong errors for low-level cognition
- Failure to extract predictable regularities
 - ➔ Everything is unpredicted !
 - ➔ Failure to filter-out all the stimuli!
 - ➔ “individuals with ASD will get flooded by the wealth of available information in a social situation.”
 - ➔ Savant skills: Unbiased exhaustive processing.

Conclusion

- **Diametrical opposites** theory integrates clinical observations, molecular & cognitive neuroscience, genetics.
- And so does **predictive coding**, progressively.
- Two new theories with clear predictions, especially on low-level aspects of cognition.
- However, there are too few tasks that directly distinguishes autism from schizophrenia.
- And these exceptions look at high-level aspects of social cognition.
- Hence, current evidence is limited because evidence is indirect and often high-level.

Thank you for your attention

Henryk Bukowski, postdoc at UCLouvain

Part 1: Social cognition related symptoms

Schizophrenia

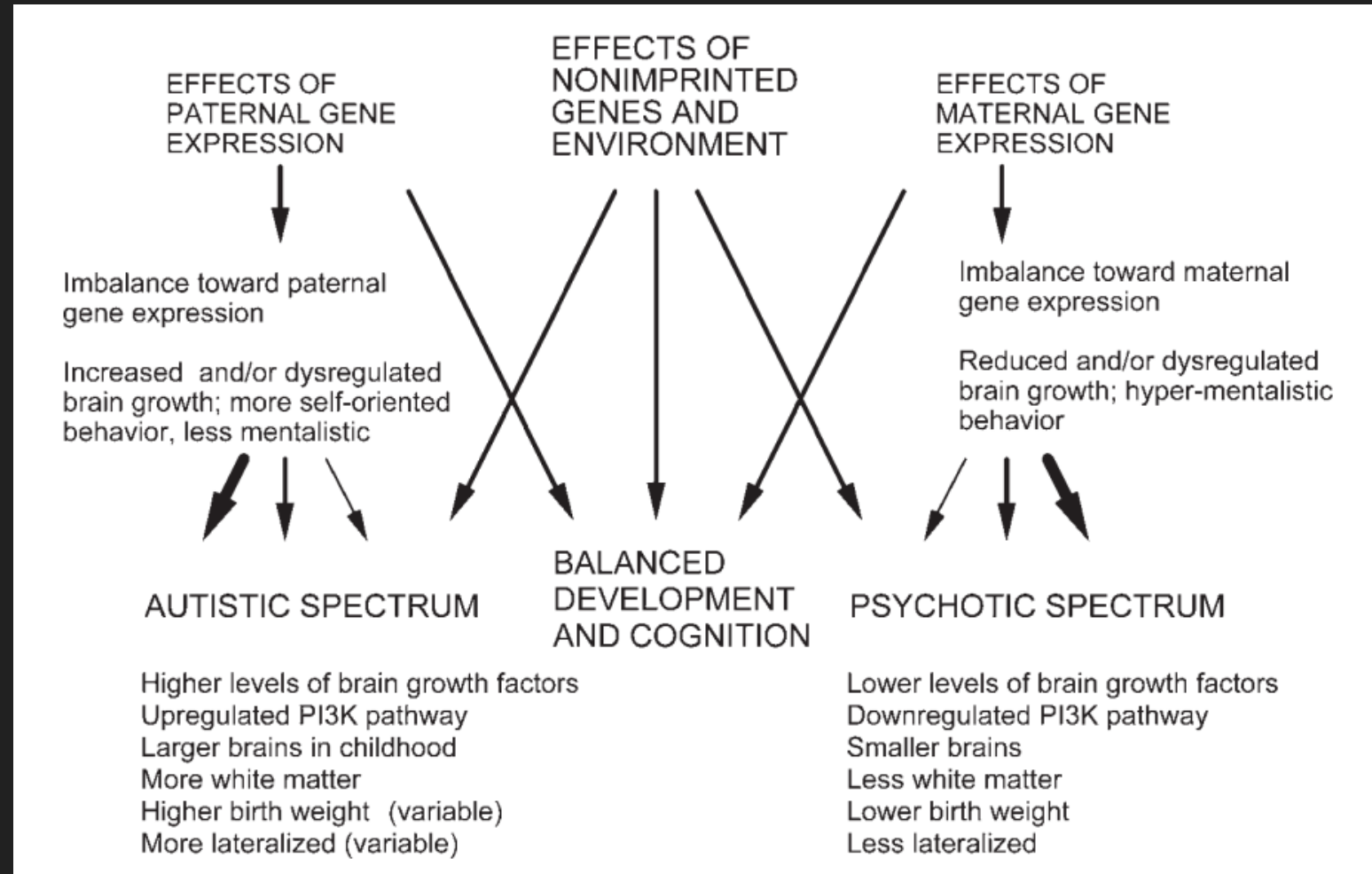
- + hallucinations (voices or any senses)
- + disorganized speech (illogical, incoherent)
- + delusions (strong irrational beliefs: being controlled or persecuted by another)
- - lack of speech
- - blunted affect
- - anhedonia (no pleasure no motivation)
- - no desire for social bonding
- Disorganized behavior (bizarre, impulse)
- (Catatonia: stupor)

First-rank symptoms of schizophrenia

Delusions & hallucinations related to disturbances of agent-mental state attribution ("who thinks what")

Autism

Part 2: Diametrical opposites hypothesis



Future studies

- Asperger: Good understanding (in lab) but fail to use in real-life
- Asperger: Preserved performance for explicit tasks but not for implicit tasks (no instruction, rely on spontaneity)