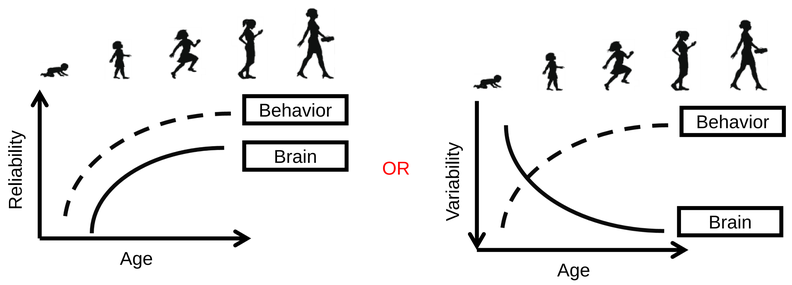
Age and sex modulate the variability of neural responses to engaging videos

Samantha Cohen[1,2], Agustin Petroni[1], Lei Ai[3], Nicolas Langer[1,3,4], Simon Henin[1], Tamara Vanderwal[5], Michael P. Milham[3,6], Lucas C. Parra[1]

[1] Department of Biomedical Engineering, City College of New York, New York, NY 10031, USA. [2] Department of Psychology, The Graduate Center of the City University of New York, New York, NY 10016, USA. [3] Center for the Developing Brain, Child Mind Institute, New York, NY 10022, USA. [4] Methods of Plasticity Research, Department of Psychology, University of Zurich, 8050, Switzerland. [5] Yale Child Study Center, New Haven, CT 06520, USA. [6] Nathan Kline Institute for Psychiatric Research, Orangeburg, NY 10962, USA.

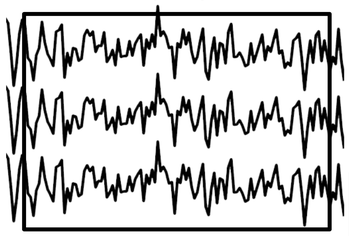
Does neural variability change with age?

Development generally corresponds with an increase behavioral reliability. Is this accompanied by an increase in neural reliability, or does neural variability increase with processing efficiency?

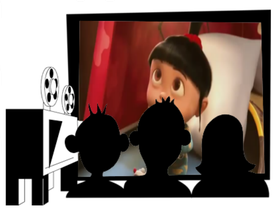


Intersubject correlation (ISC): A measure of neural variability

Inter-subject correlation (ISC)



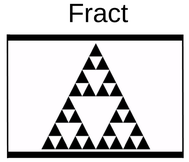
Implicated in:
- Memory (Cohen et al., 2016)
- Attention (Ki et al., 2016)
- Engagement (Dmochowski et al., 2014)



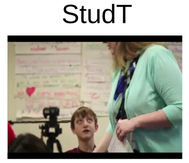
Stimuli:

Arith

Fract

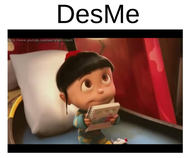


StudT

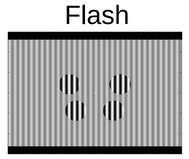


Wimpy

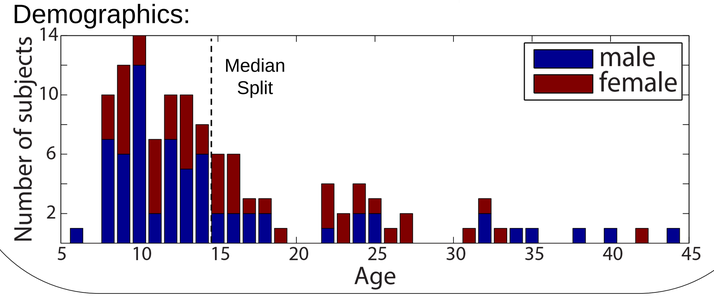
DesMe



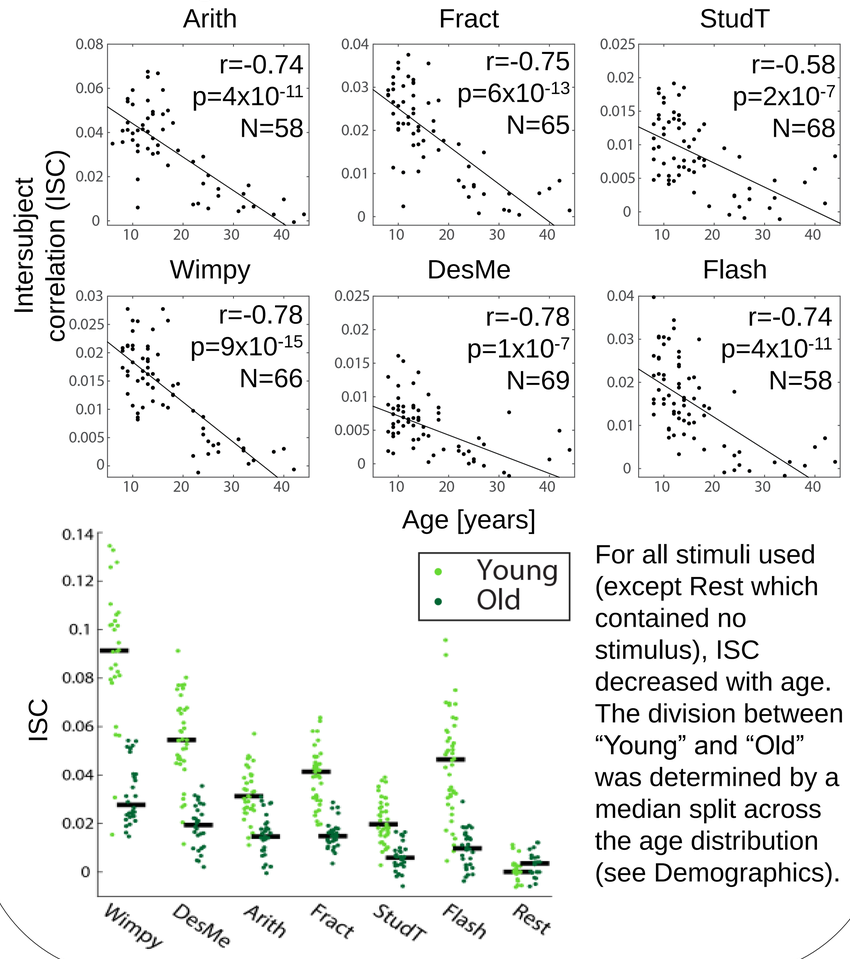
Flash



Demographics:



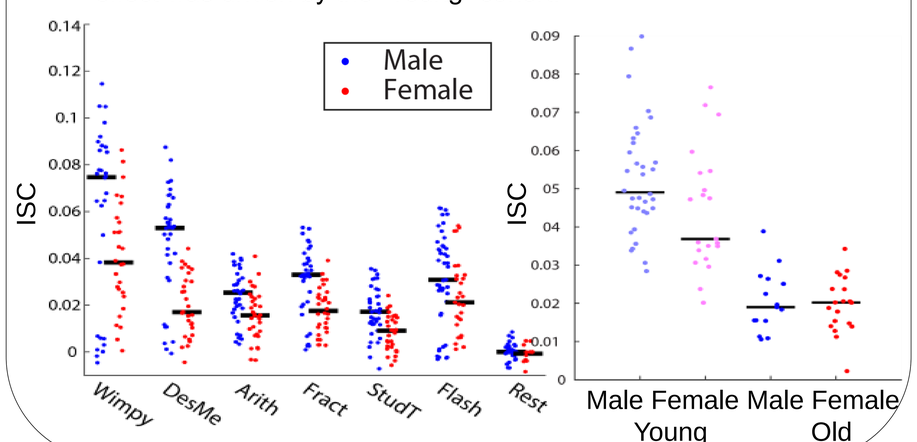
Intersubject correlation decreases with age



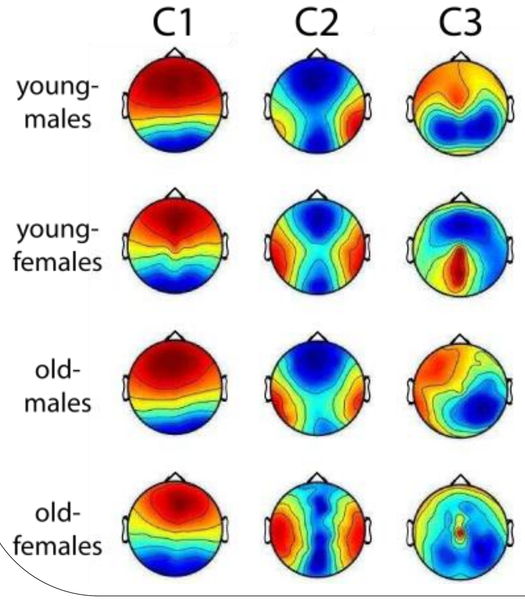
For all stimuli used (except Rest which contained no stimulus), ISC decreased with age. The division between "Young" and "Old" was determined by a median split across the age distribution (see Demographics).

Intersubject correlation is elevated in males

Across all stimuli, males had higher ISC than females. This effect was driven by the "Young" cohort.



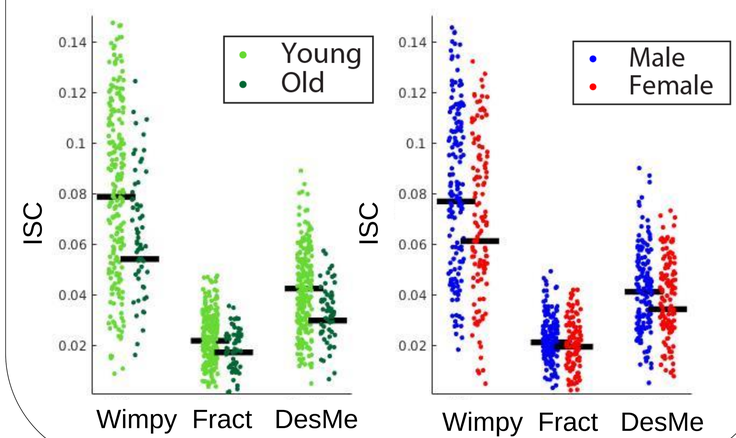
Correlated component topographies similar across age and sex groups.



The first two correlated components (C1 and C2) appear largely similar across ages and sexes. This indicates that the observed differences in ISC are due to consistent neural generators.

Replication of results

Three stimuli were shown to an additional cohort of 303 subjects. The ISC differences between the ages and sexes replicate with this additional cohort.



References & Data

Data

Alexander, L. M., Escalera, J., Ai, L., Andreotti, C., Febre, K., Mangone, A., … Mantello, G. (2017). Data Descriptor : An open resource for transdiagnostic research in pediatric mental health and learning disorders. Scientific Data, 4(170181), 1–26.

Langer, N., Ho, E. J., Alexander, L. M., Xu, H. Y., Jozanovic, R. K., Henin, S., … Kelly, S. P. (2017). A resource for assessing information processing in the developing brain using EEG and eye tracking. Scientific Data, 4, 170040. http://doi.org/10.1038/sdata.2017.40

References

Cohen, S. S., Henin, S., Parra, L. C. (2017). Engaging narratives evoke similar neural activity and lead to similar time perception. *Scientific Reports.*

Cohen, S. S., & Parra, L. C. (2016). Memorable audiovisual narratives synchronize sensory and supramodal neural responses. *eNeuro*.

Dmochowski, J. P., Bezdek, M. A., Abelson, B. P., Johnson, J. S., Schumacher, E. H., & Parra, L. C. (2014). Audience preferences are predicted by temporal reliability of neural processing. *Nature Communications*, *5*(4567), 1–9.

Dmochowski, J. P., Sajda, P., Dias, J., & Parra, L. C. (2012). Correlated components of ongoing EEG point to emotionally laden attention – a possible marker of engagement? *Frontiers in Human Neuroscience*, *6*(112), 1– 9.

Ki, J., Kelly, S., & Parra, L. C. (2016). Attention strongly modulates reliability of neural responses to naturalistic narrative stimuli. *Journal of Neuroscience*.

Petroni, A.*, Cohen, S. S.*, Langer, N., Henin, S., Vanderwal, T., Milham, M. P., Parra, L. C. (2016). The Variability of Neural Responses to Naturalistic Videos Change with Age and Sex, *eNeuro*.