Understanding Human Brain Connectivity

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Applied Statistics 2021/2022

Dataset

The Consortium for Neuropsychiatric Phenomics at Semel Institute aims to facilitate discovery of the genetic and environmental bases of variation in psychological and neural system phenotypes, to elucidate the mechanisms that link the human genome to complex psychological syndromes, and to foster breakthroughs in the development of novel treatments for neuropsychiatric disorders

Made available the scan of 272 subjects affected by different diseases and during various activities

43 ADHD

49 BIPOLAR DISORDER

50 SCHIZOPHRENIA

130 CONTROL

Resting State
Different tasks

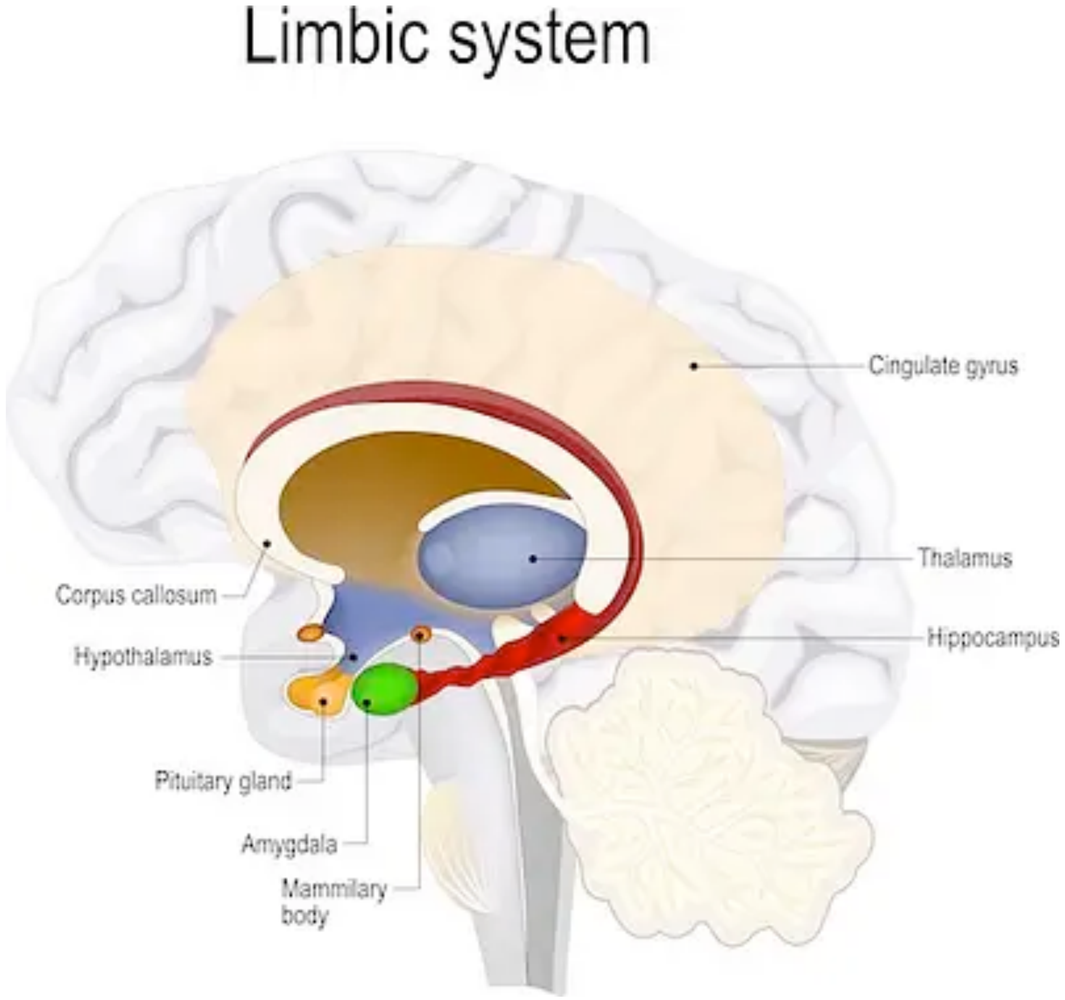
Demographic data

Details on dataset and tasks:
https://www.biorxiv.org/content/10.1101/059733v1.full.pdf

! not all subjects perform all tasks

PAMRET + ADHD

- Goal: Evaluate the impact of ADHD on associative memory. Among the cognitive impairments associated to ADHD there is memory deficit [1,2]
- Subjects: 82 healthy subjects + 36 ADHD patients
- Task: Paired Associate Memory Task
- Region of Interest: left hippocampus, a region associated with associative memory and affected by the presence of ADHD[2]
- Covariates:
  - Demographic and health
  - Performance, response time
  - California Verbal Learning Test (CVLT - II)[3]



[1] Thaler NS, Allen DN, McMurray JC, Mayfield J. Sensitivity of the test of memory and learning to attention and memory deficits in children with ADHD. Clin Neuropsychol. 2010 Feb;24(2):246-64. doi: 10.1080/13854040903277305. Epub 2009 Oct 22. PMID: 19859854.
[2] de Oliveira Rosa, V., Rosa Franco, A., Abrahão Salum Júnior, G. *et al.* Effects of computerized cognitive training as add-on treatment to stimulants in ADHD: a pilot fMRI study. *Brain Imaging and Behavior* **14,** 1933–1944 (2020). https://doi.org/10.1007/s11682-019-00137-0
[3] Lundervold AJ, Halleland HB, Brevik EJ, Haavik J, Sørensen L. Verbal Memory Function in Intellectually Well-Functioning Adults With ADHD: Relations to Working Memory and Response Inhibition. Journal of Attention Disorders. 2019;23(10):1188-1198. doi:10.1177/1087054715580842

PAMRET + ADHD: file included

- Demographics, general health
- Neuropsychiatric test results

.json and .tsv files.
The .json file includes the encoding of the data in the .tsv

- For each subject: record of the task events (performance and timing)
- Connectivity map
- R script to select the correct participants, compute mean maps, plot .vtu
- Plot .vtu file
- The .json and .tsv files can be downloaded at: https://openneuro.org/datasets/ds000030/versions/1.0.0 where further details and files are available too

Task Switch + SCHZ

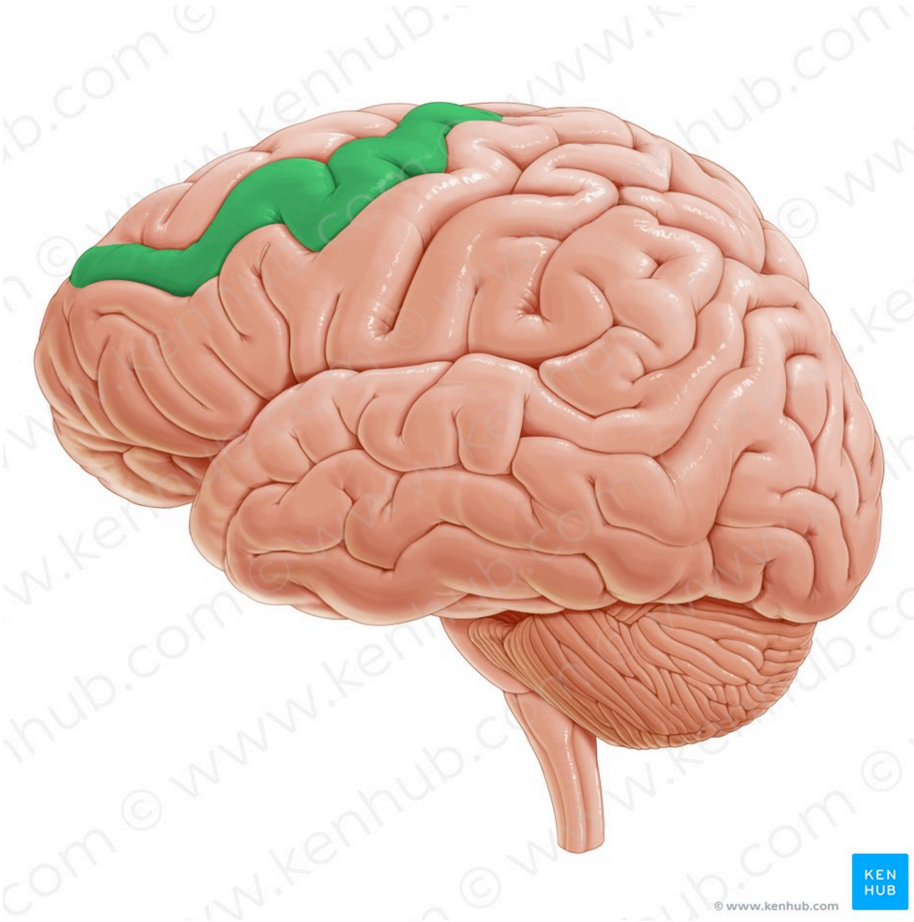
- Background: Patients affected by schizophrenia tend to perform poorly in many cognitive tasks. When it comes to task switching previous literature has found contradictory results[1,2], possibly due to compensation mechanisms

- Subjects: 125 healthy + 50 SCHZ

- Task: Task Switch Task

- Region of Interest: middle frontal gyrus region, where lies the dorsolateral prefrontal cortex (DLPFC) that has been associated to the ability of switching tasks[3]

- Covariates:
  - Demographic and health
  - Response time, given stimulus
  - Barratt Impulsiveness Scale (BIS - 11)[4,5]



[1] Meiran N, Levine J, Meiran N, Henik A. Task set switching in schizophrenia. Neuropsychology. 2000 Jul;14(3):471-82. doi: 10.1037//0894-4105.14.3.471. PMID: 10928748.
[2] Ravizza SM, Moua KC, Long D, Carter CS. The impact of context processing deficits on task-switching performance in schizophrenia. Schizophr Res. 2010 Feb;116(2-3):274-9. doi: 10.1016/j.schres.2009.08.010. Epub 2009 Sep 5. PMID: 19734013; PMCID: PMC2818092.
[3] Ravizza, S. M. and Carter, C. S. "Shifting set about task switching: Behavioral and neural evidence for distinct forms of cognitive flexibility". In: Neuropsychologia 46.12 (2008), pp. 2924–2935.
[4] Leshem R. Relationships between trait impulsivity and cognitive control: the effect of attention switching on response inhibition and conflict resolution. Cogn Process. 2016 Feb;17(1):89-103. doi: 10.1007/s10339-015-0733-6. Epub 2015 Aug 6. PMID: 26245649.
[5] Vasconcelos, Alina Gomide, Leandro Malloy-Diniz, and Humberto Correa. "Systematic review of psychometric proprieties of Barratt Impulsiveness Scale Version 11 (BIS-11)." *Clinical Neuropsychiatry* 9.2 (2012).

Task Switch + SCHZ: file included

- Demographics, general health, smoking habits
- Neuropsychiatric test results
- For each subject: record of the task events (performance and timing)
- Connectivity map
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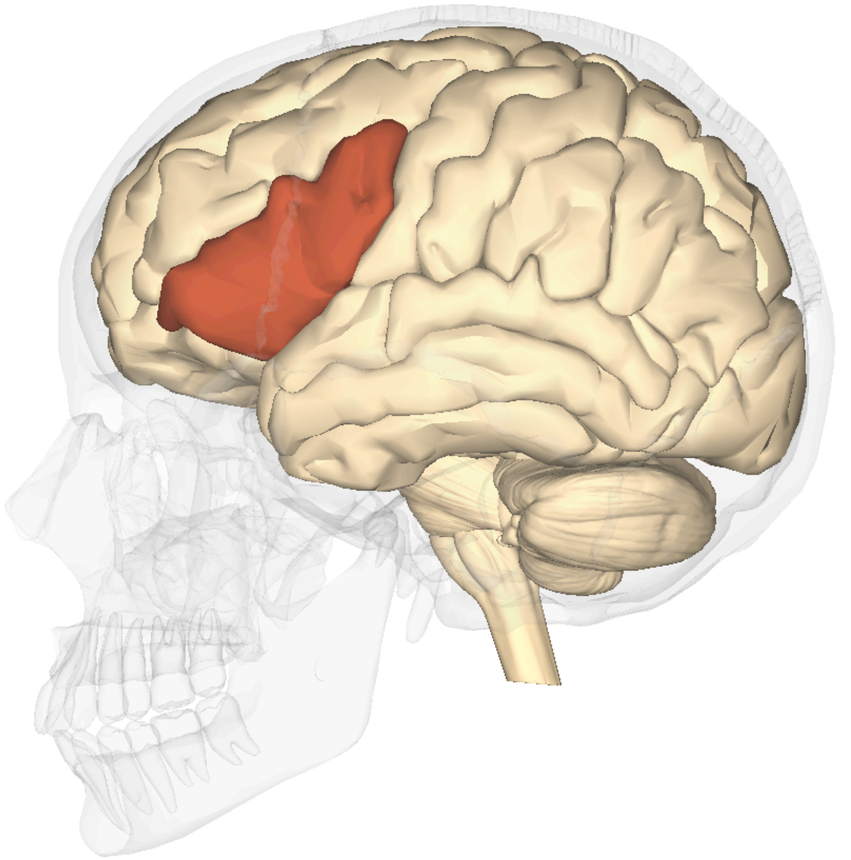
Stop Signal Task + Bipolar Disorder

- Background: Dysfunctional impulsivity is present in several psychiatric disorders that bring about risky behaviors, including bipolar disorder[1]
- Subjects: 126 healthy subjects + 49 patients affected by bipolar disorder
- Task: Stop Signal Task
- Region of Interest: right Inferior Frontal Gyrus[2,3]
- Covariates:
  - Demographic and health
  - Stimulus, response time, outcome (correct/incorrect)
  - Dickman Functional and Dysfunctional Impulsivity Scale[4]



[1] Bakhshani, Nour-Mohammad. "Impulsivity: a predisposition toward risky behaviors." *International journal of high risk behaviors & addiction* 3.2 (2014).
[2] Hughes ME, Johnston PJ, Fulham WR, Budd TW, Michie PT. Stop-signal task difficulty and the right inferior frontal gyrus. Behav Brain Res. 2013 Nov 1;256:205-13. doi: 10.1016/j.bbr.2013.08.026. Epub 2013 Aug 21. PMID: 23973765.
[3] Yang H, Di X, Gong Q, Sweeney J, Biswal B. Investigating inhibition deficit in schizophrenia using task-modulated brain networks. Brain Struct Funct. 2020 Jun;225(5):1601-1613. doi: 10.1007/s00429-020-02078-7. Epub 2020 Apr 30. PMID: 32356019.
[4] Dickman, Scott J. "Functional and dysfunctional impulsivity: personality and cognitive correlates." *Journal of personality and social psychology* 58.1 (1990): 95.

STOP + BI: file included

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- Neuropsychiatric test results
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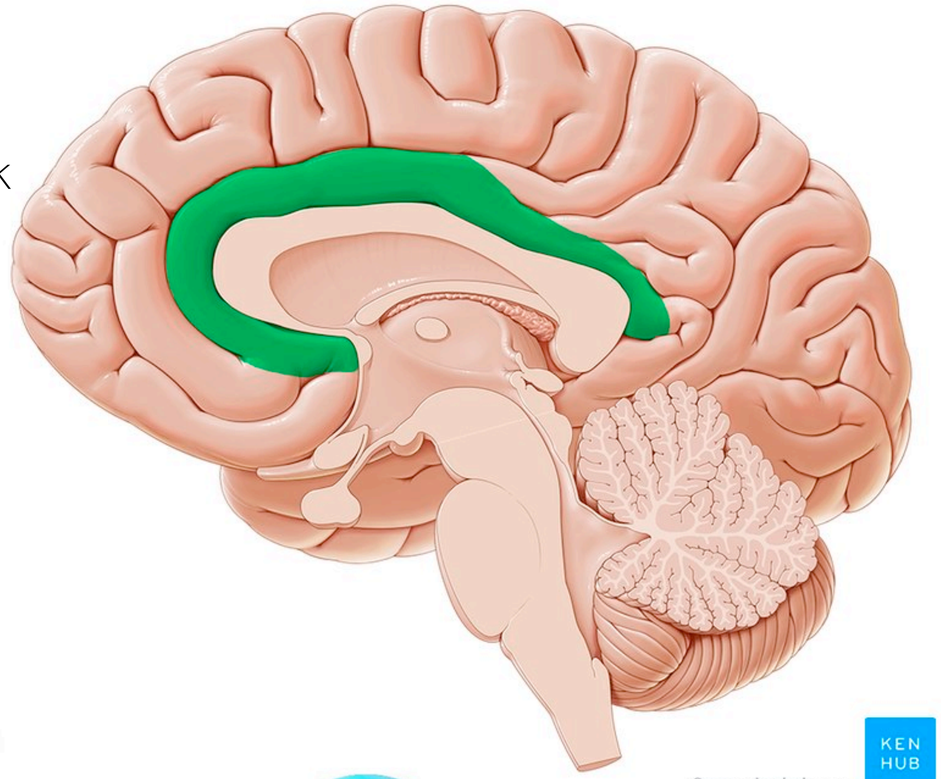
Application 3:

- Goal: patients affected with schizofrenia have been reported to be more risk averse than healthy subjects [1], investigate this phenomenon through connectivity maps
- Subjects: 121 healthy subjects + 29 patients affected by schizophrenia
- Task: Balloon Analog Risk Task (BART)
- Region of Interest: left Anterior Cingulate Gyrus[2]
- <u>Covariates</u>:
  - Demographic and health
  - Amount collected, decision taken (inflate/cash out)
  - Scale for the Assessment of Negative Symptoms (SANS) and Scale for the Assessment of Positive Symptoms (SAPS) [3]



[1] Reddy LF, Lee J, Davis MC, Altshuler L, Glahn DC, Miklowitz DJ, Green MF. Impulsivity and risk taking in bipolar disorder and schizophrenia. Neuropsychopharmacology. 2014 Jan;39(2):456-63. doi: 10.1038/npp.2013.218. Epub 2013 Aug 21. PMID: 23963117; PMCID: PMC3870783.
[2] Fukunaga, R., Brown, J. W., and Bogg, T. "Decision Making in the Balloon Analogue Risk Task (BART): Anterior Cingulate Cortex Signals Loss-Aversion but not the Infrequency of Risky Choices". In: Cogn Affect Behav Neurosci 12.3 (2012), pp. 479–490.
[3] Andreasen, N. (1989). The Scale for the Assessment of Negative Symptoms (SANS): Conceptual and Theoretical Foundations. *British Journal of Psychiatry, 155*(S7), 49-52. doi:10.1192/S0007125000291496

Task Switch + SCHZ: file included

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