The effects of mild developmental disorders in decoding visual and auditory emotional information

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This work has been made in collaboration with **Dr. Maria Teresa Riviello**

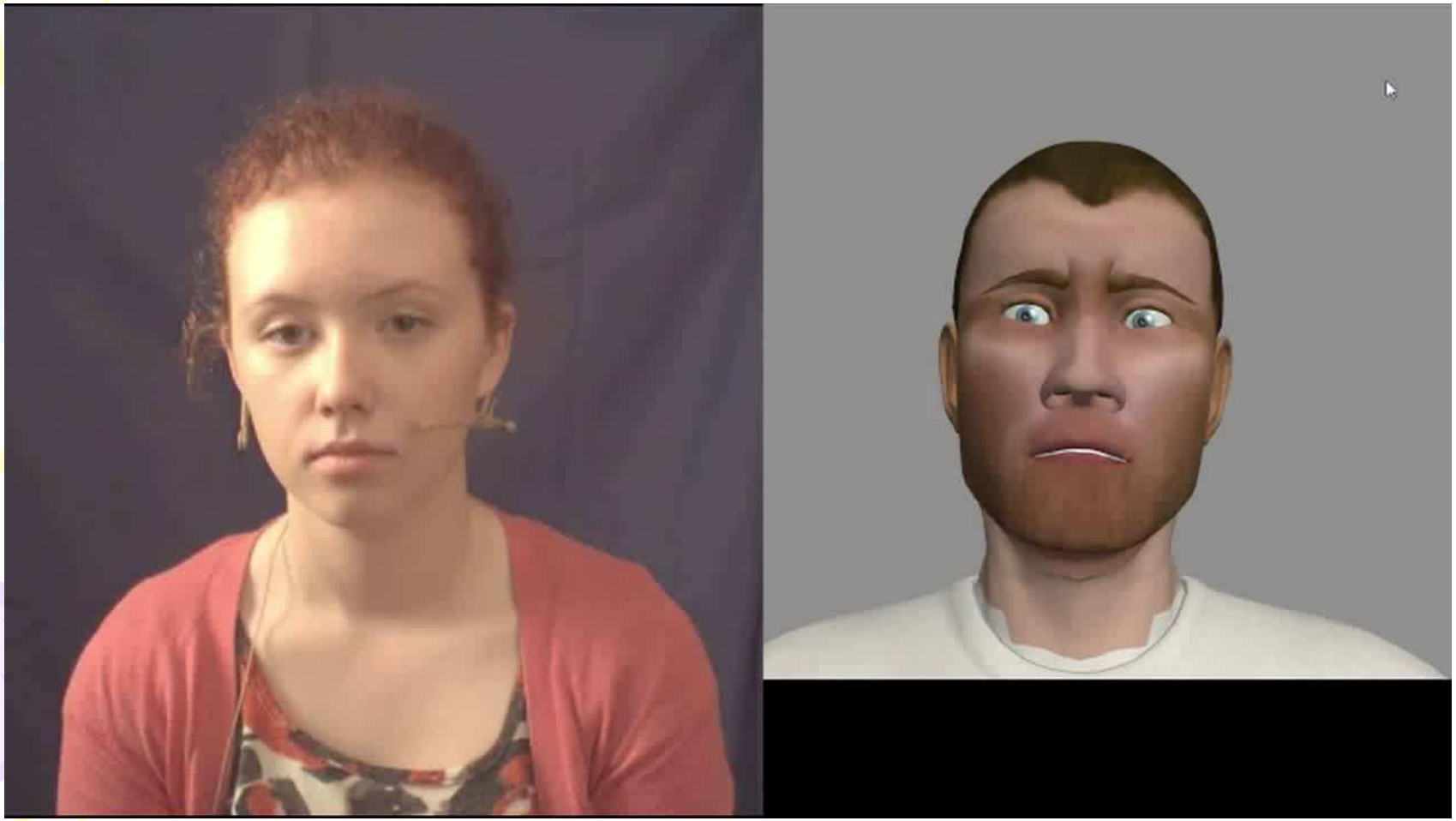
Premises

- To implement a friendly and socially believable human-machine interaction would require to account of three important research aspects:
  - How communication practices are transformed in different contexts
  - An investigation on the user cognitive and emotional consequences when interacting with machines
  - An effective “machine processing” of behavioral and contextual information

Perspective

- As a consequence it would be necessary to:
  - Explore new data to gather models of behaviours in a multimodal communication environment
  - Elaborate new mathematical models accounting of contextual, social, cognitive and emotional effects

An example: Interacting with a virtual agent
The Semaine project http://semaine.sourceforge.net/



Why children?

- The changing of the structure, function, and organization of brain in response to new experiences: the neural plasticity concept
- Early diagnosis and intervention (see autistic therapies, Sally Rogers 2012)
- Can be exploited for any developmental (and aging) disorders
- Can bring to the implementation of ICT rehabilitation tools reducing therapeutic costs and facilitating rehabilitation exercises

Open Questions

- How children encode emotional information through the exploitation of single and multimodal communication modes?
  - Does multimodality increase children ability to encode emotional feelings?
  - Is one communication mode (voice) more powerful than another one (face and/or body)?
  - Is there any differences between typically and developmentally disordered children?

The Proposed Research

- **Experiment 1:** Comparing dyslexic and typical children's performance in decoding static emotional facial expressions
- **Experiment 2:** Comparing dyslexic and typical children's performance in decoding emotional vocal expressions
- **Experiment 3:** Comparing typical and mild learning disabled (LD) children's performance in decoding dynamic (videos) emotional expressions

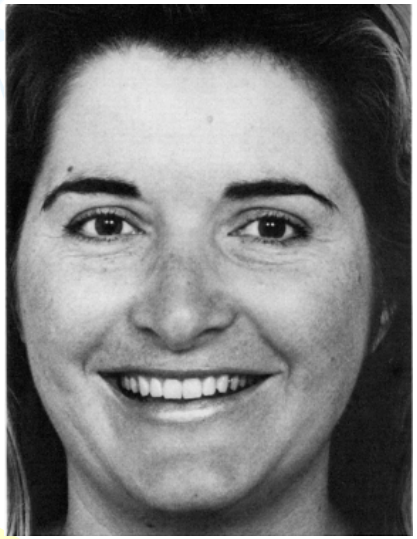
The Experimental set-up

- 3 groups of participants
- Each consisted of 40 children (20 typical and 20 with developmental reading disorders or other mild disabilities (disgraphia, …) aged from 9 to 10 years
- The first two group aged fro 9 to 10 year olds, the remaining from 7 to 9 year old

The Experimental Procedure

- Participants were asked to label as ***happy***, ***sad***, ***anger***, ***fear***, and ***surprise*** the following stimuli:
  - Group 1: 20 facial emotional expressions (10 human faces from FACS (Ekman & Friesen 1978); 10 stylized faces from a comic book (Esposito 2009)
  - Group 2: 20 vocal emotional expressions, extracted from the COST 2102 database (Esposito & Riviello 2010, 2011)
  - Group 3: 20 emotional video clips, extracted from the COST 2102 database (Esposito & Riviello 2010, 2011)

Examples of facial stimuli



Examples of vocal expressions




Examples of video-clips

Results

- Results are displayed in terms of confusion matrices
- Significance is assessed through statistical analyses

Confusion matrices for facial emotional expressions (no significant differences, $X^2 = 4.23$, Critical value=11.07, α=0.05.)

Facial Expressions Typical Children	Happy	Anger	Surprise	Sad	Fear	Another emotion	No emotion
Happy	97,5	0	1,25	1,25	0	0	0
Anger	0	88,75	1,25	6,25	1,25	1,25	1,25
Surprise	10	3,75	67,5	2,5	13,75	1,25	1,25
Sad	8,75	8,75	2,5	57,5	6,25	2,5	13,75
Fear	0	2,5	33,75	2,5	60	1,25	0

Facial Expressions Dyslexic Children	Happy	Anger	Surprise	Sad	Fear	Another emotion	No emotion
Happy	98,75	1,25	0	0	0	0	0
Anger	0	82,25	2,5	2,5	3,75	0	5
Surprise	7,5	0	61,25	3,75	27,5	0	0
Sad	10	8,75	5	67,5	1,25	2,5	5
Fear	0	1,25	21,25	5	71,25	0	1,25

Confusion matrices for vocal emotional expressions (no significant differences, Anova F(1,38) =.599, ρ=.44)

Vocal Expressions Typical Children	Happy	Anger	Surprise	Sad	Fear	Another emotion	No emotion
Happy	84	1,25	15	0	0	0	0
Anger	1,25	83,75	0	8,75	5	0	0
Surprise	12,5	1,25	61,25	13,75	11,25	0	0
Sad	10	7,5	16,25	46,25	15	0	3,75
Fear	3,75	28,75	11,25	21,25	35	0	2

Vocal Expressions Dyslexic Children	Happy	Anger	Surprise	Sad	Fear	Another emotion	No emotion
Happy	88,75	5	5	1,25	0	0	0
Anger	6,25	83,75	5	2,5	2,5	0	0
Surprise	16,25	10	41,25	16,25	12,5	3,75	0
Sad	15	10	8,75	56,25	8,75	0	0
Fear	3,75	36,25	10	27,5	22,5	0	0

Confusion matrices for emotional video-clips

Emotional Videos Typical Children	Happy	Anger	Surprise	Sad	Fear
Happy	98,75	0	1,25	0	0
Anger	0	86,25	2,5	5	6,25
Surprise	0	3,75	92,5	3,75	0
Sad	0	3,75	2,5	92,5	1,25
Fear	2,5	13,75	13,75	3,75	66,25

Emotional Videos LD Children	Happy	Anger	Surprise	Sad	Fear
Happy	86,25	0	12,5	0	1,25
Anger	1,25	85,00	6,25	3,75	3,75
Surprise	10	3,75	78,75	2,5	5
Sad	2,5	1,25	6,25	85	5
Fear	5	11,25	13,75	6,25	63,75

ANOVA (α =.05) significance on video data

- *Typical and LD children* were the between and *emotion categories* the within subject variables

- *Typical and LD children* significantly differ in the emotion recognition rate ($F(1,38)= 4.193$, $\rho =.0475$)
- *Emotion categories* significantly affect the recognition rate ($F(4,152)= 9.310$, $\rho= .00001$) of both typical and LD children
- *Typical and LD children's condition* and *emotion categories* ($F(4,152)= .649$, $\rho=. 6288$) do not interact

- POST HOC TESTS revealed that:
  - Happiness ($F(1,38)= 6.835$, $P = .013$) and surprise [$F(1,38)= 4.644$, $P = .038$] made the difference for the two groups
  - Fear made the difference among the emotion categories:
    - fear/ happiness [$F(1,38)= 20.436$, $P = .0001$]
    - fear /surpise [$F(1,38)=8.796$, $P = .0052$]
    - fear /sadness [$F(1,38)= 16.832$, $P = .0002$]
    - fear /anger [$F(1,38)= 16.228$, $P = .0001$]

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Differences on the communication mode for typical children

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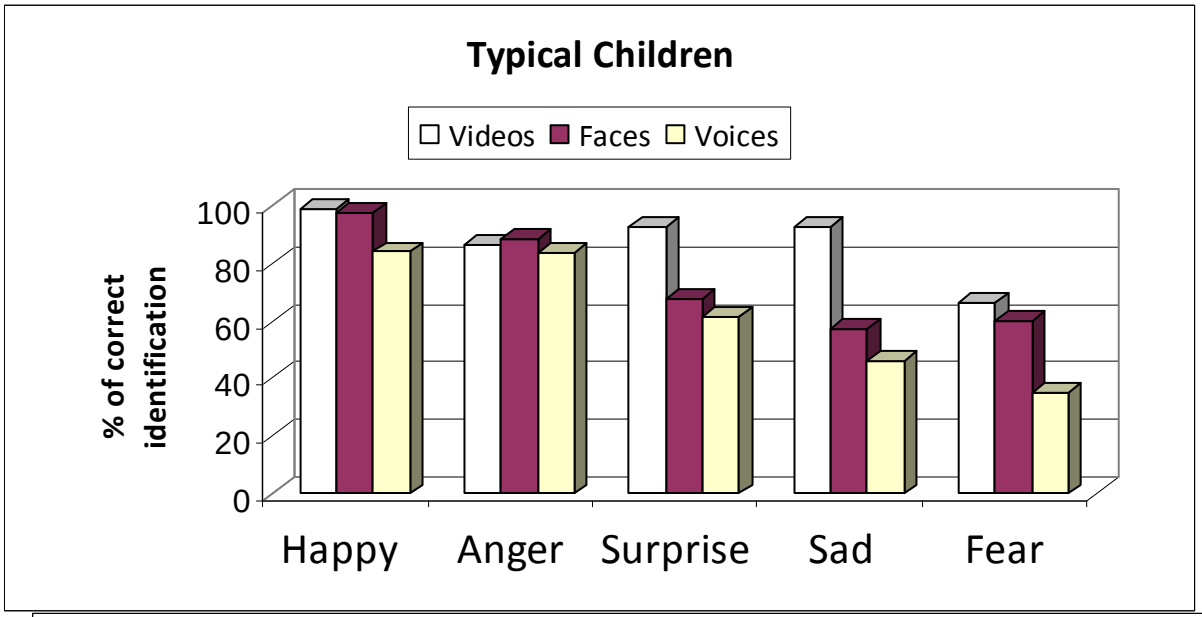
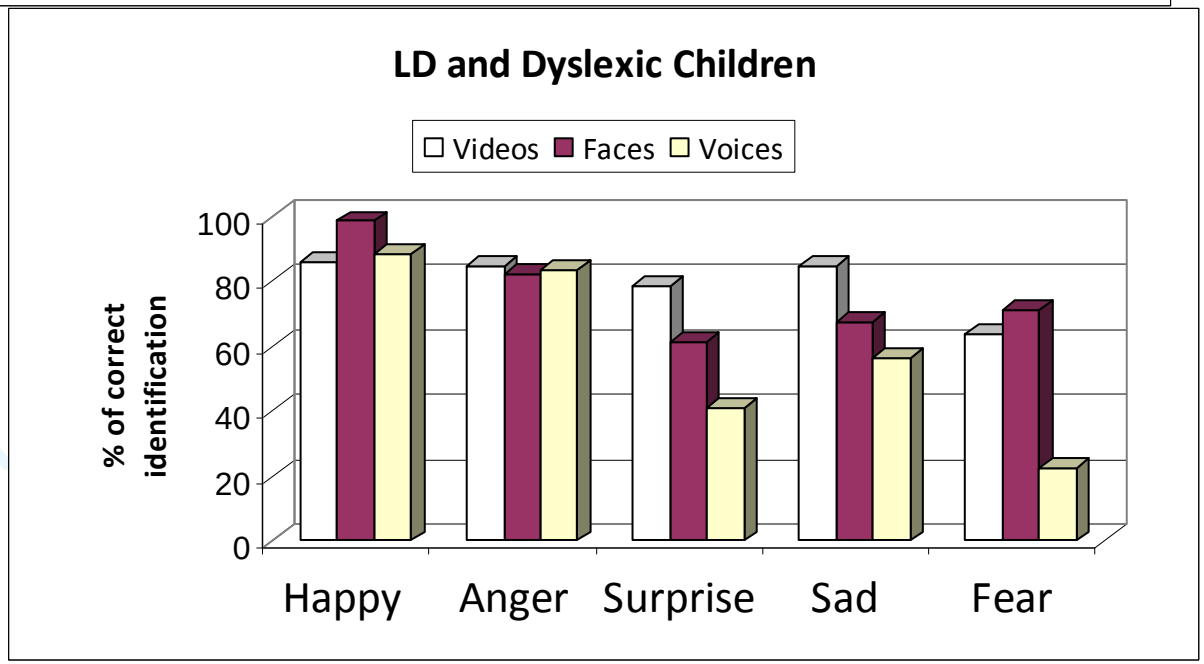
Differences on the communication mode for developmentally disordered children

Summary


Typical Children
Videos
Faces
Voices
% of correct identification
100
80
60
40
20
0
Happy
Anger
Surprise
Sad
Fear


LD and Dyslexic Children
Videos
Faces
Voices
% of correct identification
100
80
60
40
20
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Happy
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Surprise
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Fear

Conclusions

- The children ability to decode emotional expressions is a function of the communication mode:
  - Static faces and vocal expressions are less emotionally informative than dynamic stimuli but not for all the emotions:
  - Happiness and anger are equally well decoded
  - Surprise and sadness are better decoded in dynamic stimuli
  - Fear is poorly decoded no matter the communication mode
- Mild learning disorders does not affect the ability to decode static visual faces
- Mild learning disorders interfere with children ability to decode dynamic stimuli (video clips) of happiness and surprise.
- Emotion categories make the difference and combined emotional cues do not sum up linearly

Thanks