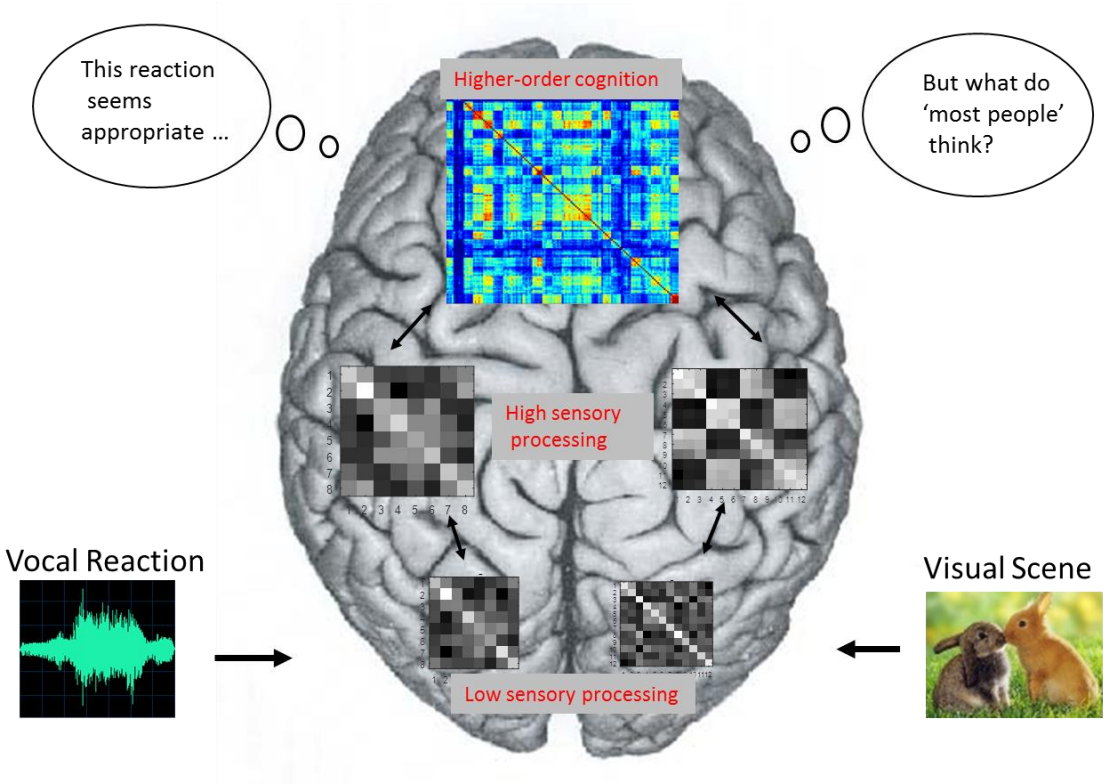
Studying **multiple neural representations** at once in autism and controls



Felipe Pegado
MD, PhD

Laboratoire de Psychologie Cognitive
Aix-Marseille Université, France

Autism abnormalities

Social

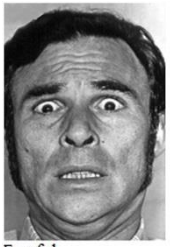
↑

High sensory

↑

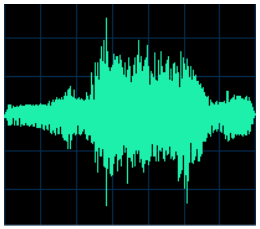
Low sensory

faces

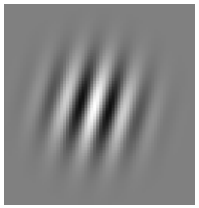


Fearful

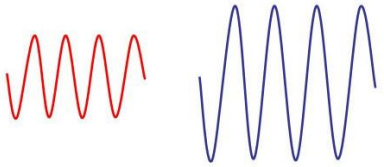
voices



gabor



loudness



DSM-5: ASD- Autism Spectrum Disorders

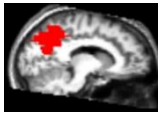
- A. Persistent **deficits in social communication** and social interaction across multiple contexts
- B. **Restricted, repetitive patterns of behavior**, interests, or activities
- C. Present in the **early developmental** period
  D. **Significant impairment** in social, occupational areas.
- E. These disturbances are **not better explained** by intellectual disability or global developmental delay.

B4. **Hyper-or hypo-reactivity 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).

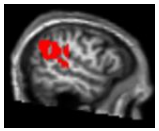
Typical studies

mentalizing network

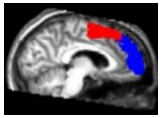
Precuneus-PC

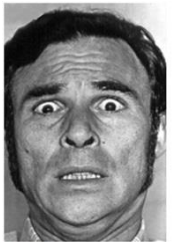


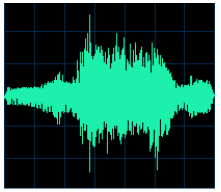
TPJ

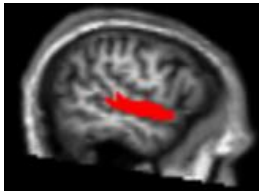


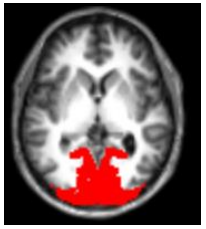
posterior & anterior mPFC

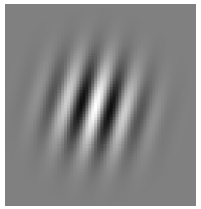


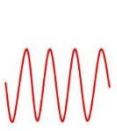


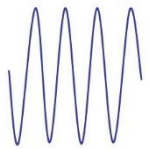


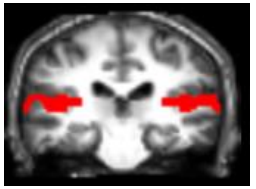






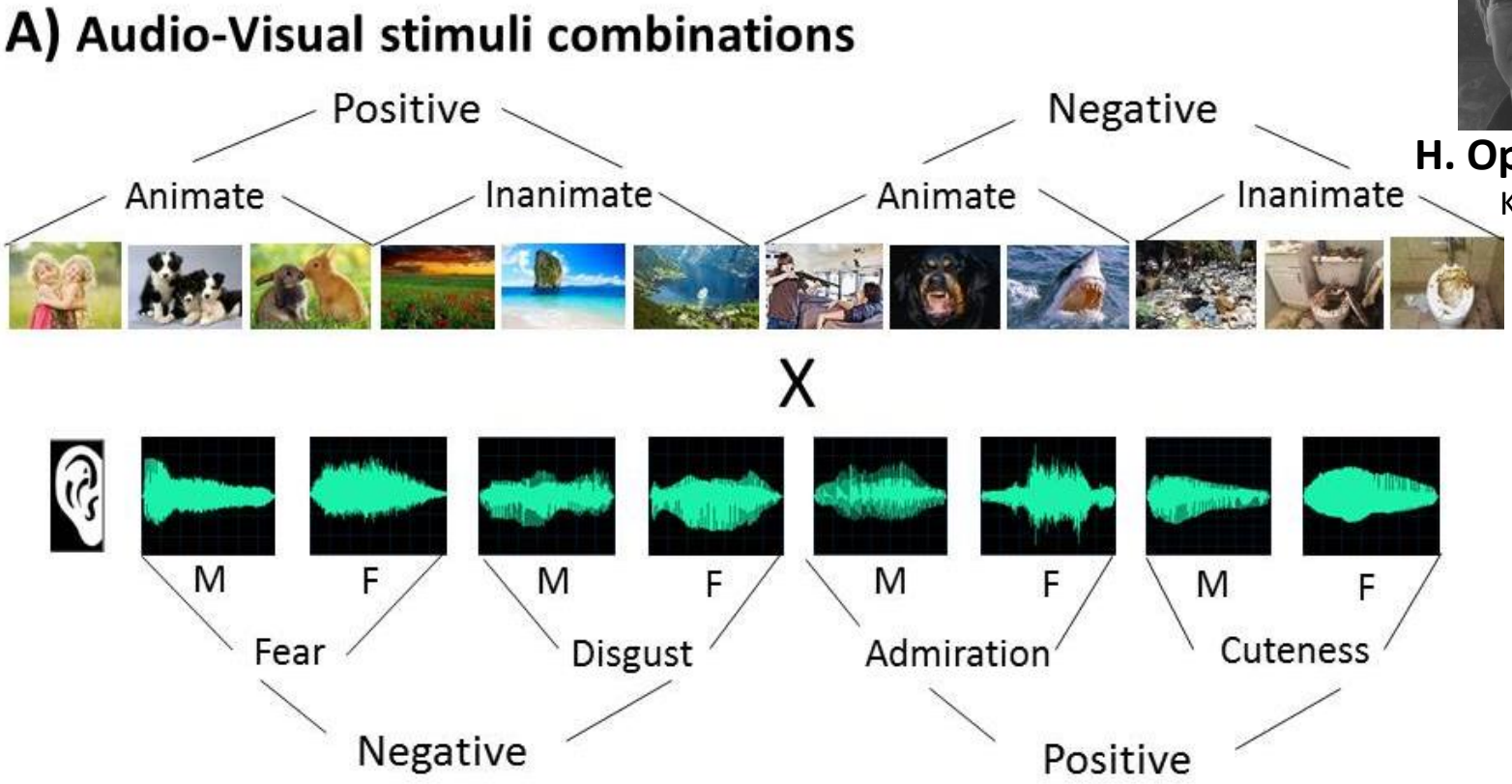






Studying **multiple brain representations** at once

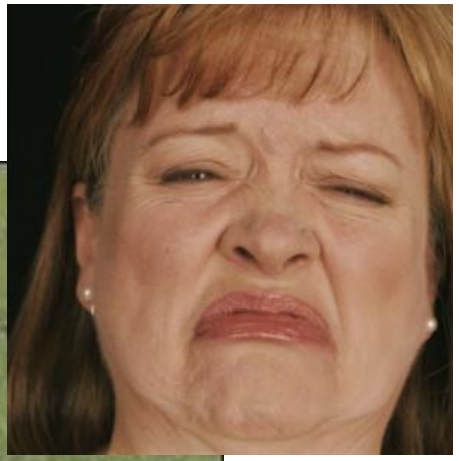
H. Op de Beeck
KU Leuven



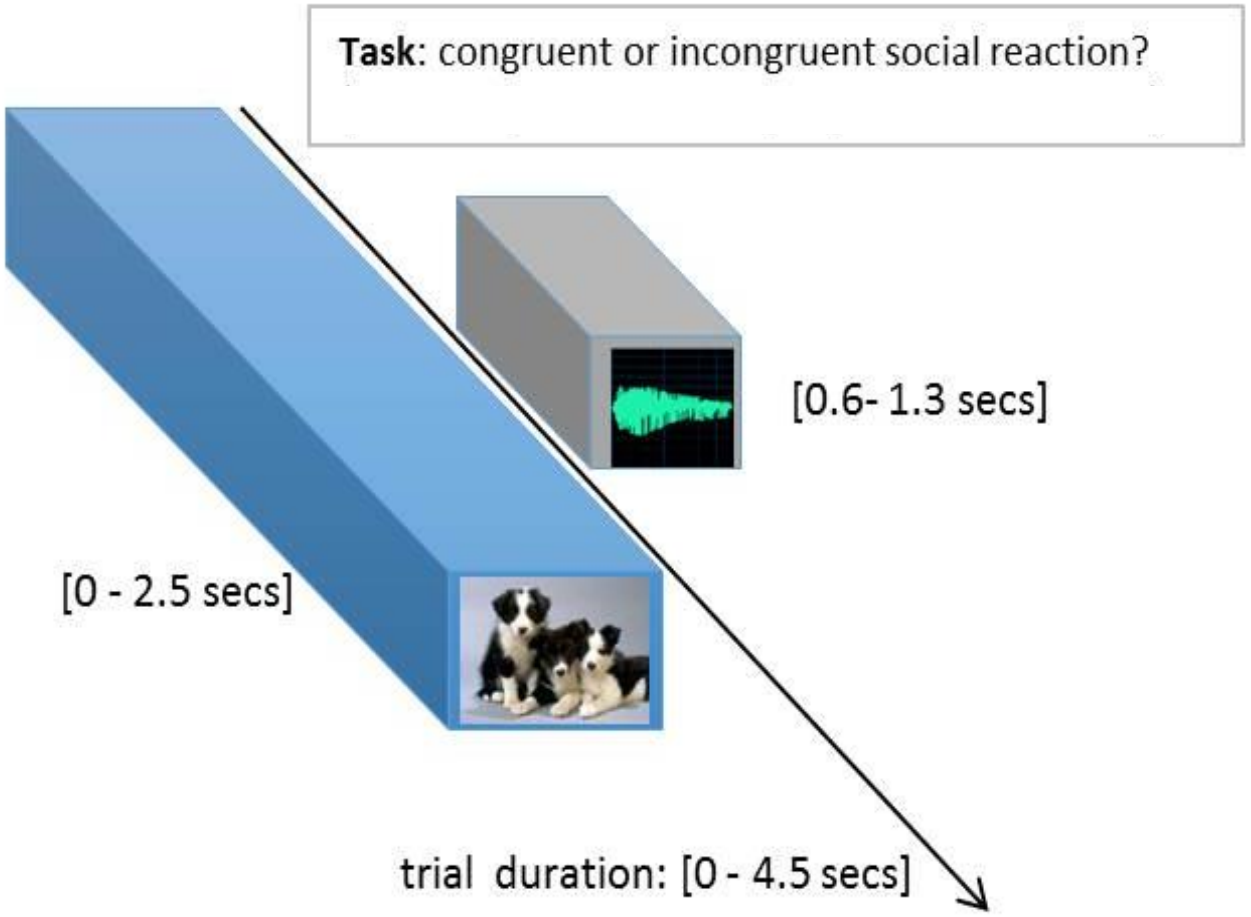
Congruent **Incongruent**

Congruent reaction

Incongruent reaction

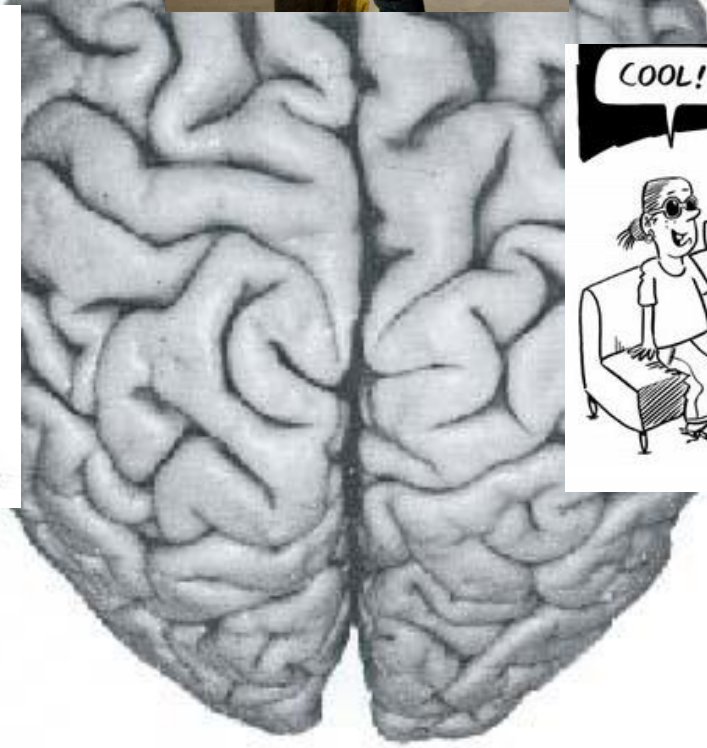


Experimental trials



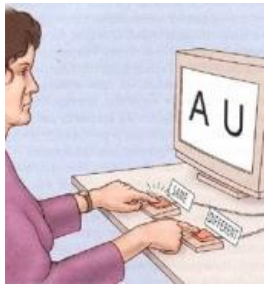
For me this is appropriate

But what do ‘most people’ think?



Behavioral task validation

« Self-reference » task



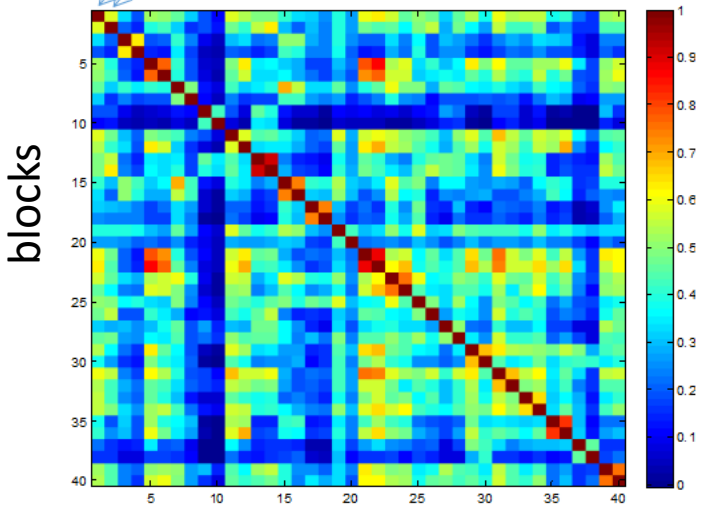
versus

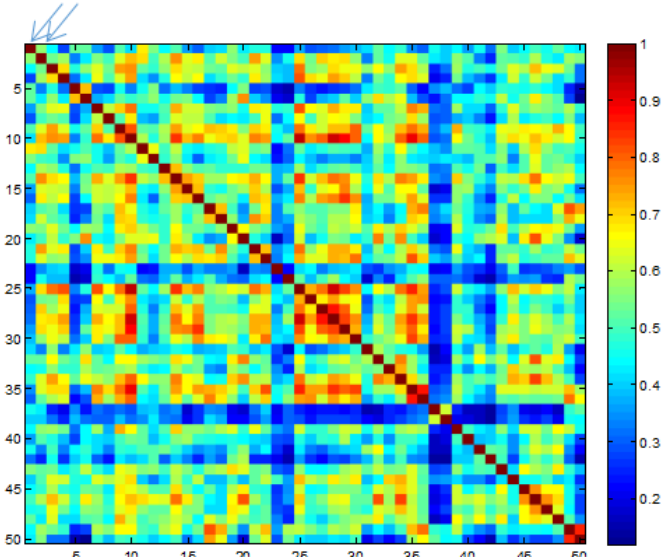
« Social norm » task

Similarity of response patterns

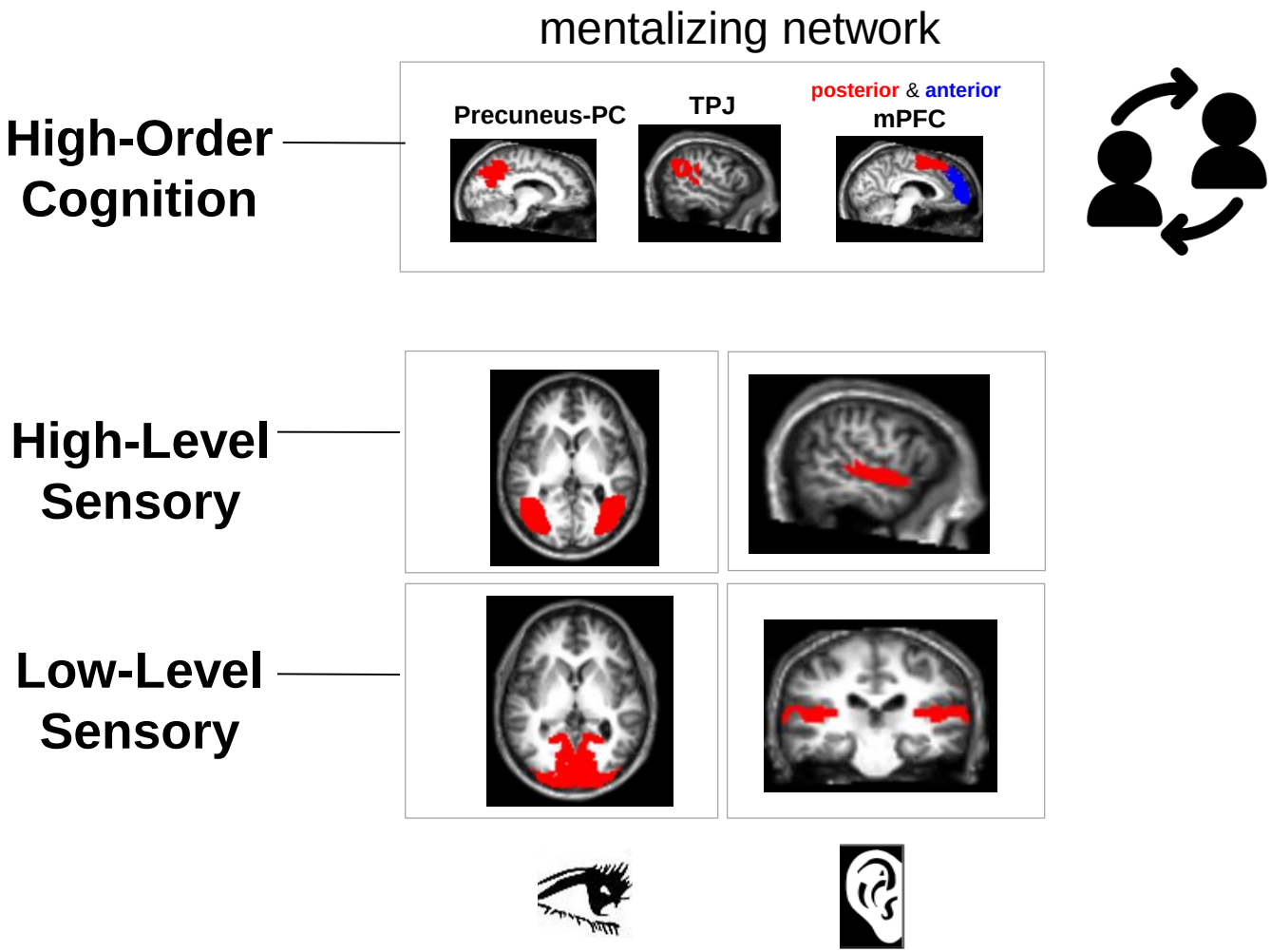
Within-subjects: r = 0.65 vs 0.67; t(43) = −0.3

*** **Between-subjects**: r = 0.33 vs 0.50; t(43) −7.1; p < 0.0001





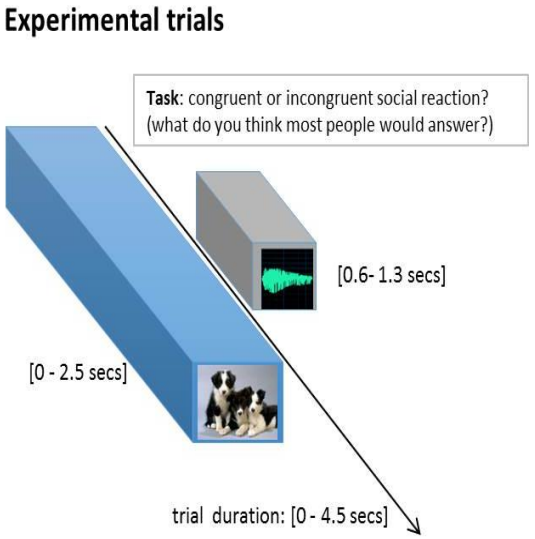
Hierarchical Brain Areas



Separate GLMs :
visual, **audio** and **congruency** GLMs

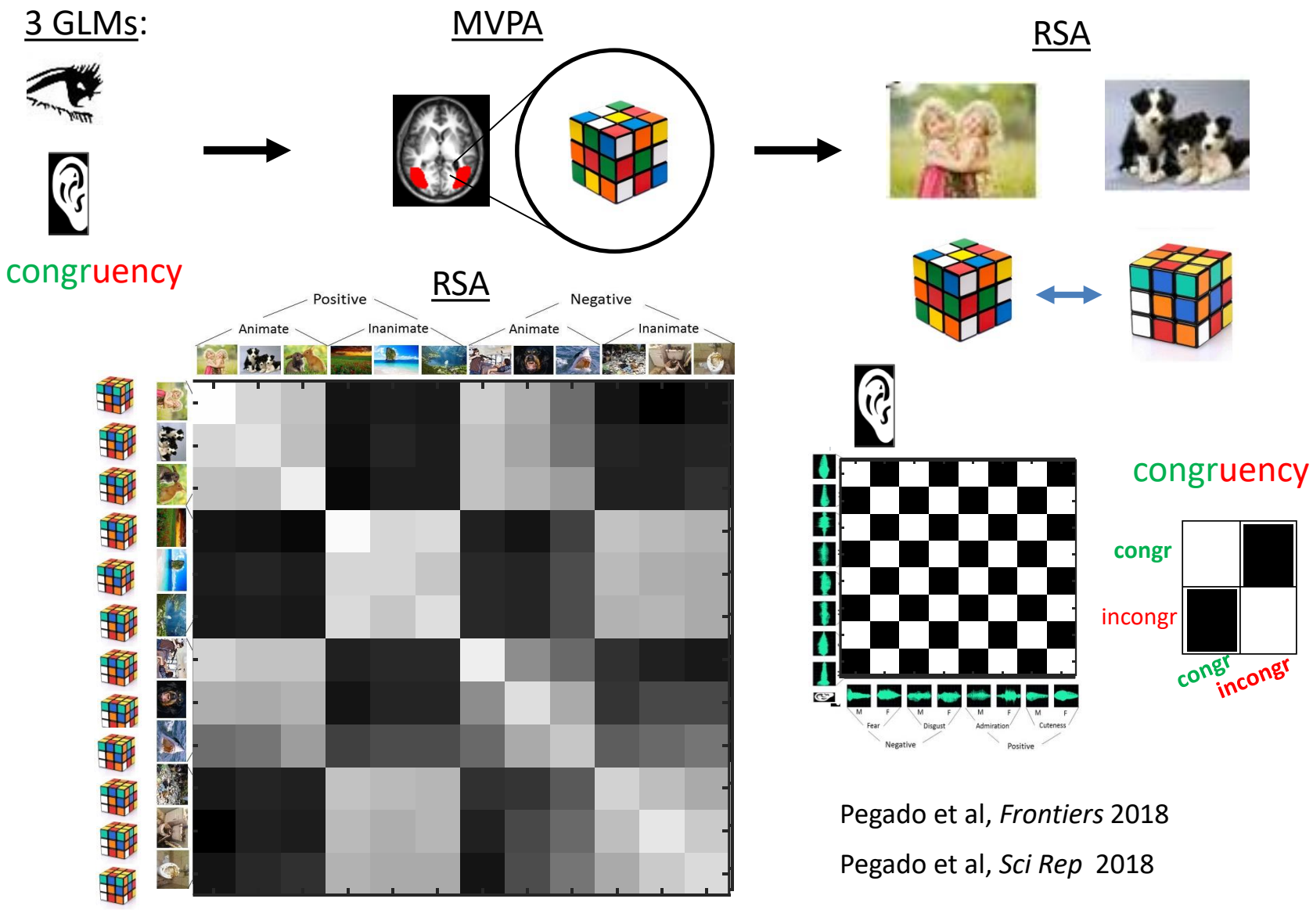
Visual GLM
- Duration & onset for *visual* stimuli (0-2.5 sec)
- Conditions: 12 visual stimuli

Auditory GLM
- Duration & onset for *auditory* stimuli (0.6-1.3 sec)
- Conditions: 8 auditory stimuli



Congruency GLM
- Duration & onset : 0.6 - 4.5 sec
- 2 Conditions: congruent vs incongruent

Studying **multiple brain representations** at once



Pegado et al, *Frontiers* 2018

Pegado et al, *Sci Rep* 2018

Groups' matching

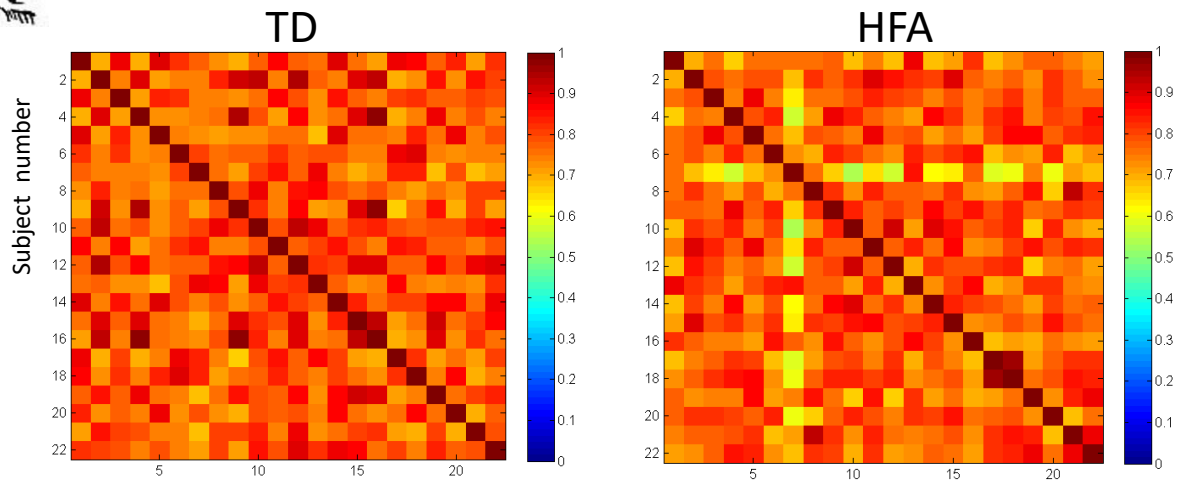
22 High-Functioning Autism (**HFA**)
vs
22 matched Typically Developing (**TD**)

	ASD N = 22	Matched TD N = 22	T-statistic	P-value
Age	**22.5** (+/- 4.09)	**22.8** (+/- 2.94)	T(42) = 0.34	P = 0.74
IQ	**108.6** (+/- 14.5)	**112.4** (+/- 15.4)	T(42) = 0.84	P = 0.40
SRS-A	**63.0** (+/- 13.0)	**49.0** (+/- 8.0)	T(42) = 4.28	P = 0.0001

Variability across subjects

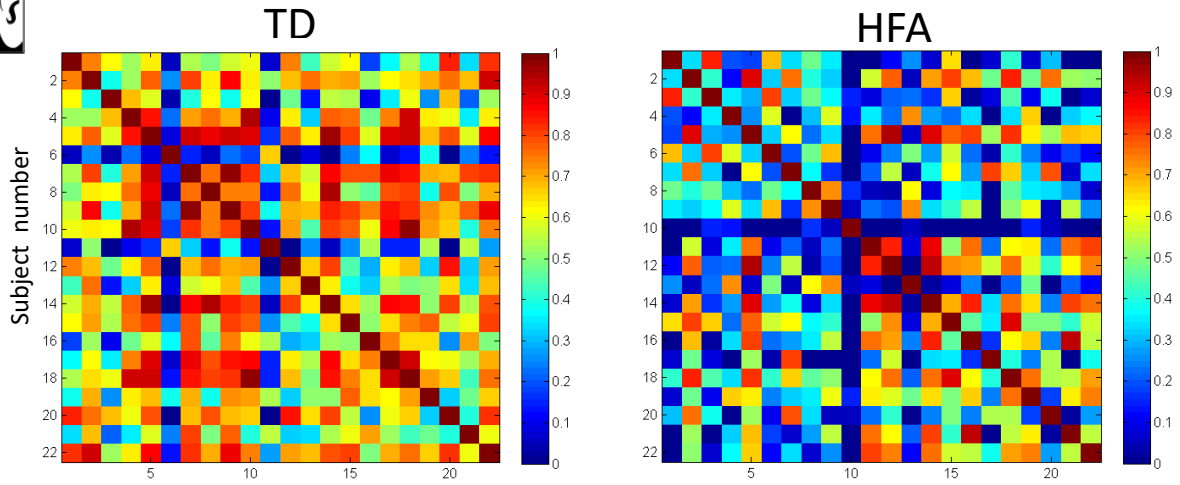
Behavioral ratings

Similarity of ***visual*** **valence** ratings across participants

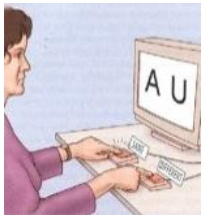


** T(42) = -2.83;
p = 0.007

Similarity of ***auditory*** **valence** ratings across participants



*** T(42) = -4.78;
p < 0.0001



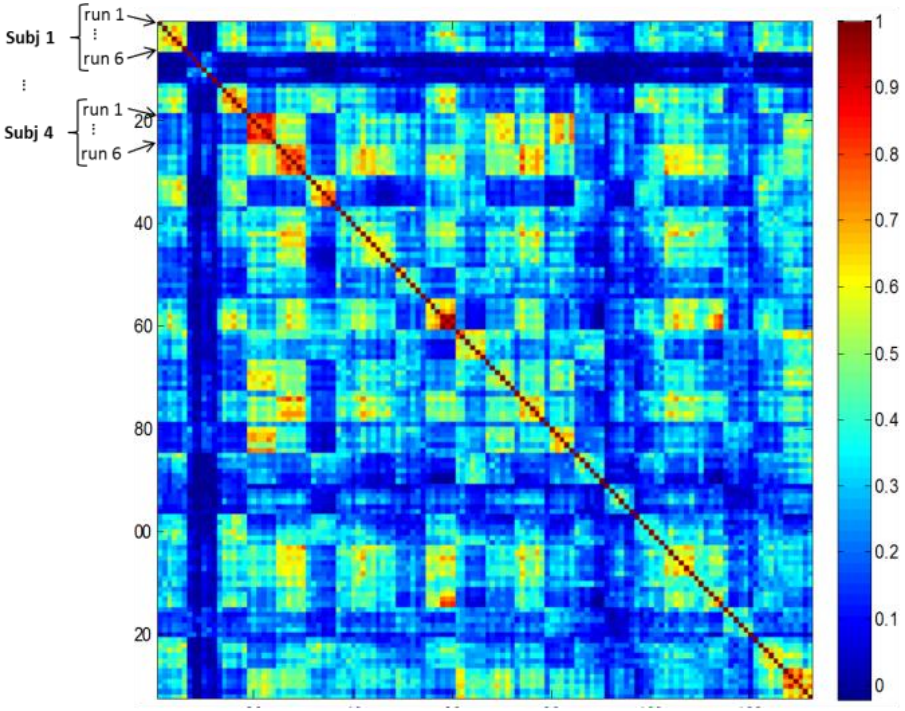
Behavioral ratings

Similarity of ***congruency*** **judgements**

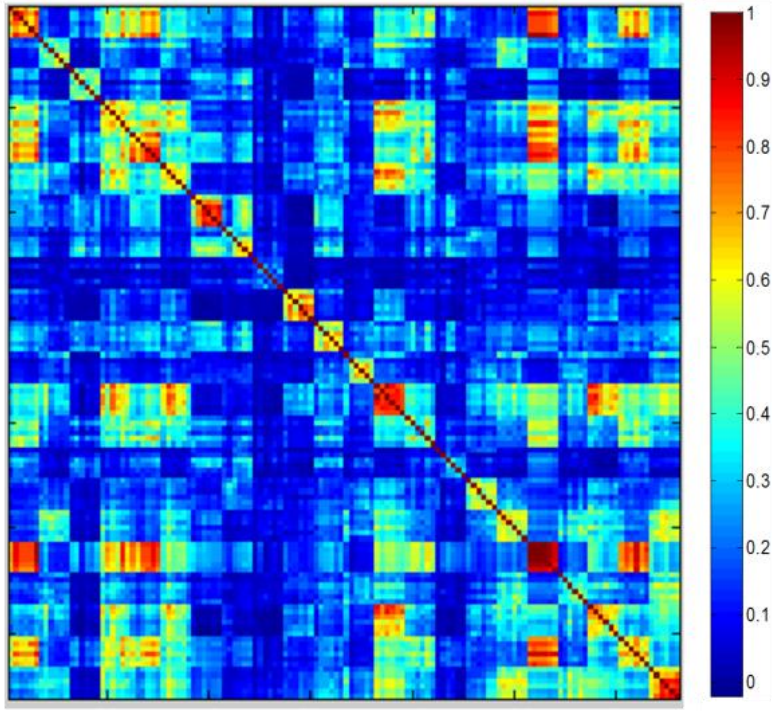
within and *between* participants

(inside the scanner)

TD

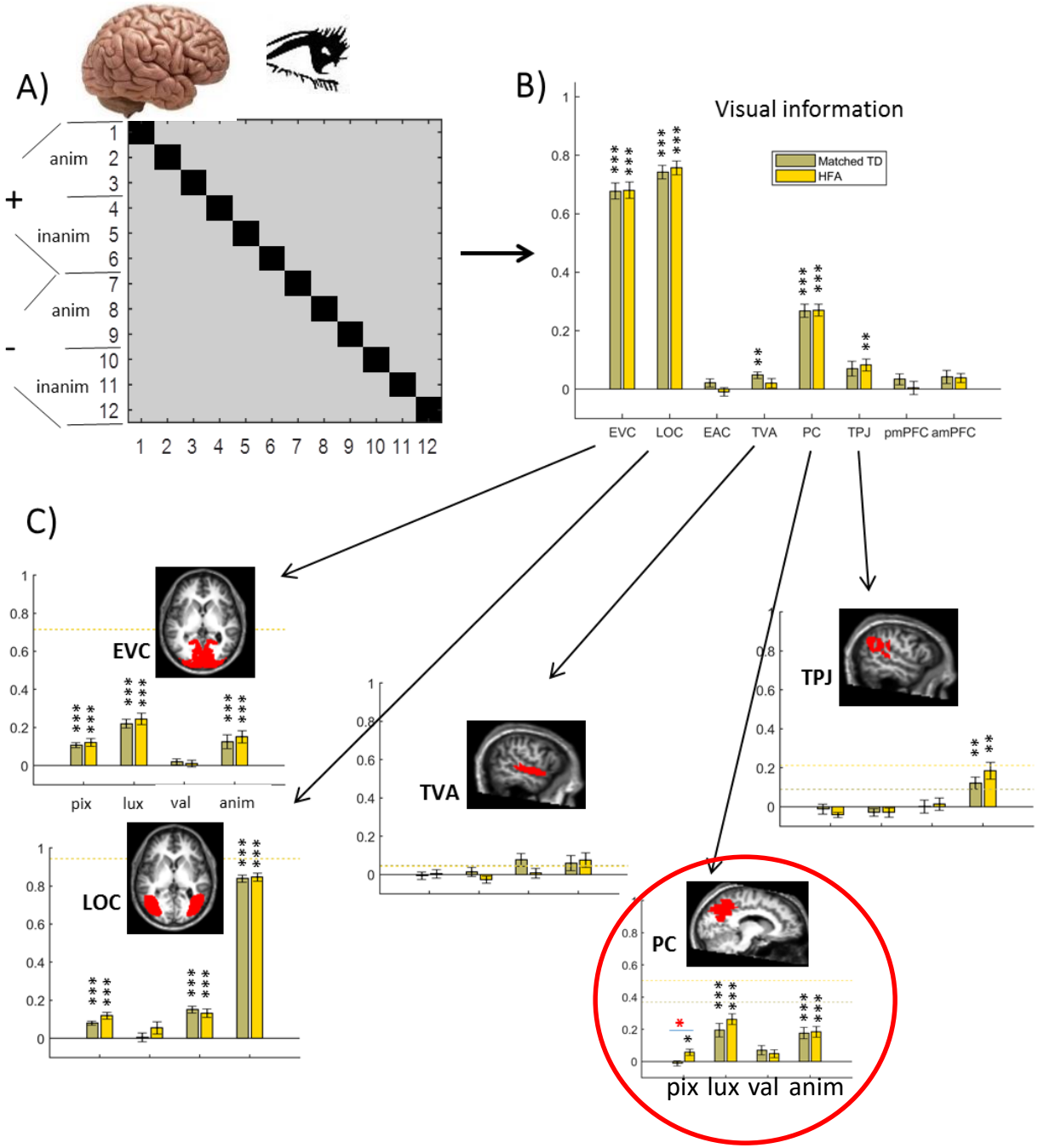


HFA

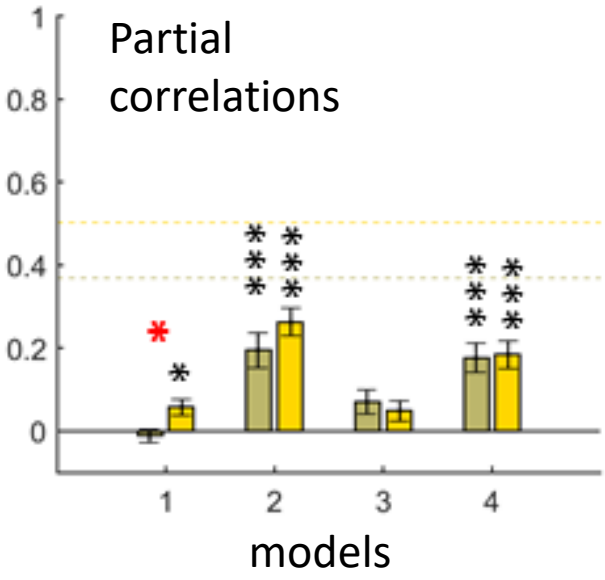


***within*-subject** correlations (TD: r = 0.51 vs ASD: r = 0.54; T(42) = -0.59; p = 0.56).

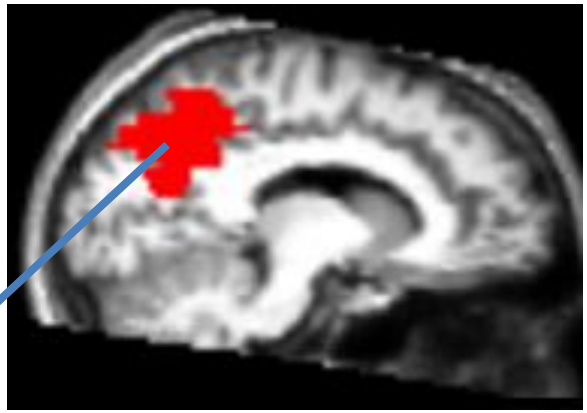
** ***between*-subject** correlations (TD: r = 0.26; ASD: r = 0.19; T(42) = 2.62; p = 0.01).

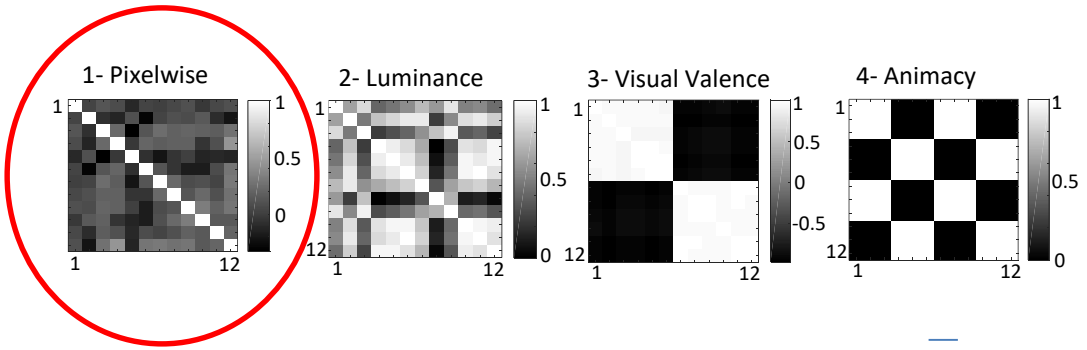

A)
anim
inanim
anim
inanim
+
-
1 2 3 4 5 6 7 8 9 10 11 12
B)
Visual information
Matched TD
HFA
EVC LOC EAC TVA PC TPJ pmPFC amPFC
C)
EVC
pix lux val anim
TVA
TPJ
LOC
PC
pix lux val anim

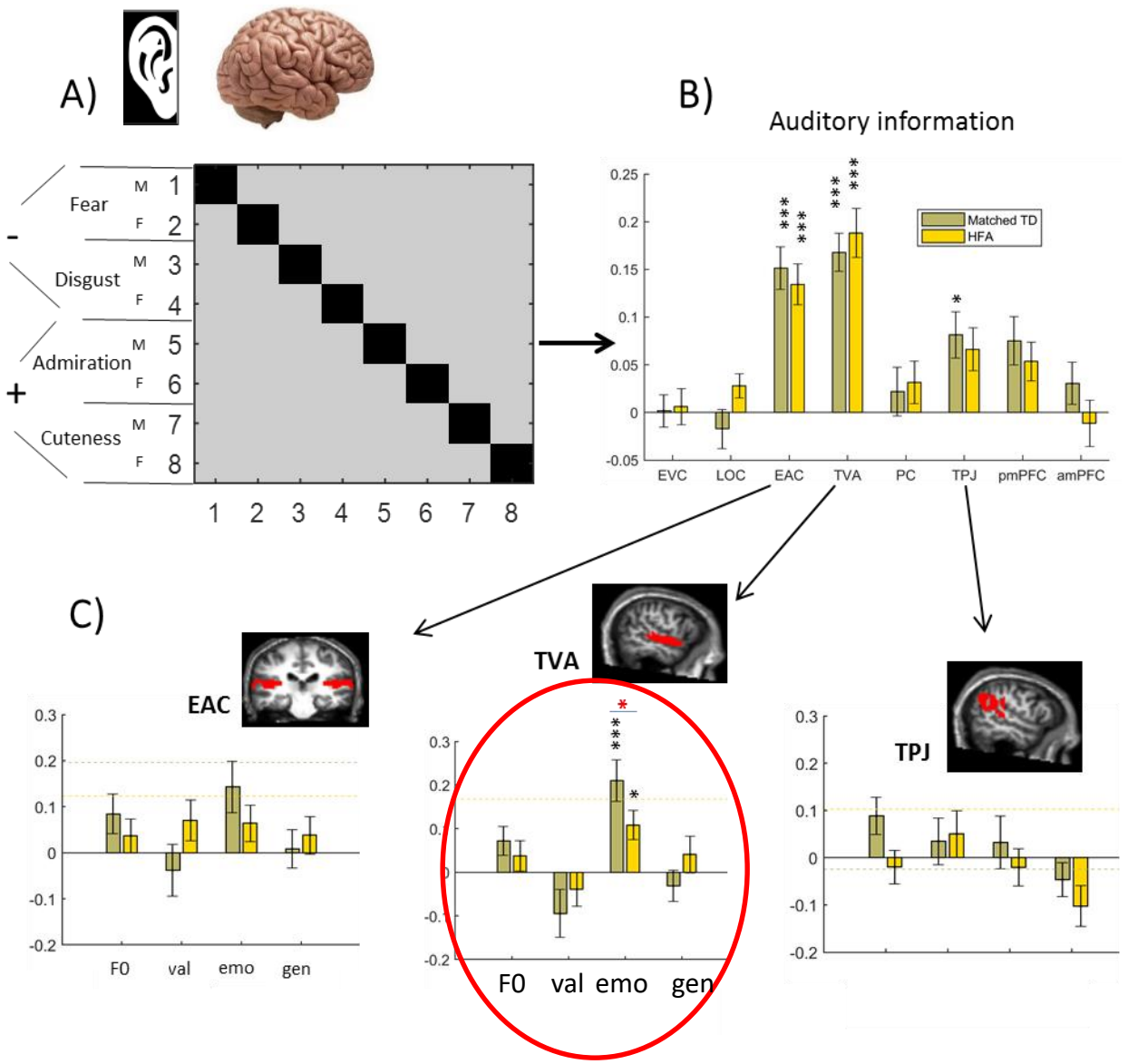
HFA show more *low-level* visual information in PC

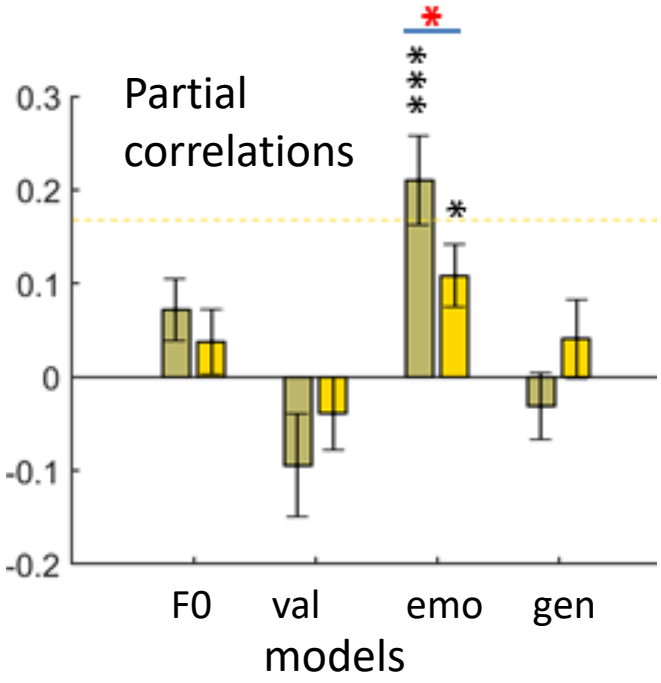


Precuneus-PC

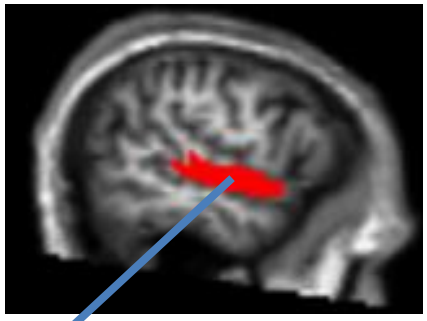


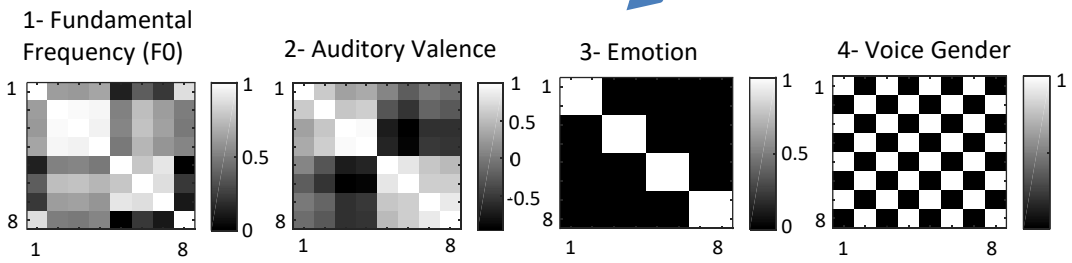



A)
B)
Auditory information
Fear
Disgust
Admiration
Cuteness
M
F
1
2
3
4
5
6
7
8
-
+
1 2 3 4 5 6 7 8
Matched TD
HFA
EVC
LOC
EAC
TVA
PC
TPJ
pmPFC
amPFC
C)
EAC
TVA
TPJ
F0
val
emo
gen

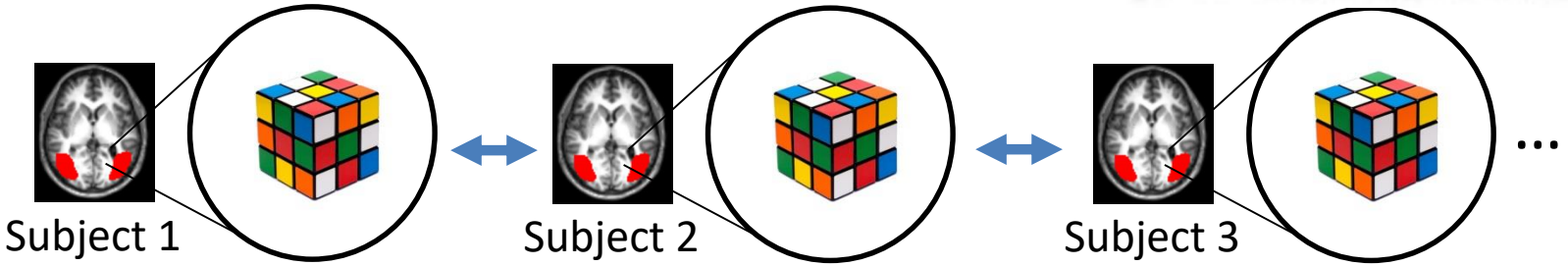


Temporal Voice Area- TVA

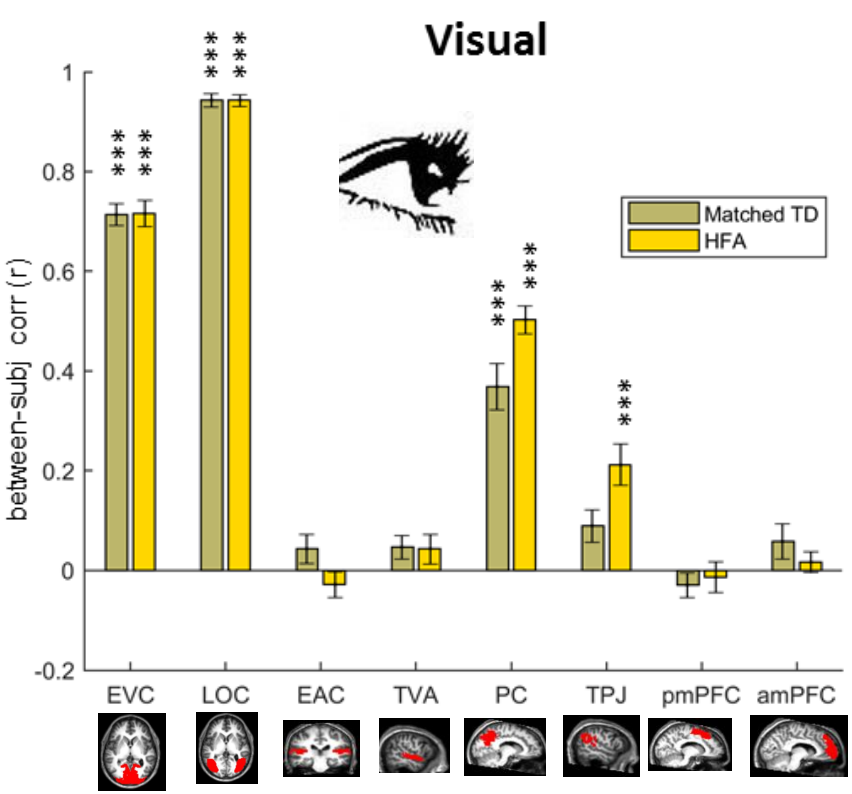


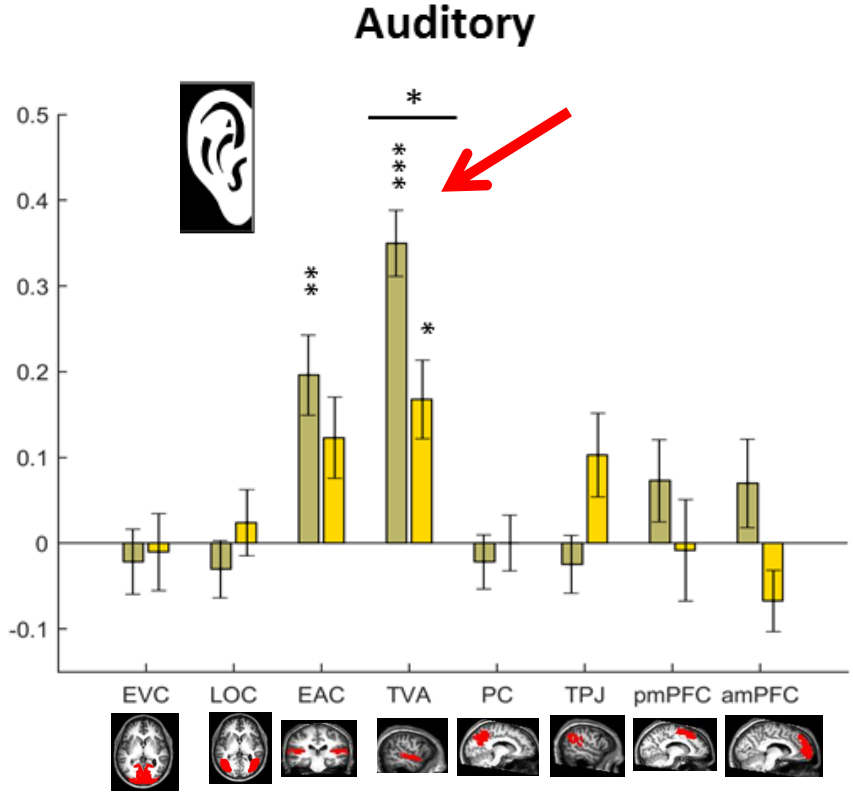


Variability across subjects

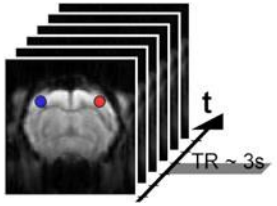


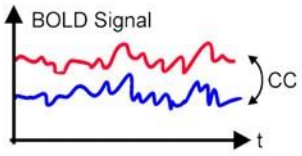
Similarity of Neural Representations across subjects





Functional Connectivity

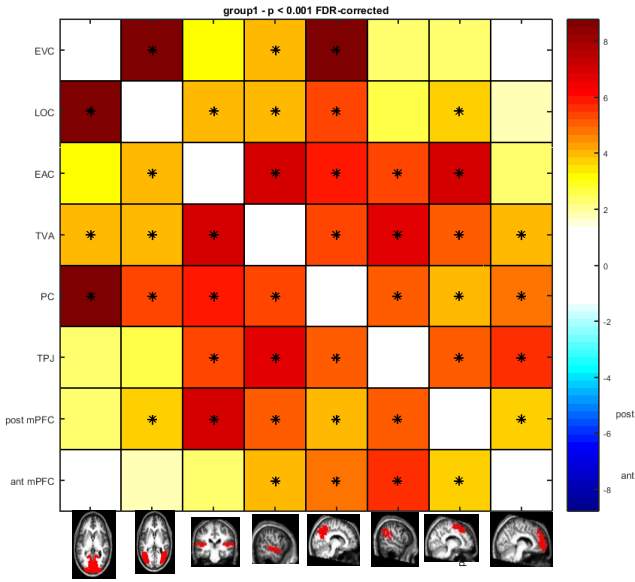


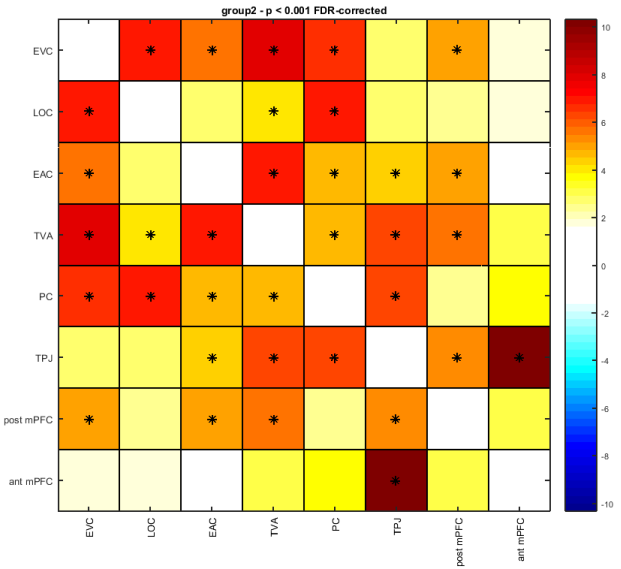


TD

HFA

Between brain regions



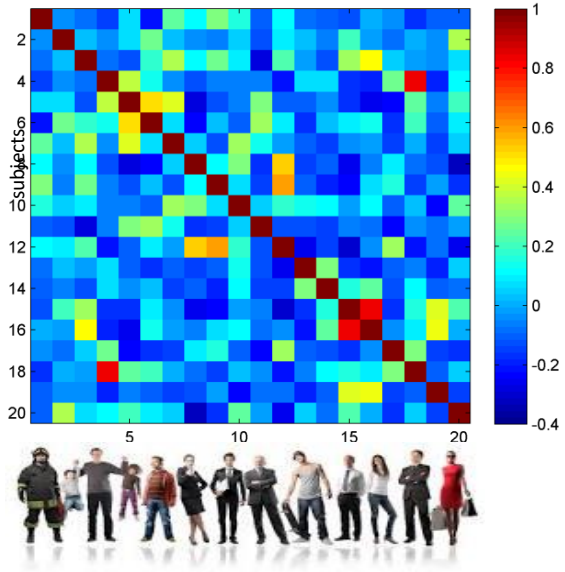


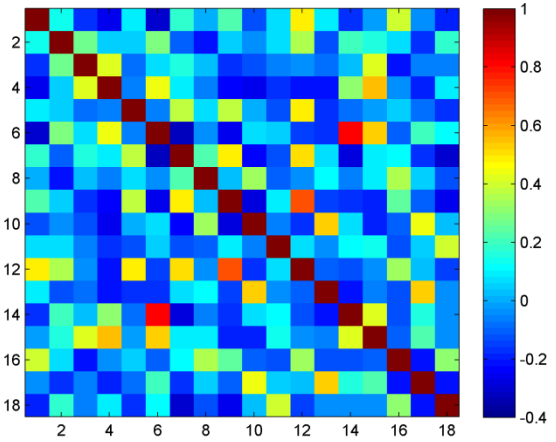
n.s.

TD

HFA

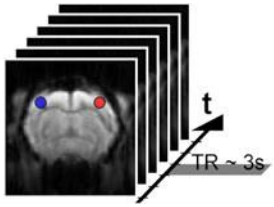
Between subjects [all 8 ROI]

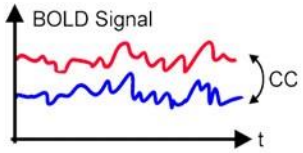




n.s.

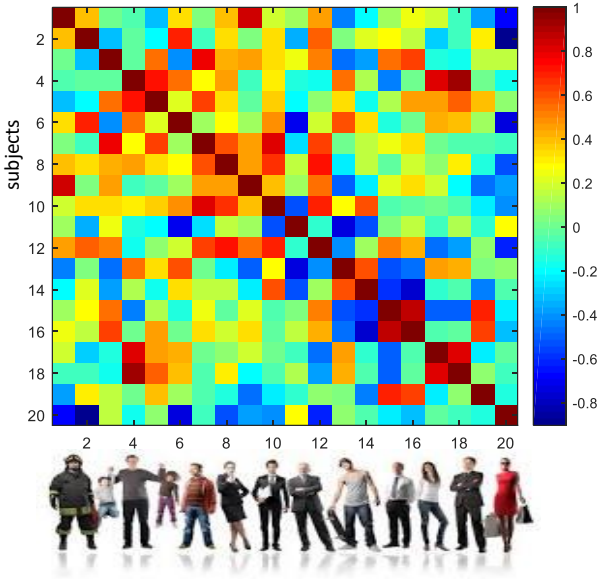
Functional Connectivity



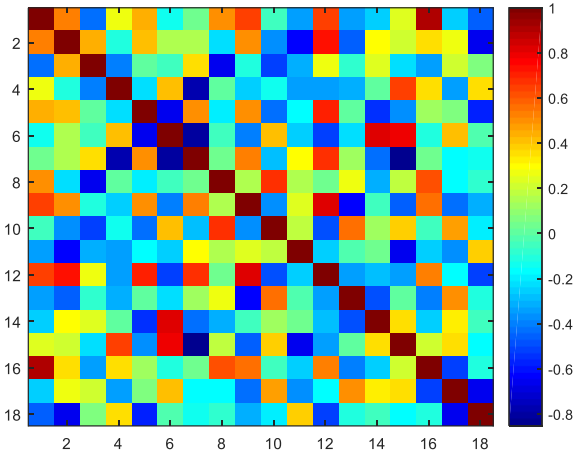


Between subjects
[Only TVA]

TD

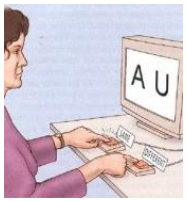


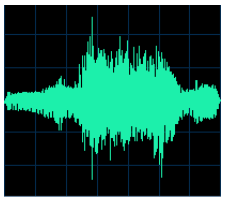
HFA

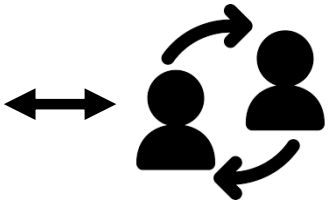


**** group difference**
T(36) = 2.76;
p = 0.009

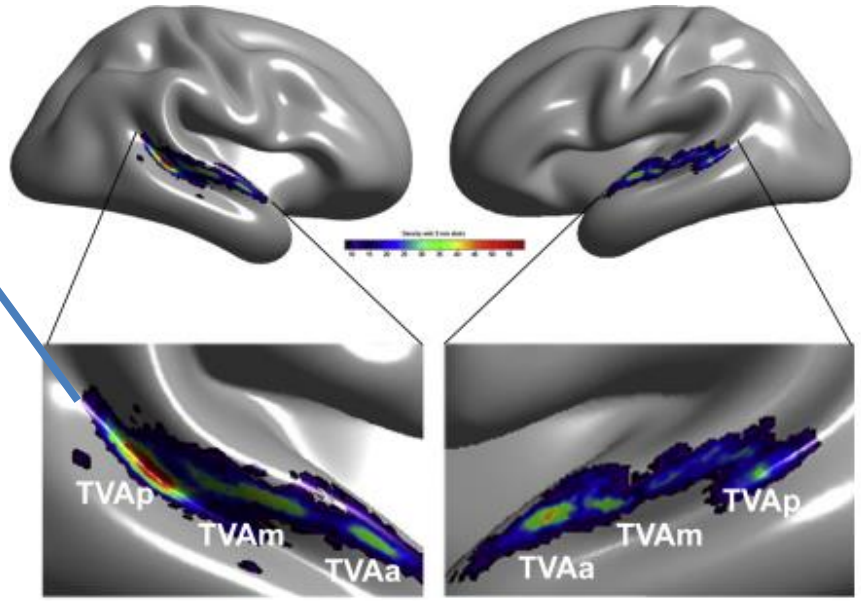
HFA show ***more uniqueness*** of neural patterns and functional connectivity in the **Voice Area**







behavioral judgments of **auditory valence**...



and those of **auditory congruency** were also **more idiosyncratic in HFA**

High Functioning Autism

Social

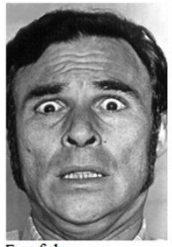
↑

High sensory

↑

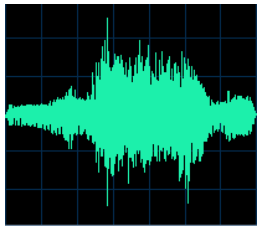
Low sensory

faces

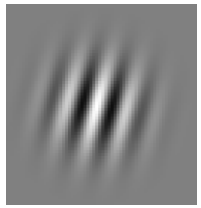


Fearful

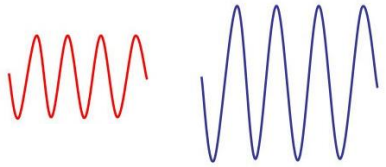
voices



gabor



loudness



Financial Support

Open science

Summary

- **Striking similar neural representations among HFA and TD** adults at **all hierarchical levels**, including low and high level sensory processing and higher-order social processing.

- The only exception is a **high-level area** (Precuneus) **carrying more low-level information** (pixel information) in HFA.

- At the individual-subject level, one brain region showed **more interindividual variability in the HFA** group, both for neural **representations** and functional **connectivity**: the **Temporal Voice Area** (TVA).

- This **larger neural idiosyncrasy in HFA matches with the increased behavioral idiosyncrasy**, both for **valence ratings of auditory** stimuli (outside the scan) and for the **congruency of these vocalizations with visual contexts** (inside and outside the scanner).

idiosyncrasy in the functioning of high-sensory areas relevant for social understanding could underlie the idiosyncrasy in social behavior in HFA.