

ANC, Cambridge, 10th Sept 2010

Towards a unifying theory of ASD

Bruno GEPNER, M.D., Ph.D

Speech and Language Laboratory

UMR CNRS 6057, Aix-Marseille University,
Aix-en-Provence, France



ANC, Cambridge, 10th Sept 2010

Towards a unifying theory of ASD ?

Bruno GEPNER (M.D., Ph.D)

Speech and Language Laboratory

UMR CNRS 6057, Aix-Marseille University,

Aix-en-Provence, France



The *autism* *puzzle*

* Deficit of facial identity recognition

Langdell, 1978

* Preserved/Enhanced facial identity recognition of upside-down faces

* Deficit of facial emotion recognition

Hobson et al., 1986

* Deficit of lip-reading and eye-direction detection

De Gelder et al., 1991

• Deficit of eyes-reading

Baron-Cohen et al., 1995



Facial processing

- Impaired processing of various facial aspects :
 - Visuo-auditory association
 - Global pattern
 - Facial dynamics : emotional gestures, eyes' movements, lips' movements



Gepner et al., *Child Neuropsychol*, 1996

**These deficits are present at the age of 3,
and probably earlier.**

Gepner et al., *Infant Behav*, 1994

Facial processing

- Identification of faces is rather based on details and high spatial frequencies

Rondan et al., Child Neuropsychol, 2003

Deruelle et al., J Autism Dev Disord, 2004

- Good analytic processing of faces at the expense of configural processing

Deruelle et al., Int J Psychol, 2006

Review by Dawson et al., 2005

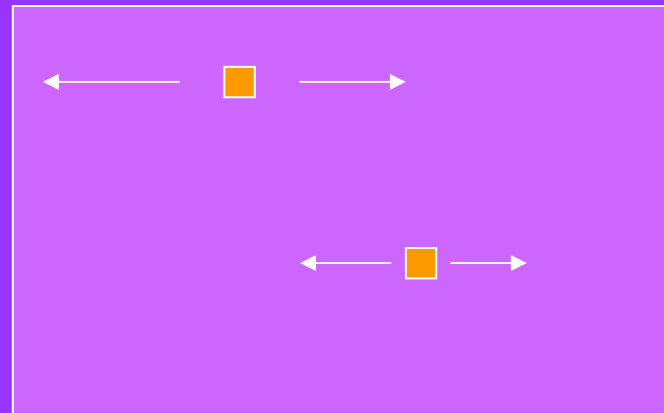
Confirmed by fMRI studies

A blurred image of a man in a white t-shirt, suggesting motion. The man is positioned in the center of the frame, and the background is a dark, textured surface. The overall effect is one of movement and transition.

Movement...

Visual perception of speed and direction of movements

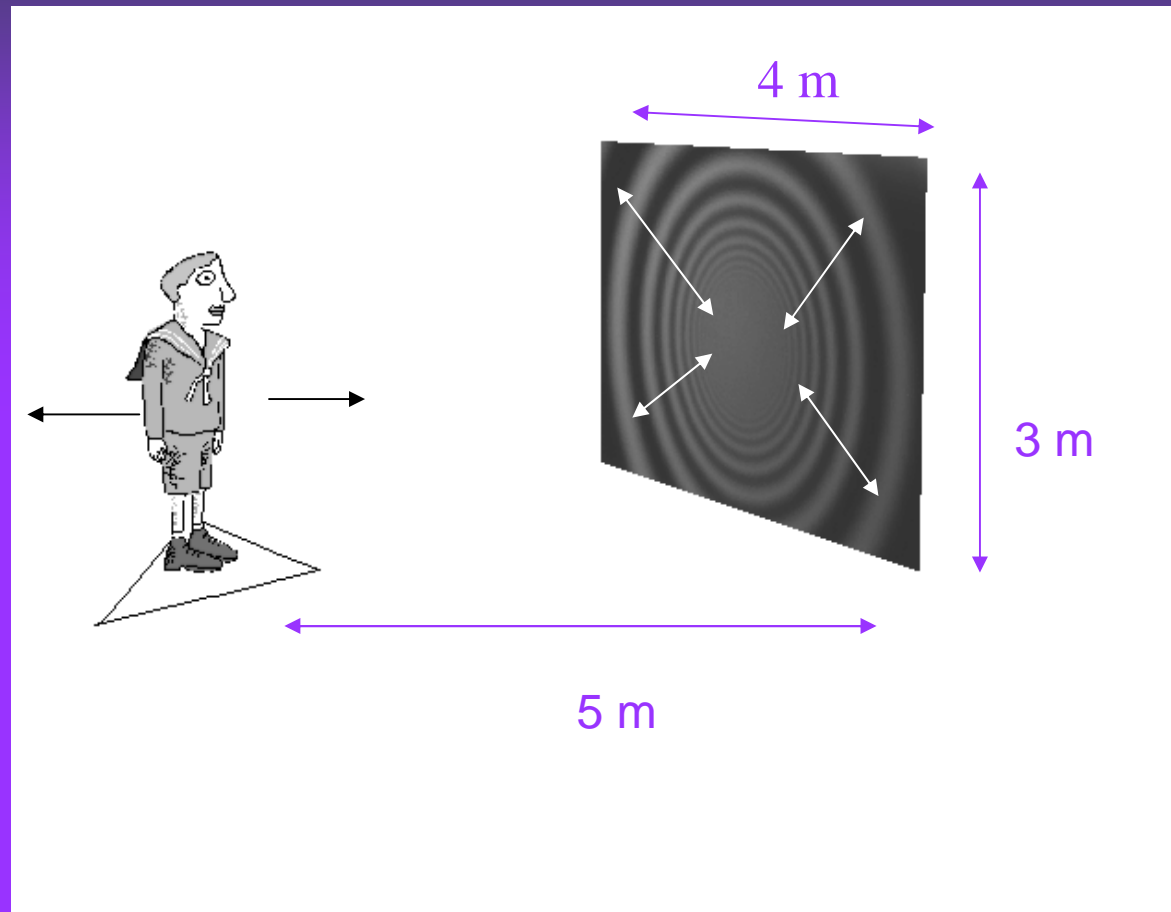
Deficit in comparing two speeds, **especially as** speeds increase and directions become more complex and less foreseeable



Gepner, unpublished PhD thesis, 1997

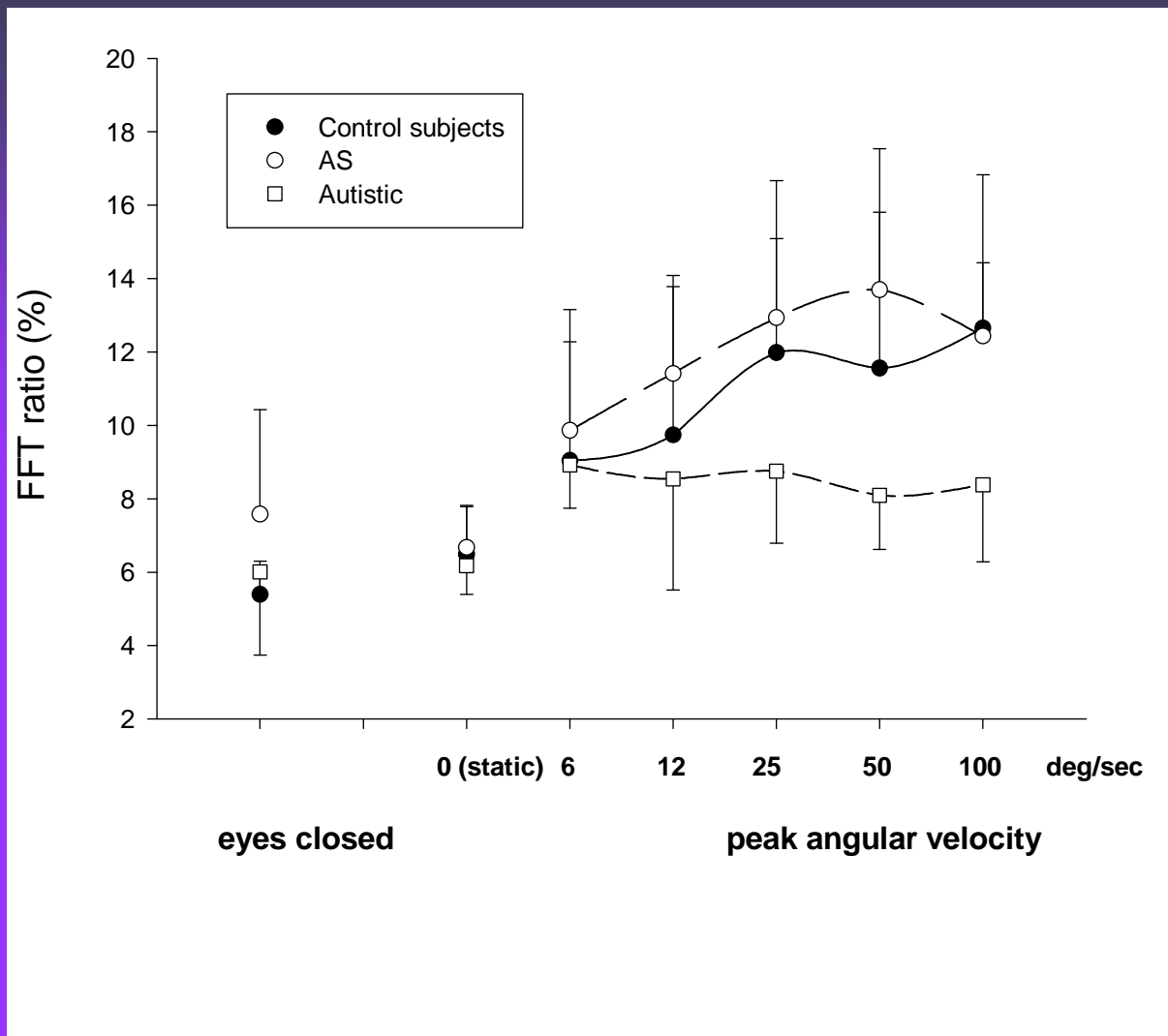
Gepner & Mestre, Trends Cogn Sci, 2002

Postural reactivity to environmental movement



Decreased visuo-postural reactivity

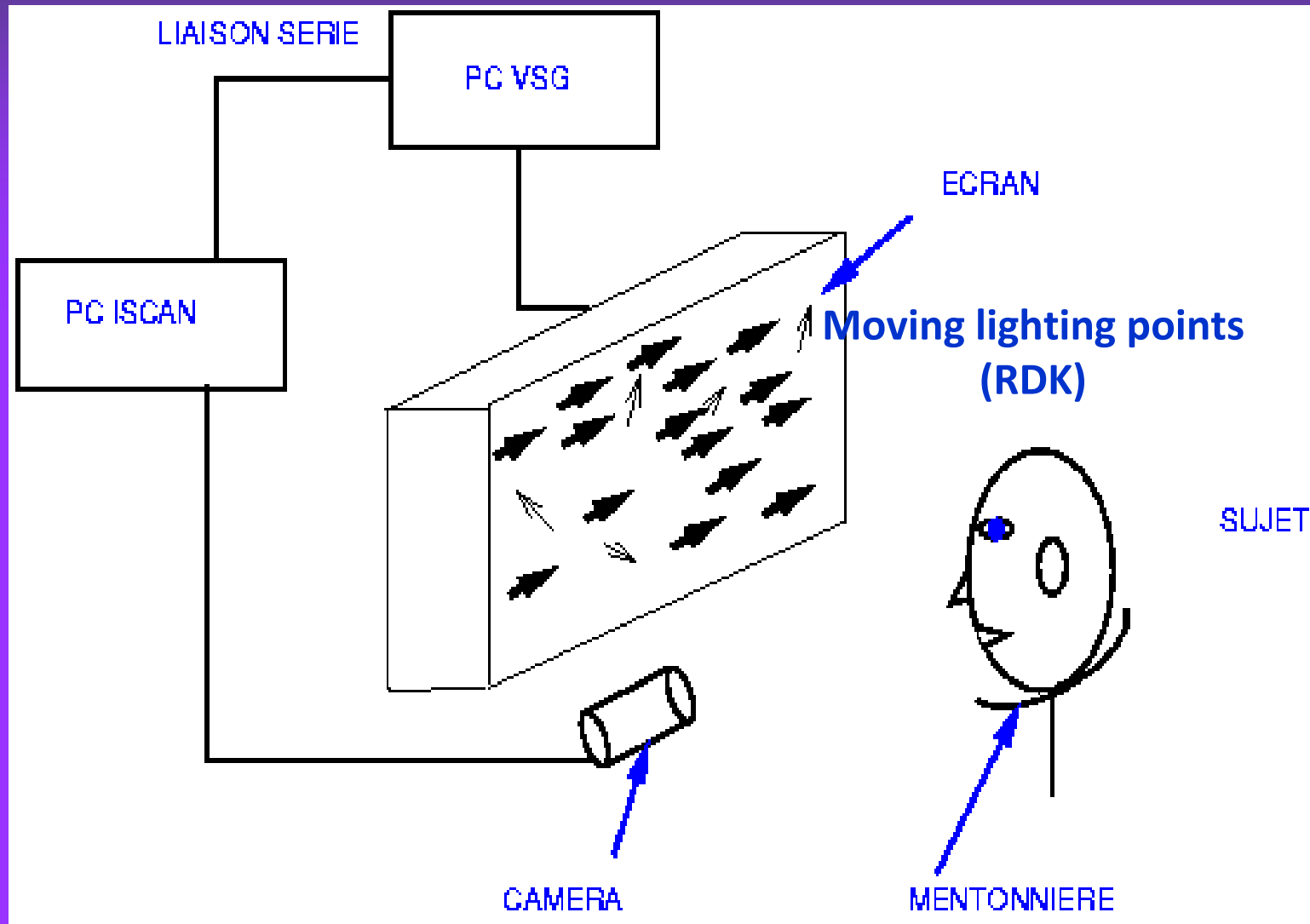
Gepner et al., *NeuroReport*, 1995

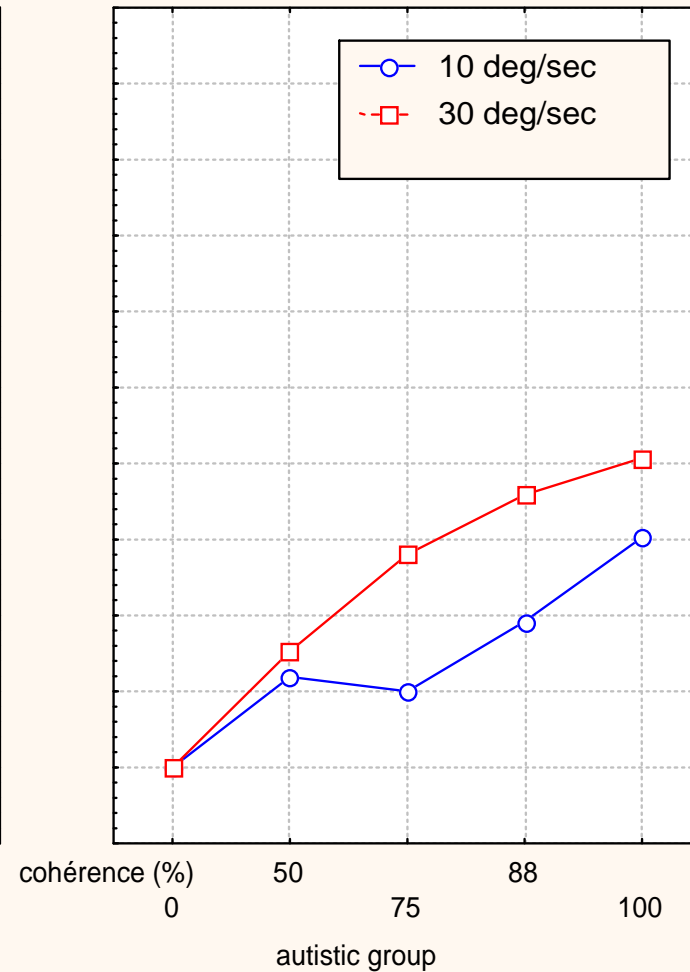
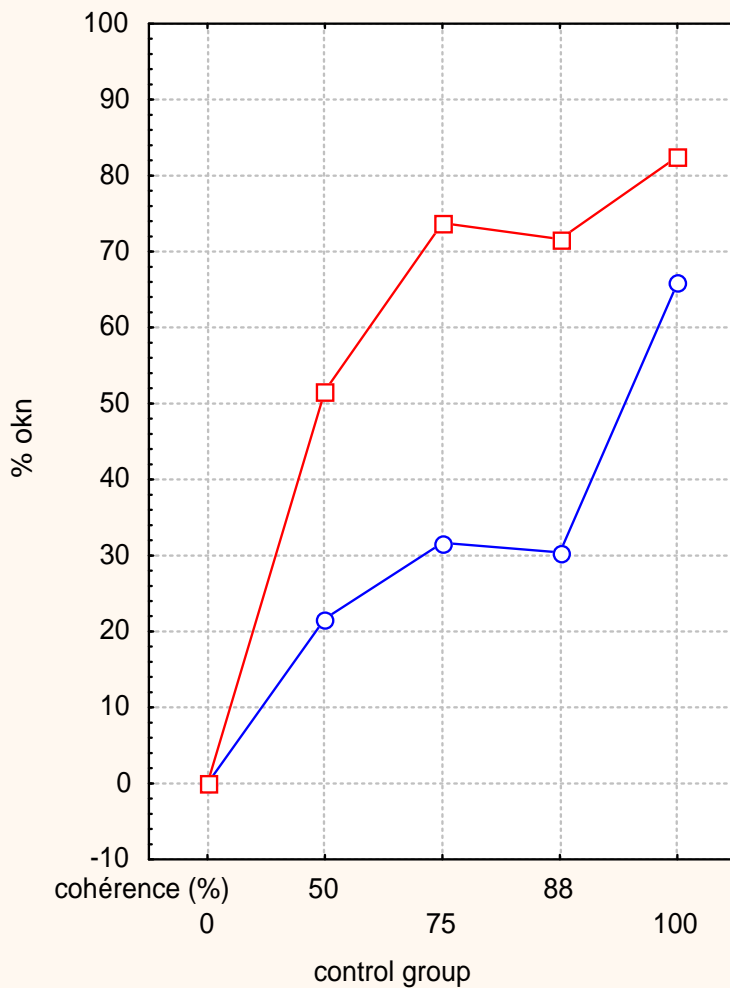


Visuo-postural coupling disorders

Gepner & Mestre, *J Autism Dev Disord*, 2002

Oculomotor reactivity to visual motion





Hypo- or hyper-reactivity to (fast) movement

Gepner & Mestre, *Trends Cogn Sci*, 2002

Mestre *et al.*, *TIPA*, 2002

See also: Spencer *et al.*, 2000; Milne *et al.*, 2002

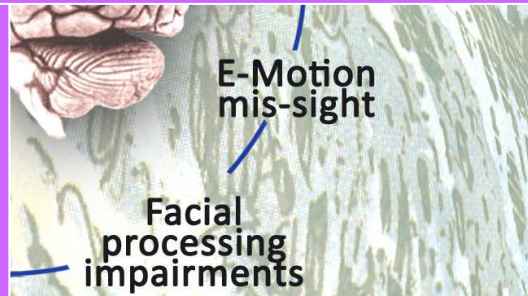
B. Gepner, Cambridge, 10th Sept 2010

Motion mis-sight
Emotion mis-sight

E-Motion mis-sight



Gepner, *Psychiatrie Enfant*, 2001
Gepner & Mestre, *Trends Cogn Sci*, 2002
Gepner, *Devenir*, 2006



h Sept 2010

Weak central coherence : Frith, Happé

Enhanced detail perception : Mottron

Imitation deficits : Rogers

Executive dysfunction: Hughes, Hill

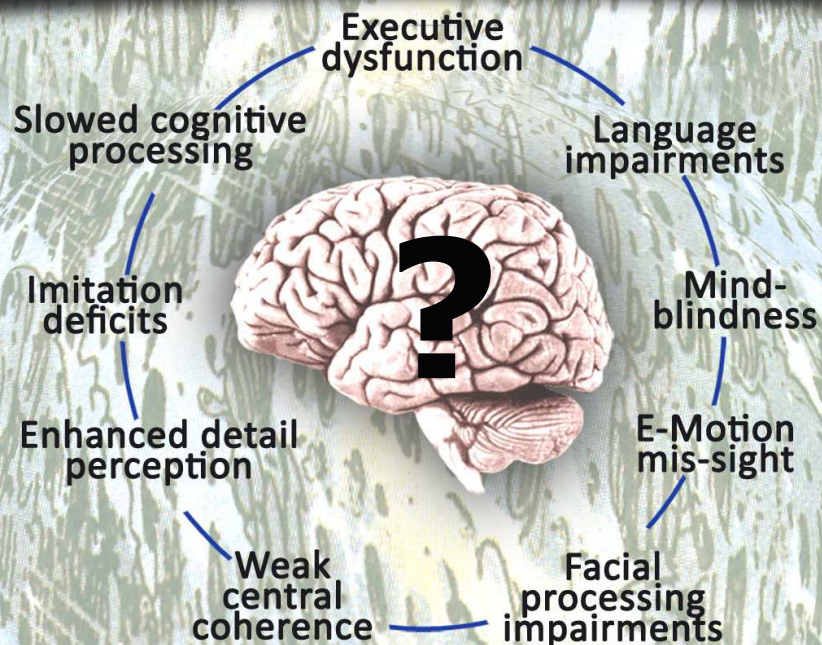
Planification, anticipation, inhibition

Language impairments : Tager-Flusberg, Rapin

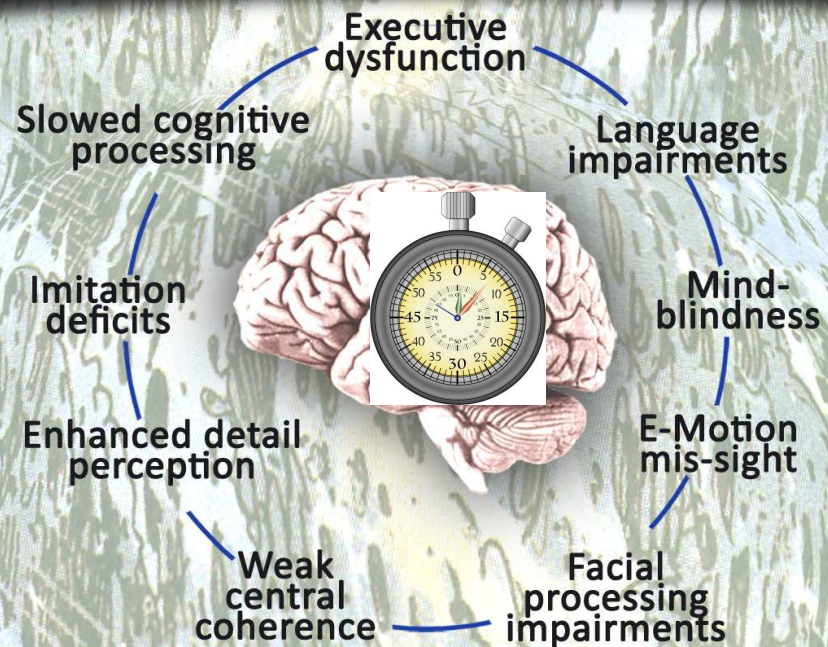
Mindblindness, empathizing deficit : Baron-Cohen

h Sept 2010

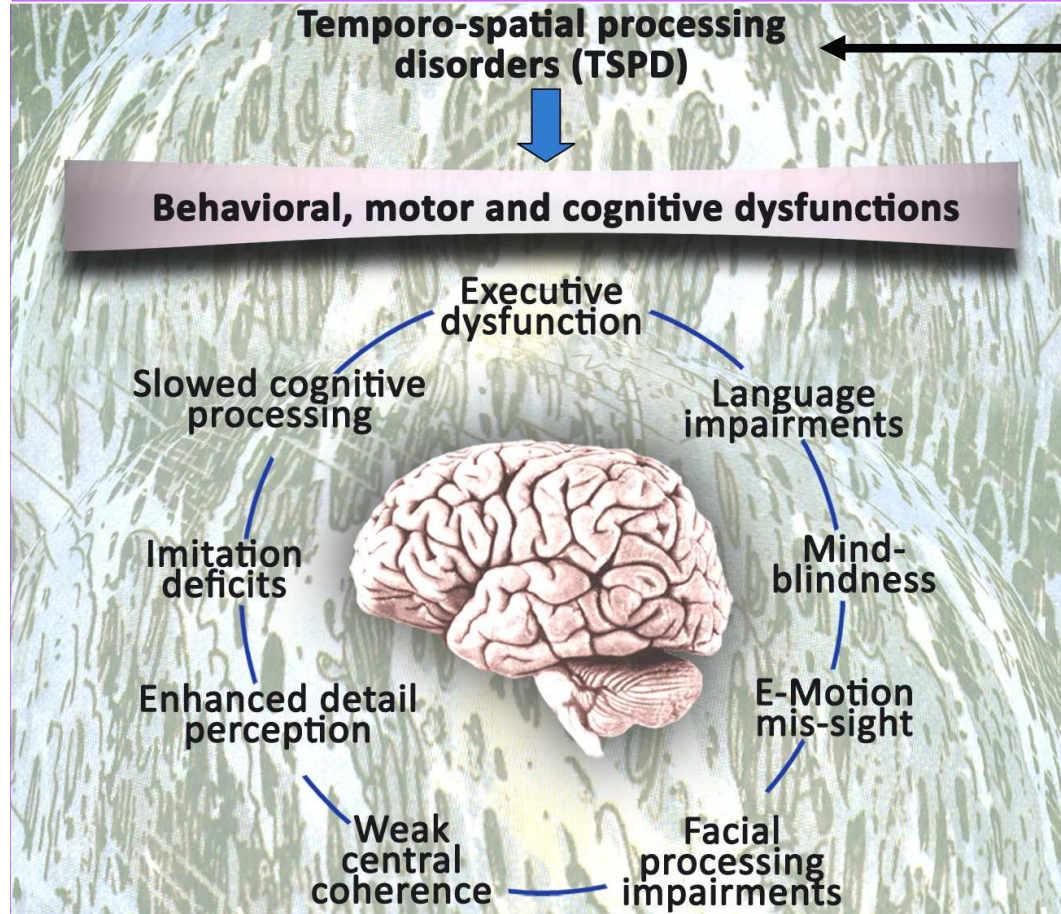
Behavioral, motor and cognitive dysfunctions



Behavioral, motor and cognitive dysfunctions



Anomalies of online perception and on time sensorymotor - integration of dynamic sensory stimuli



Self reports of adults with ASD/Asperger

B. Gepner, Cambridge, 10th Sept 2010

Constant changes and slowing down



*“The **constant change** of most things never seemed to give me any chance to **prepare myself** for them.*”

*The stress of trying to **catch up and keep up** often became too much, and I found myself trying to **slow everything down** and take some time out...”*

Donna WILLIAMS, *Nobody nowhere*, 1992

Movement and autistic continuum



Some of the problems autistics have with making eye contact may be nothing more than an intolerance for the movement of the other person's eyes. One autistic person reported that looking at people's eyes was difficult because the eyes did not stay still ...

"Minor sensory processing deficits heightened my attraction to certain stimulation (e.g. airport's doors), whereas a greater sensory processing defect might cause another child to fear and avoid the same stimulus..."

Temple GRANDIN, *Thinking in pictures*, 1997

Speed of language and delay for answer



« *Gurcharan used to speak very fast and I sometimes found difficult to follow her ... the rapid succession of her questions was intrusive, like the plic-ploc of the rain on my head, and it took some time to answer her... »*

Daniel TAMMETT, *Born on a blue day*, 2006

Confirmed by Oram Cardy et al., 2005; Roberts et al., 2010

Time and space

« For me, **time seems to flow out rapidly**, or in other terms, a non-autistic person sees me as **living slowly**.

During a certain period of time a non-autistic person can digest more percepts than me because I am constrained to digest each object piece by piece.

Time phenomenon is relative (to space), and strongly related to the number of distinct entities to process.

*I like to compare eyes of autistic persons to the faceted eyes of insects: there are numerous different **subtile details**, but they are **not integrated together**... »*

Van DALEN, *Seeing with a mild autistic person's eyes*, 1994



Weak central coherence

Static detail perception



Urville, Gilles Tréhin

B. Gepner, Cambridge, 10th Sept 2010



B. Gepner, Cambridge, 10th Sept 2010



Enhanced local and static perception : « photographic » perception

Enhanced spatial memory and graphic abilities

B. Gepner, Cambridge, 10th Sept 2010

Early visual signs in ASD

B. Gepner, Cambridge, 10th Sept 2010

Family home movies

e.g. *Sauvage ; Teitelbaum; Dawson; Muratori...*

First semester

- Gaze abnormalities : default of ocular pursuit of moving objects and persons
- Poor or no interest for moving games
- Peculiar interests for hands, details and static patterns



Second semester



Deficit of gaze contact, impression of blindness

- *Swaying, self-sensory (visual, auditory, proprioceptive, vestibular) stimulation (e.g. hands or fingers flapping in front of the eyes...), other motor stereotypes, delayed motor milestones*

The world is changing too fast for autistic people



So please, slow down !

B. Gepner, Cambridge, 10th Sept 2010

Benefits from slowing down biological movements

- Relatively good emotional and non emotional facial expressions recognition when facial gestures are presented dynamically and slowly on video

Gepner et al., J Autism Dev Disord, 2001

- Facial expression recognition and facial/vocal induced imitation are enhanced when facial movements and vocal sounds are slowed down

Tardif et al., J Autism Dev Disord, 2007

- Facial and body intentional imitation is improved when facial and body gestures are slowed down

Lainé et al., Enfance, 2008

Lainé et al., under revision

Benefits from slowing down verbal language

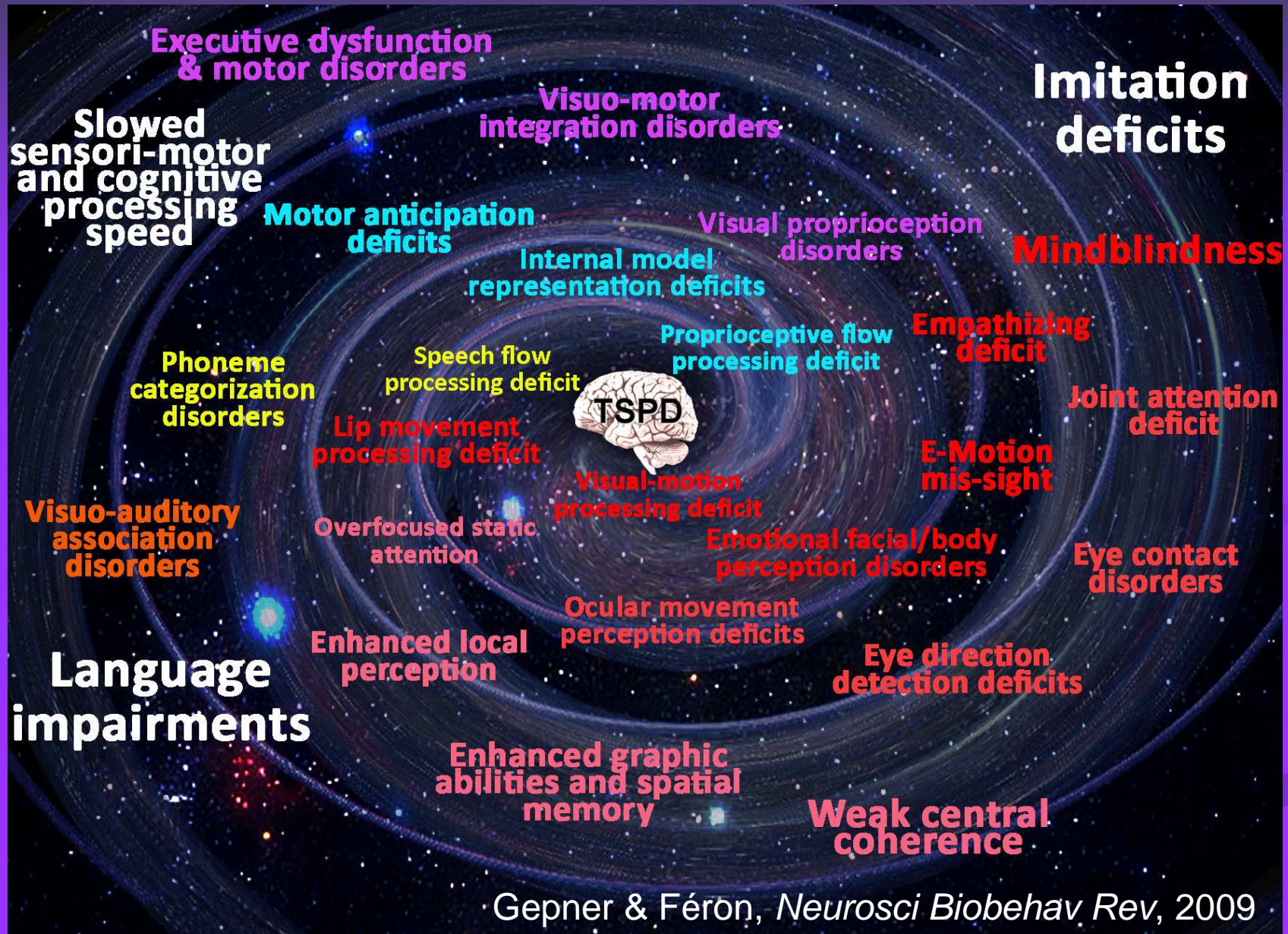
- Performances in
 - phonemes categorization,
 - words comprehension,
 - sentence comprehensionare enhanced when verbal flow is slowed down

Tardif et al., *Parole*, 2002

Lainé et al., *Enfance*, 2009

Lainé et al., *in preparation*

The *Temporo-Spatial Processing Disorders (TSPD)* hypothesis



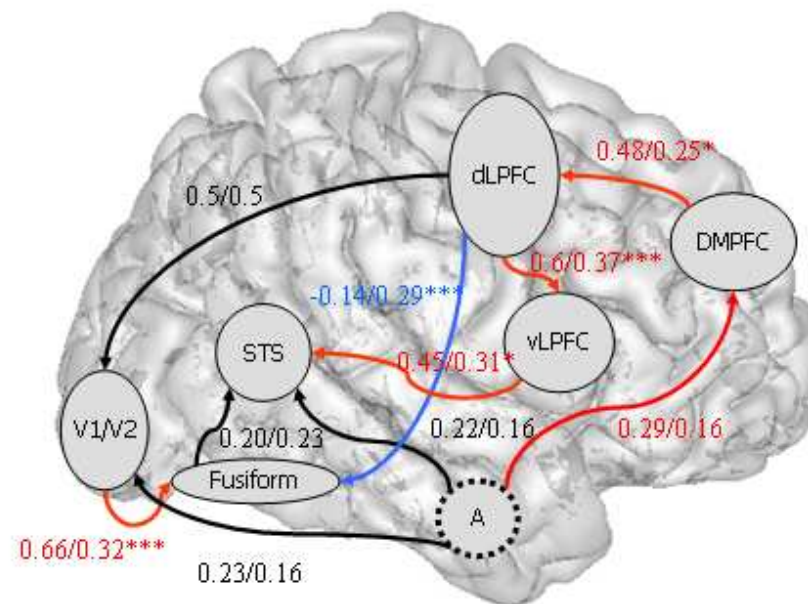
Gepner & Féron, *Neurosci Biobehav Rev*, 2009

B. Gepner, Cambridge, 10th Sept 2010

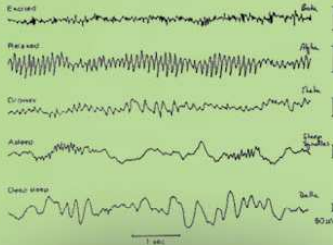
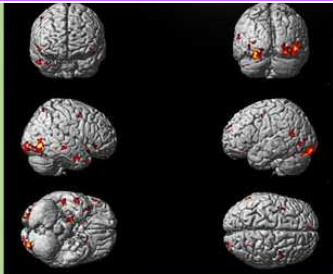
What signature in the brain ?

B. Gepner, Cambridge, 10th Sept 2010

Effective connectivity (fMRI) during emotional facial gestures processing



Wicker, Fontlupt, Hubert, Tardif, Gepner, Deruelle,
Soc Cogn Affect Neurosci, 2008



Functional brain anomalies

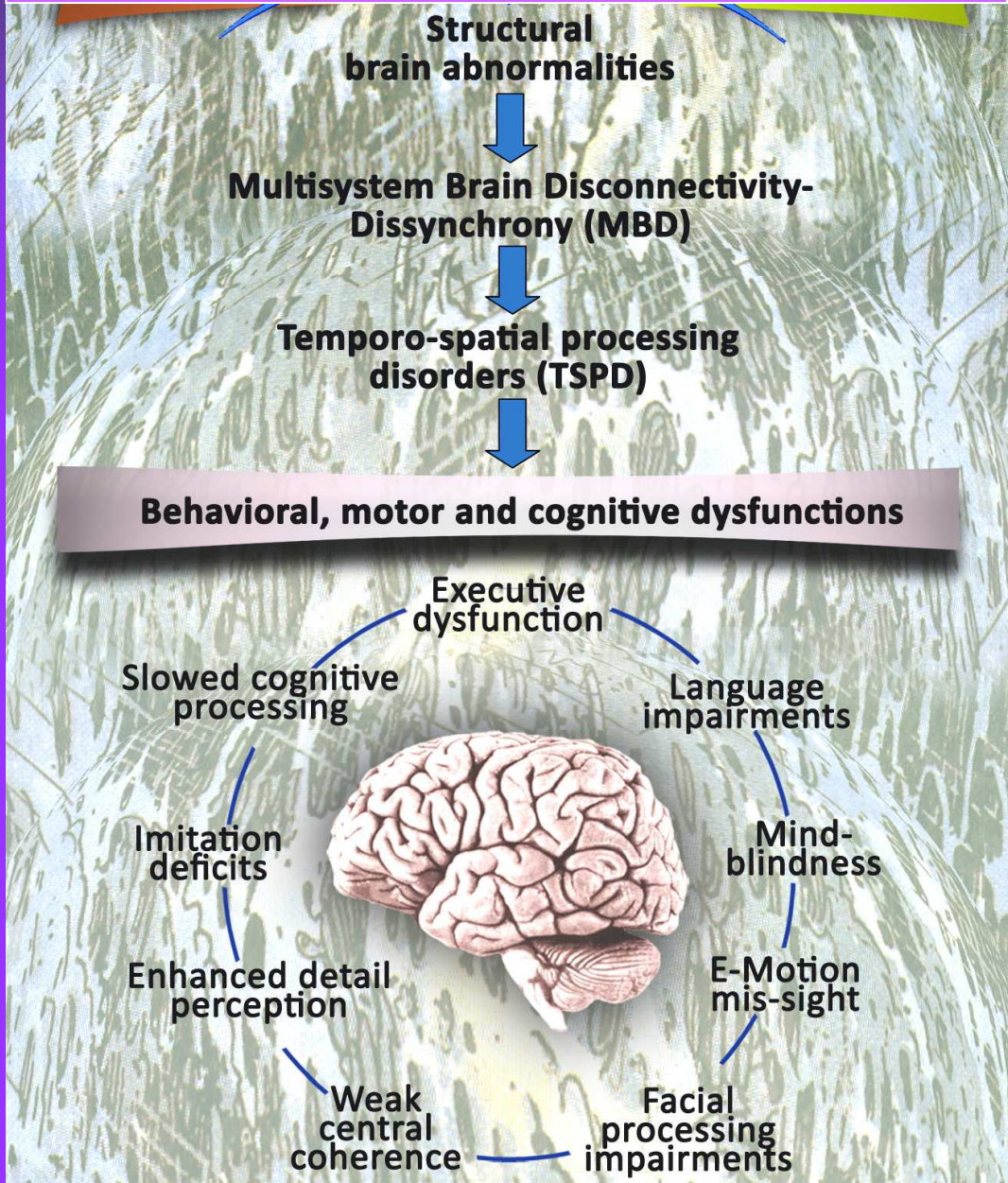
– under-connectivity (+++) or over-connectivity (+) between multiple cortical and subcortical areas, at rest and during simple and complex cognitive tasks

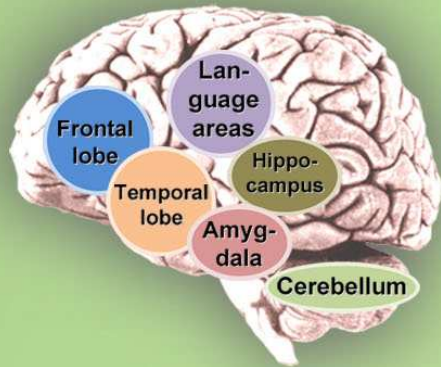
– local or distant neural hypo- or hyper-synchronization, at rest and during simple and complex cognitive tasks



Multi-system Brain Disconnectivity-Dissynchrony (MBD)

Gepner & Féron, *Neurosci Biobehav Rev*, 2009





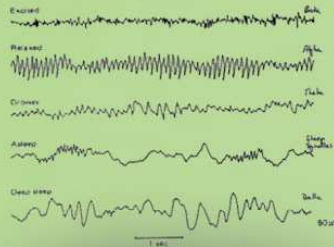
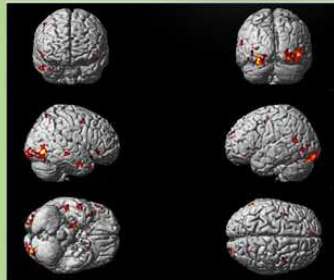
Structural brain anomalies

- genetic and environmental constraints
- brain growth abnormalities
- distributed anomalies
- developmental and compensatory mechanisms



Functional brain anomalies

- under-connectivity (+++) or over-connectivity (+) between multiple cortical and subcortical areas, at rest and during simple and complex cognitive tasks

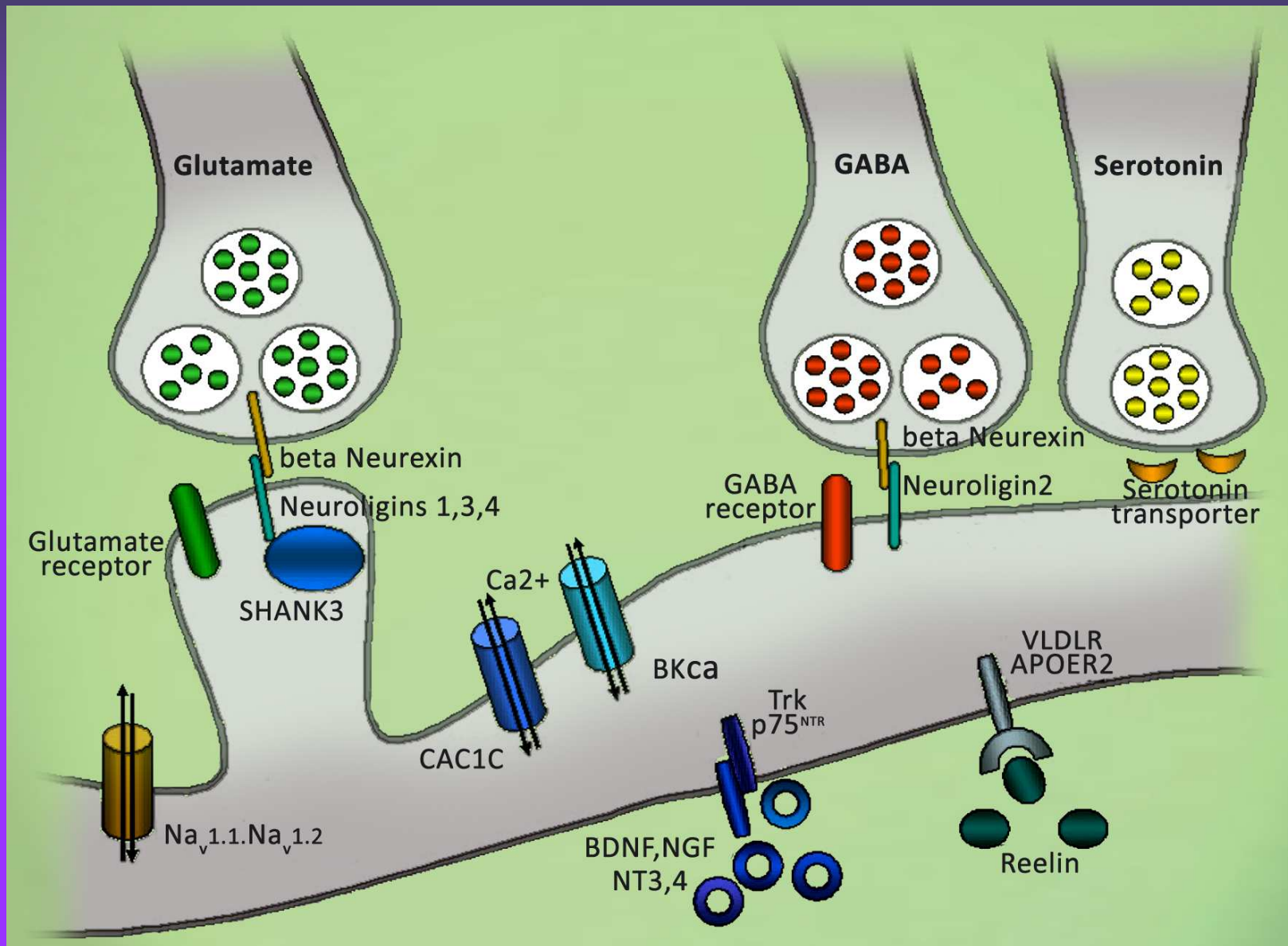


- local or distant neural hypo- or hyper-synchronization, at rest and during simple and complex cognitive tasks



Multi-system Brain Disconnectivity-Dissynchrony (MBD)

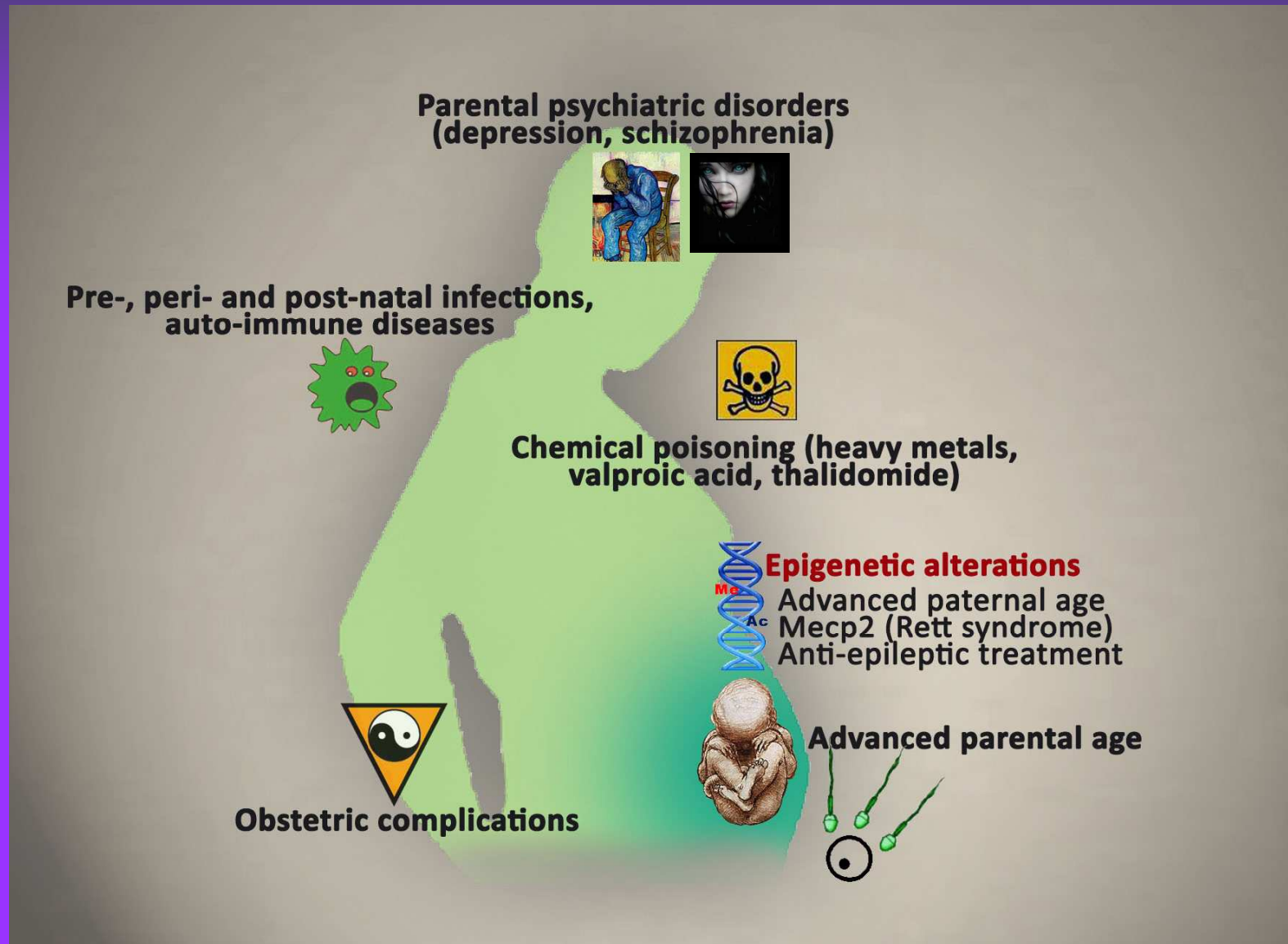
Genetic risk factors

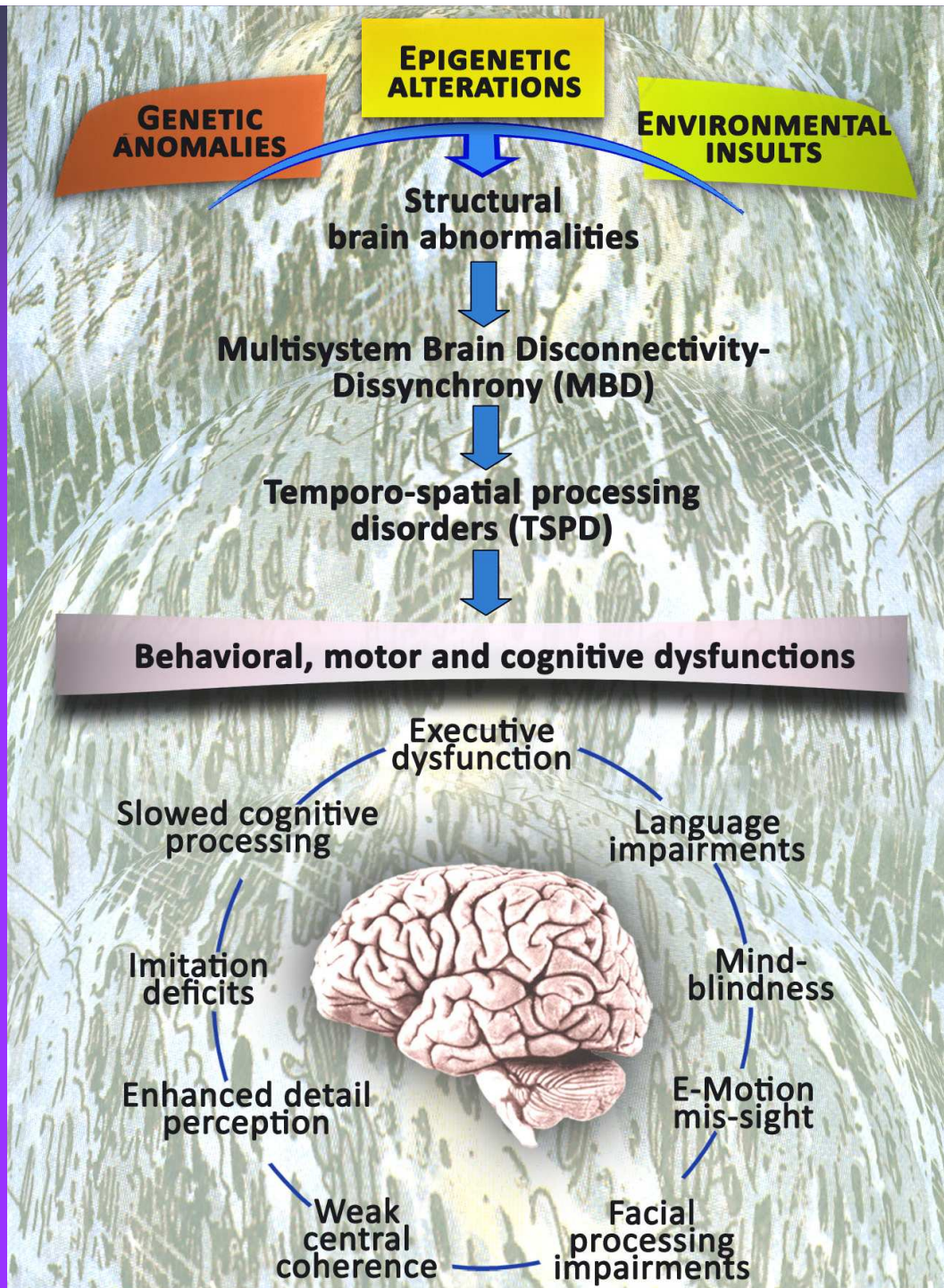


Gepner & Féron, *Neurosci Biobehav Rev*, 2009

B. Gepner, Cambridge, 10th Sept 2010

Environmental risk factors





From
Genes/Environment
to
Behaviors

Gepner & Féron,
Neurosci Biobehav Rev, 2009

Conclusion and perspectives for treatment

B. Gepner, Cambridge, 10th Sept 2010

Clinical Perspectives

Being very attentive *here and now* to the interactive sensory rhythm and flow (e.g. speed, intensity, energy) with autistic persons

Adjusting our *tempo* to that of the autistic person, and slow it down *more or less*

e.g. Chantal Lheureux-Davidse, 2004, 2010

Coming next

Measuring the impact of slowed sensory flows on young autistic children's evolution

- Development of a software aimed at slowing down *automatically, simultaneously* and *online* the visual and auditory stimuli, without voice modification
- Test the impact of using this software on imitative, verbal and socio-cognitive abilities of 2-3 years old children with ASD (behavioral, oculometric and electrophysiologic measures)

Propositions ...

**Multi-centric essay and analysis of
this software, with a common
method**

Thanks to :

- **Carole TARDIF**, Department of Psychology, Aix-Marseille University, Aix-en-Provence, France
- **France LAINE**, Department of Educational and Counseling Psychology, McGill University, Montreal, Quebec, Canada
- **Stéphane RAUZY & Philippe BLACHE**, Speech and Language Lab
- **François FERON**, Department of Neurobiology, CNRS, Marseille University



Financial supports

- **INSERM**
- **CNRS**
- **Fondation de France**
- **Fondation Orange**

