



Autism and the predictive brain

PETER VERMEULEN



AUTISM in CONTEXT
from neurodiversity to neuroharmony
www.petervermeulen.be

Please note that the PowerPoint slides are copyrighted and they will not be shared.

1

What do we know about ASD?

DSM-5 criteria for autism spectrum disorders
An individual must meet criteria A, B, C and D:

A. Persistent deficits in social communication and social interaction across contexts, not accounted for by general developmental delays, and manifested by all 3 of the following:

- Deficits in social-emotional reciprocity, ranging from abnormal social approach and failure of normal back-and-forth conversation through reduced sharing of interests, emotions, and affect and response to total lack of initiation of social interaction.
- Deficits in nonverbal communicative behaviors used for social interaction, ranging from poorly integrated verbal and nonverbal communication, through abnormalities in eye contact and body language, or deficits in understanding and use of nonverbal communication, to total lack of facial expression or gestures.
- Deficits in developing and maintaining relationships, appropriate to developmental level (beyond those with caregivers), ranging from difficulties adjusting behavior to suit different social contexts through difficulties in sharing imaginative play and in making friends to an apparent absence of interest in people.


B. Restricted, repetitive patterns of behavior, interests, or activities as manifested by at least two of the following:

- Stereotyped or repetitive speech, motor movements, or use of objects (such as simple motor stereotypes, echolalia, repetitive use of objects, or idiosyncratic phrases).
- Excessive adherence to routines, ritualized patterns of verbal or nonverbal behavior, or excessive resistance to change (such as motor rituals, insistence on same route or food, repetitive questioning or extreme distress at small changes).
- Highly restricted, fixated interests that are abnormal in intensity or focus (such as strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interests).
- Hypersensitivity or hyposensitivity to sensory input or unusual interest in sensory aspects of environment (such as apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, fascination with lights or spinning objects).


C. Symptoms must be present in early childhood (but may not become fully manifest until social demands exceed limited capacities)

D. Symptoms together limit and impair everyday functioning

SOCIAL & COMMUNICATION PROBLEMS



LACK OF FLEXIBILITY



2

Autism friendliness

- There is no such category as “autistic behaviors”, only “human behaviors (Barry Prizant)
- An autism friendly approach starts from an understanding of autism from within!
- Knowledge of “autistic thinking” is the key to success in education and treatment!

3

Autism friendliness

- An autism friendly approach starts from an understanding of autism from within!
- Knowledge of “autistic thinking” is the key to success in education and treatment!



4

Autism:
absolute thinking in a relative world

But: Nothing has an absolute meaning

So, basic problem: UNCERTAINTY

5

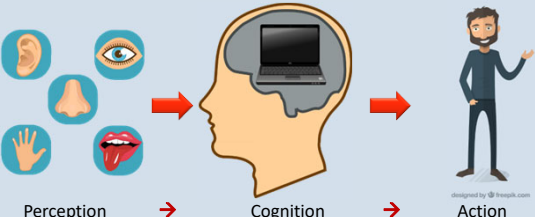
Standard idea about the brain

Computational analogy

Input

Processing

output



PerceptionCognitionAction

6

What’s wrong with our current ideas about the brain?

- Sense making is not just integrating all the details of the sensory input
 - There isn’t enough time to calculate and make that puzzle! (Daniel Kahneman)
 - Processing all the sensory input (computing) is not very helpful for survival! (Smilodon story)
- So, the brain does not compute, It guesses,
- And it can make smart guesses because it uses context,
- This is known as: **the predictive mind**

7

So, it does NOT work like this

```
graph LR; Senses[senses] --> Brain[brain]; Senses --> Input[input]; Input --> Processing[processing]; Processing --> Meaning[meaning];
```

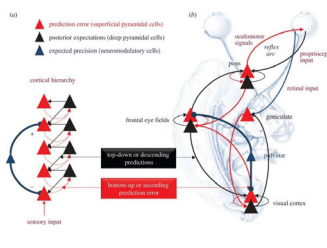

8

But it works like this

```
graph RL; Brain[brain] --> Senses[senses]; Brain --> Input[input]; Input --> Stimuli[stimuli];
```

9

The brain does not process stimuli, only what is different from the stimuli it predicted...



From *The Lancet*

10

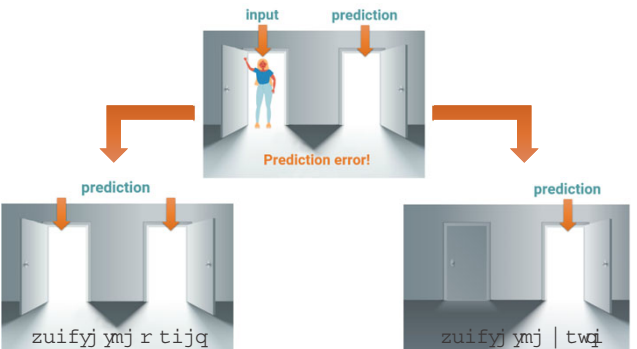
Prediction errors

- The brain has only one goal: helping us to survive by minimizing prediction errors, either by learning or by changing the world
- The brain doesn't like prediction errors (they cause stress)
- The brain knows it cannot avoid all prediction errors. Therefore, it uses **a variable precision** in handling prediction errors

Depending on the **context** the brain will treat a prediction error as

- Noise or normal variation (irrelevant)
- Signal, so something that should lead to learning or action

11




12

Predictive mind

Predicts the sensory input. If there is a prediction error, the brain has to decide whether it ignores it or do something with it: learning (updating the model/prediction) or changing the world.

13



Autism and the predictive brain

HIPPEA:
High, Inflexible Precision of Prediction
Errors in Autism
(Van de Cruys a.o., 2013, 2014)

Development of Theory of Mind in Autism
Van de Cruys et al., 2013, 2014

At 2014 European Psychological Association
Meeting, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024

Precise Minds in Uncertain Worlds: Predictive Coding in Autism

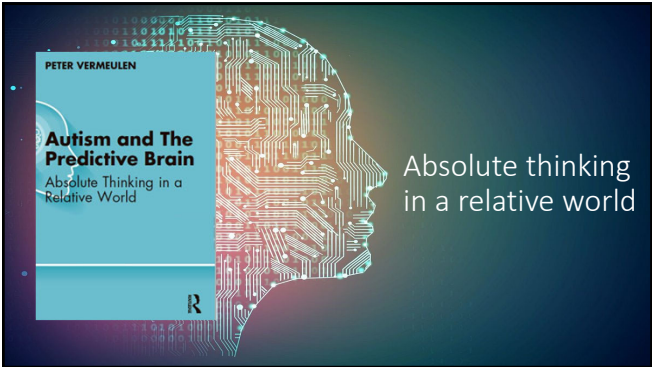
Sander Van de Cruys, Kris Evers, Roel Van der Hallen, Lisa Van Eylen,
Bart Boets, Lee de-Wit, and Johana Wagemans
KU Leuven

14

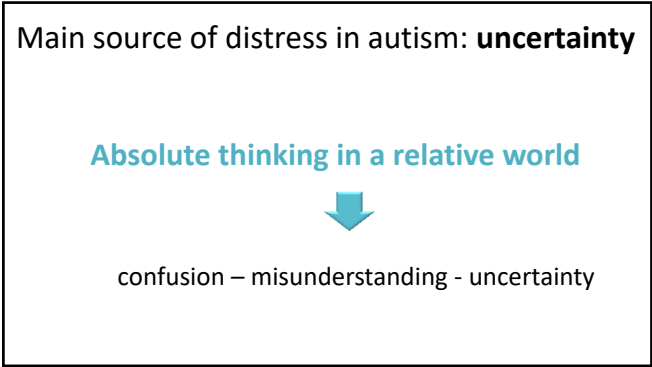
Temple Grandin: My mind is a web browser



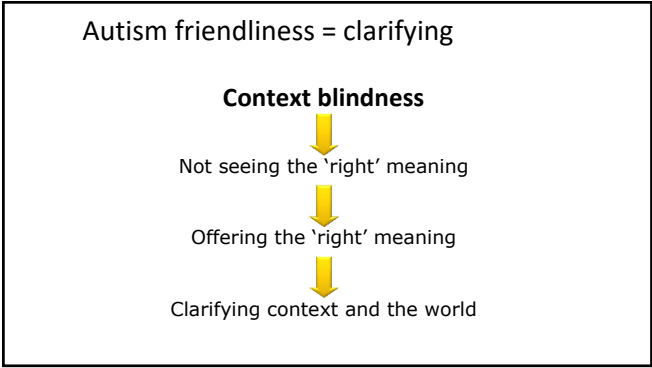
15



16



17



18



19

Autism as a prediction disorder

This new idea could change our ideas about many things in autism such as:

- Sensory issues and what to do about them
- Communication
- Emotion recognition and how to teach socio-emotional skills

20

Important difference!

Hypersensitivity:

- Physiological response
- Sensory threshold

The Sensory System


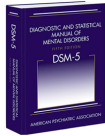
≠

Hyperreactivity:

- Psycho-emotional / behavioural response

The Limbic System

21



Proposed DSM-5 criteria for autism spectrum disorders

An individual must meet criteria A, B, C and D:

A. Persistent deficits in social communication and social interaction across contexts, not accounted for by general developmental delays, and manifest by all 3 of the following:

1. Deficits in social-emotional reciprocity, ranging from abnormal social approach and failure of normal back and forth conversation through reduced sharing of interests, emotions, and affect and response to total lack of initiation of social interaction.
2. Deficits in nonverbal communicative behaviors used for social interaction, ranging from poorly integrated verbal and nonverbal communication, through abnormalities in eye contact and body-language, or deficits in understanding and use of nonverbal communication, to total lack of facial expression or gestures.
3. Deficits in developing and maintaining relationships, appropriate to developmental level (beyond those with caregivers), ranging from difficulties adjusting behavior to suit different social contexts through difficulties in sharing imaginative play and in making friends to an apparent absence of interest in people

B. Restricted, repetitive patterns of behavior, interests, or activities as manifested by at least two of the following:

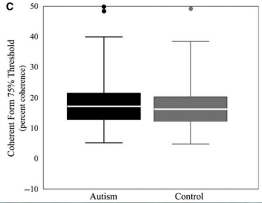
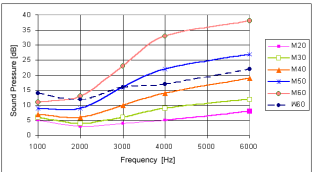
1. Stereotyped or repetitive speech, motor movements, or use of objects, (such as simple motor stereotypies, echolalia, repetitive use of objects, or idiosyncratic phrases).
2. Excessive adherence to routines, ritualized patterns of verbal or nonverbal behavior, or excessive resistance to change (such as motoric rituals, insistence on same route or food, repetitive questioning or extreme distress at small changes).
3. Highly restricted, fixated interests that are abnormal in intensity or focus, (such as strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interests).
4. Hyper- or hypo-sensitivity to sensory input or unusual interest in sensory aspects of environment, (such as apparent indifference to pain/heat/cold, adverse response to specific sounds or textures, excessive smelling or touching of objects, fascination with lights or spinning objects).

C. Symptoms must be present in early childhood (but may not become fully manifest until social demands exceed limited capacities)

D. Symptoms together limit and impair everyday functioning

22

No unambiguous, clear indications for difference in sensory thresholds in autism



23

Understanding Sound Sensitivity in Individuals with Autism Spectrum Disorders

Lillian N. Stiegler¹ and Rebecca Davis¹

Abstract

Literature on sound sensitivity in individuals with and without autism spectrum disorders (ASD) is reviewed in this article. Empirical evidence is examined, and physiologic and psychoemotional-behavioral perspectives are described. There is virtually no evidence of true physiological differences in auditory systems of individuals with ASD. It is evident, however, that many people with ASD (a) feel fearful and anxious about sound, and (b) may experience unpleasant physiological sensations because of autonomic and/or behavioral responses to nonpreferred sounds, but (c) can learn to react in less stigmatizing, more effectively self-regulating ways. Current assessment and intervention practices are discussed, and a case is presented. Heightened understanding of this issue among caregivers and interventionists may ultimately improve life participation for individuals with ASD.

HAMMILL INSTITUTE ON DISABILITIES

Focus on Autism and Other Developmental Disabilities
25(2) 67-75
© 2010 Hammill Institute on Disabilities
Reprints and permission:
sagepub.com/journalsPermissions.nav
DOI: 10.1177/1088357610364530
http://fox.sagepub.com

SAGE

24

No stronger sensory response, but stronger experience of stimuli

J Autism Dev Disord (2016) 46:127–137
DOI 10.1007/s10803-015-2520-8

RESEARCH ARTICLE

Perceptual and Neural Response to Affective Tactile Texture Stimulation in Adults with Autism Spectrum Disorders

Carissa J. Caci, Doreen J. Miano-Filho, Steve Gass, Mary Beth Nebel, Jonathan Weisner, Grace T. Baranik, and Gregory K. Etnick

RESEARCH ARTICLE

Tactile Hypersensitivity and GABA Concentration in the Sensorimotor Cortex of Adults with Autism

Laurie-Anne Sapey-Triomphe, Franck Lamberton, Sandrine Sonié, Jérémie Mattout, and Christina Schmitz

Tactile Perception in Adults with Autism: a Multidimensional Psychophysical Study

Carissa Caci, Francis McGee, Stephen Edgar, Vicky Tannan, Grace Baranik, Karla A. Whalley, Gregory Etnick

Interventions should focus on the limbic system, rather than on the sensory system ...

25

Uncertainty drives anxiety, sensory issues in autism

BY ANN GRISWOLD / 8 APRIL 2016



Sensory overload: Children with autism may perceive uncertainty as a threat.
@salutestack.com/
@university_ofkent

J Autism Dev Disord (2016) 46:1062–1071
DOI 10.1007/s10803-016-2724-8

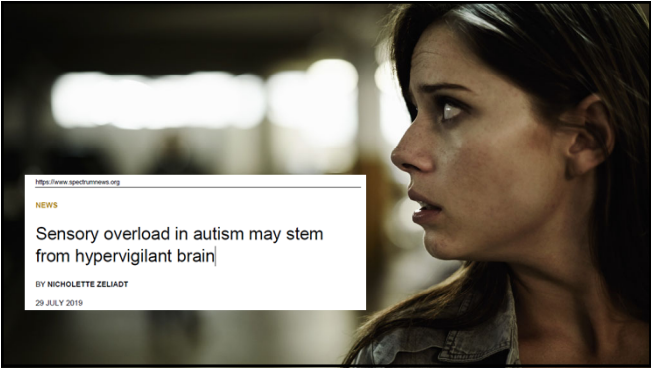
ORIGINAL PAPER

The Relationship Between Intolerance of Uncertainty, Sensory Sensitivities, and Anxiety in Autistic and Typically Developing Children

Lauree Neil, Nora Cheser Olsson, Elizabeth Pellicani

CrossMark

26



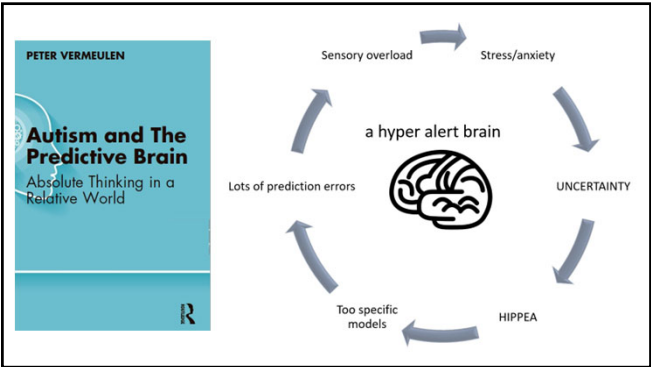
<https://www.spectrumnews.org>

NEWS

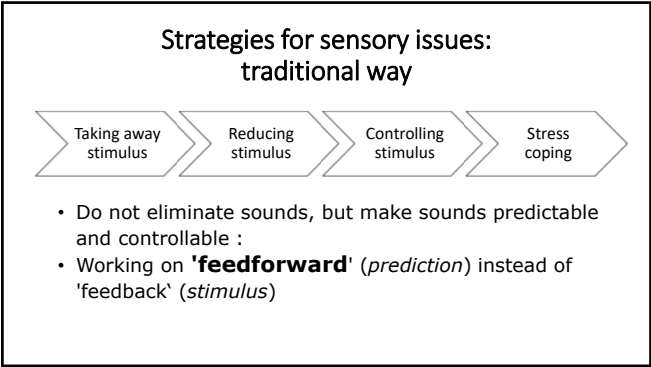
Sensory overload in autism may stem from hypervigilant brain

BY NICHOLETTE ZELADT
29 JULY 2016

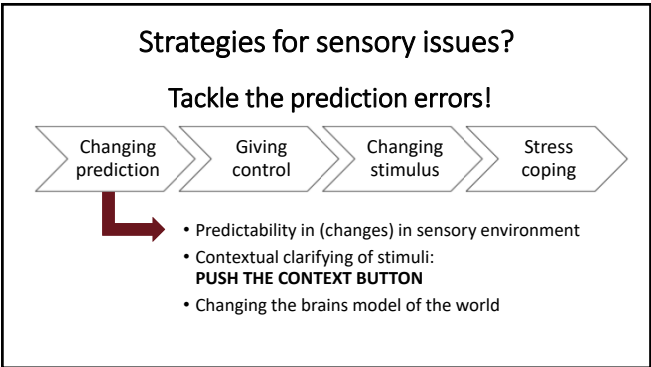
27



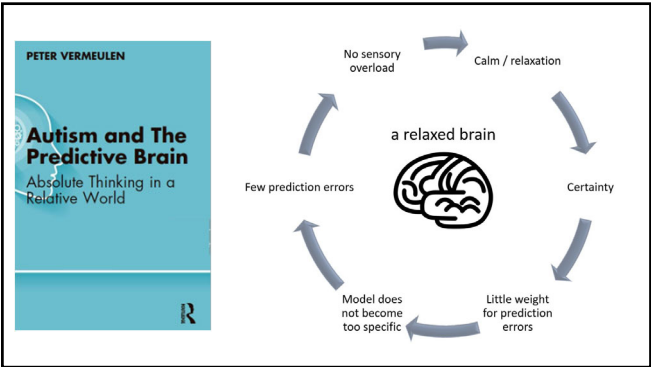
28



29



30



31

Relaxing the brain and stimulus reactivity

This will be bad → stress ↗ → hyperreactivity
You will be OK → stress ↘ → no hyperreactivity

F1000Research F1000Research 2018, 8:162 Last updated: 17 MAR 2019 Check for updates

CORRESPONDENCE
Sensory-specific predictive models in the human anterior insula
[version 1; peer review: 2 approved]

GI Sharvit¹, Patrik Vuilleumier^{2,3}, Corrado Corradi-Dell'Acqua^{2,4}

¹Hebrew School of Business, University of California, Berkeley, Berkeley, USA
²Geneva Neuroscience Center, University of Geneva, Geneva, Switzerland
³Unit for the Study of the Brain and Cognition, Department of Neuroscience, University of Geneva, Geneva, Switzerland
⁴Faculty of Psychology and Educational Sciences, University of Geneva, Geneva, Switzerland


32

The image features a logo on the left consisting of a stylized brain with colorful nodes, surrounded by concentric circles and larger green and orange circles. To the right of the logo, the text "H.A.P.P.Y." is written in a large, bold, blue font. Below this, the full name of the project is written in a smaller blue font: "Happiness in Autism Personal Project for Young people".

33

H.A.P.P.Y.


developing evidence based, personalized and autism friendly strategies that aim at increasing the wellbeing of an autistic individual



34

10 well-being strategies


1. Accepting and loving yourself
2. Good Feeling toolbox
3. Flow activities
4. Physical exercise
5. Problem focused coping strategies
6. Emotion focused coping strategies
7. Positive thinking
8. Gratitude
9. Kindness
10. Personal projects: learning something new



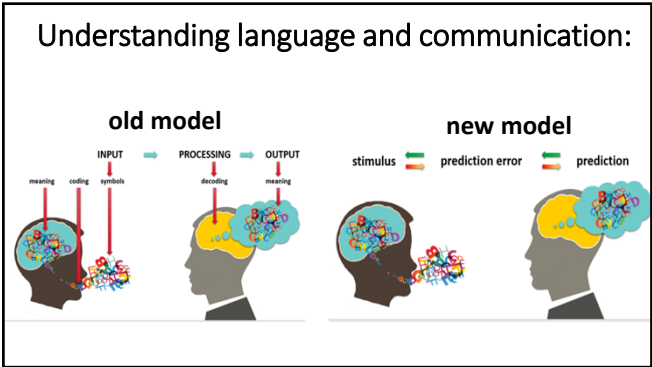
35

How to help autistic students cope with sensory overload?

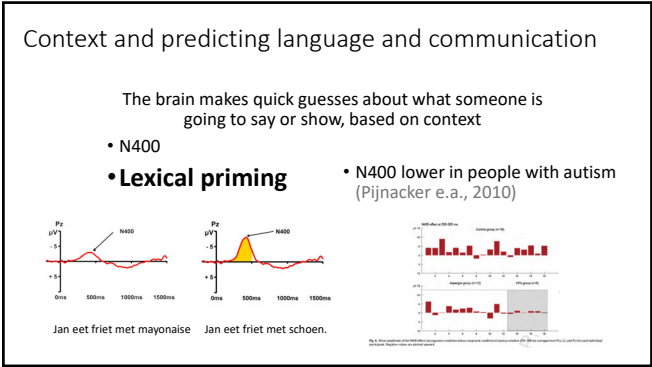
- Make stimuli predictable and understandable, so the world becomes safer
- Give control
- Work on well-being and good-feeling



36



37



38

Special issue Cortex, July 2015

Cortex
Volume 68, July 2015, Pages 155-168
Special issue: Prediction in speech and language processing

Special issue: Review
A predictive coding framework for rapid neural dynamics during sentence-level language comprehension
Ashley G. Lewis, Marcel Bastiaansen

Understanding language = predicting language!
If the person cannot predict, then slow down your communication and push the context button

39

Context

- Does not only help us to predict and recognize communication
- It also helps us to avoid all the confusion of the ever changing meanings of what people say or show us

40

Context and communication

What is difficult for people with ASD, is to find out what something (a word, a sentence, a gesture, a picture etc.) means *in this context*

So, give time to process and ‘push the context button’

41

Pushing the context button means:


Concrete Communication
makes very concrete
what something means
in this specific context

42


Context and emotion recognition

Relation facial expression –emotion is not fixed


We never see facial expressions out of context




sad



happy



sad



happy

43

Facial expressions: inherently ambiguous!!

emotionreview

Emotion Review
Vol. 5, No. 1 (January 2023) 60-45
© The Author(s) 2023
ISSN 1754-0739
DOI: 10.1177/1754073923010331
e-ajph.org

Inherently Ambiguous: Facial Expressions of Emotions, in Context

Ran R. Hassin
Department of Psychology, Hebrew University, Israel
The Center for the Study of Rationality, Hebrew University, Israel

Hillel Aviezer
Department of Psychology, Hebrew University, Israel
Department of Psychology, Princeton University, USA

Shlomo Bentin
Department of Psychology, Hebrew University, Israel
Center for Neural Computation, Hebrew University, Israel

44

We don't read emotions FROM faces,
we read emotions INTO faces

Recognizing emotions

prediction error

prediction

CONTEXT

mouth a bit open

mouth corner up

He's pleased!

45

© Peter Vermeulen - www.petervermeulen.be

15

Again: context...

aps
PSYCHOLOGICAL SCIENCE

Current Directions in Psychological Science
20(5) 286-290
© The Author(s) 2011
Reprints and permission:
sagepub.com/journalsPermissions.nav
DOI: 10.1177/0963721411422522
http://dx.doi.org/10.1177/0963721411422522

SAGE

Context in Emotion Perception

Lisa Feldman Barrett^{1,2}, Batja Mesquita³, and Maria Gendron¹

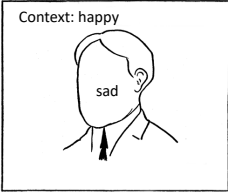
¹Department of Psychology Boston College, ²Department of Psychiatry and the Harvard Center for Biomedical Imaging, Massachusetts General Hospital/Harvard Medical School, and ³Department of Psychology, University of Leuven, Belgium

Abstract
We review recent work demonstrating consistent context effects during emotion perception. Visual scenes, voices, bodies, other faces, cultural orientation, and even words shape how emotion is perceived in a face, calling into question the still-common assumption that the emotional state of a person is written on and can be read from the face like words on a page. Incorporating context during emotion perception appears to be routine, efficient, and, to some degree, automatic. This evidence challenges the standard view of emotion perception represented in psychology texts, in the cognitive neuroscience literature, and in the popular media and points to a necessary change in the basic paradigm used in the scientific study of emotion perception.


46

Context more important than the face!

Context: happy



happy



happy

Righart & De Gelder (2008)

47


Context more important than the face!

But people with autism rely on the face, not the context!

Short Report

Emotion recognition from congruent and incongruent emotional expressions and situational cues in children with autism spectrum disorder

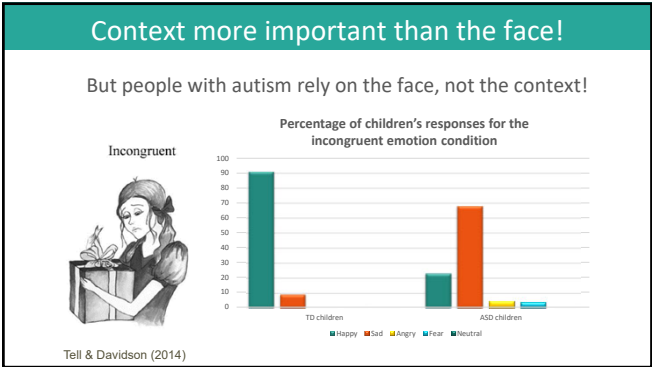
Dina Tell and Denise Davidson



Autism
1-5
© The Author(s) 2014
Reprints and permission:
sagepub.com/journalsPermissions.nav
DOI: 10.1177/1362246114265676
aut.sagepub.com

SAGE

48



49



50

Link emotions to context

Available online at www.sciencedirect.com

ScienceDirect

Procedia - Social and Behavioral Sciences 93 (2013) 1148 – 1153

Procedia
Social and Behavioral Sciences

3rd World Conference on Learning, Teaching and Educational Leadership – WCLTA 2012

Interpreting social contexts and emotions and ASD

Rosalyn Adamowycz, MA, BCBA^a*, Sorchia Parker, MSc, BCBA^a

^a Autism Consultant, 24 Cote Lane, Stamford, Prince Edward Island, C1B1L1, Canada

^{*} Private Practice Consultant, 65 Sturges Drive, Lower Sackville, Nova Scotia, B4C2C2, Canada

Abstract

Deficits in social skills are a feature of Autism Spectrum Disorder (ASD). An eight year old with ASD and disruptive behaviors was taught to correspond ranges of emotions to different situational contexts to improve functional social skills. A lesson from the Feuerstein Instructional Enrichment (FIE) Program was modified according to applied behavioral approaches (ABA). The Social Skills Rating System, lesson results and interviews indicated improvement in social skills after intervention, specifically in cooperation, self-control, responsibility, and empathy. This teaching intervention focusing on situational contexts and emotional ranges may enhance social skills and thus warrant further investigation and research.

51



Despite intact Theory of Mind difficulties predicting what other people will do

Cognition 160 (2017) 17–25

Contents lists available at ScienceDirect

Cognition


journal homepage: www.elsevier.com/locate/COGNIT



Original Articles

Reduced sensitivity to social priors during action prediction in adults with autism spectrum disorders

Valerian Chambon^{a,b,*}, Chloé Farrer^c, Elisabeth Pacherie^a, Pierre O. Jacquet^d, Marion Leboyer^e, Tiziana Zalla^{a,*}



52

Context and social competence

- The biggest problem in ASD is not social skills (knowing **what** and **how** to do)
- The biggest problem in ASD is knowing **where** and **when** to do it and where and when **not**

Social competence requires contextual sensitivity

53

Loth a.o. (2010)

J Autism Dev Disord

DOI: 10.1007/s10803-009-0020-7

ORIGINAL PAPER

Variety is Not the Spice of Life for People with Autism Spectrum Disorders: Frequency Ratings of Central, Variable and Inappropriate Aspects of Common Real-life Events

Eva Loth · Francesca Happé · Juan Carlos Gómez

Contextual variations are often seen as central or as fixed rules, even in those who pass high level ToM tests
e.g. having a dessert when going to a restaurant

54

Contextualized teaching


Do not use decontextualized materials

Do not teach 'skills' but start from contexts

Link behaviours always to contexts

Starting a conversation

context



55

Contextualized teaching

Teaching and clarifying context:

✓ What can happen in that context?

✓ What can you do in that context?

✓ What can you say in that context?

56

Contextualized teaching

Does not start from skills but from contexts

Teaching context # 1

including

Skill # 1

Skill # 2

Skill # 3

Teaching context # 2

including

Skill # 1

Skill # 2

Skill # 3

57


© Peter Vermeulen - www.petervermeulen.be

19

Contextualized scripts

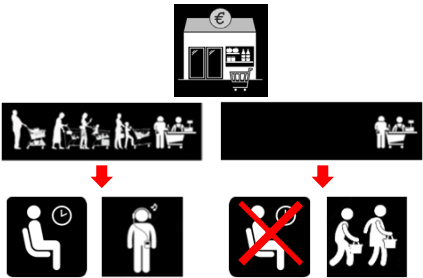
Welcoming someone at your home:

- When the person wears a coat, you ask "May I take your coat?".
- If the person says "no", invite him/her to come further in.
- If the person says "yes", wait until he/she gives you the coat and hang it on the coat rack. If you don't have a coat rack, hang the coat carefully over a chair.



58

Contextualized scripts



59

Pushing the context button helps to 'predict' an uncertain world with all its ever changing meanings



60



61
