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# *Social Skills and Psychopathology are associated with Autonomic Function in children: a full robust Bayesian approach for a small sample size, data rich study*

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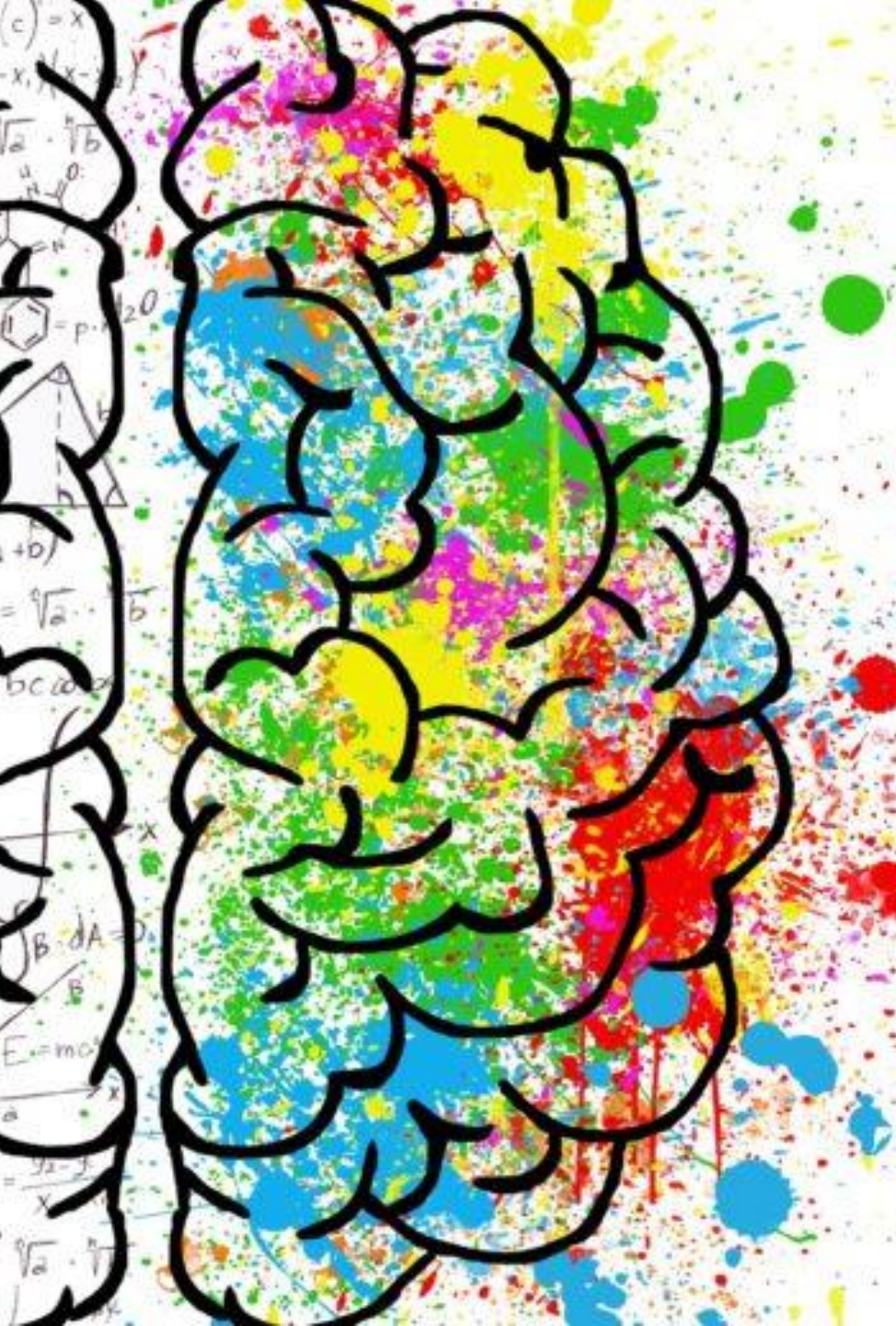
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# Introduction

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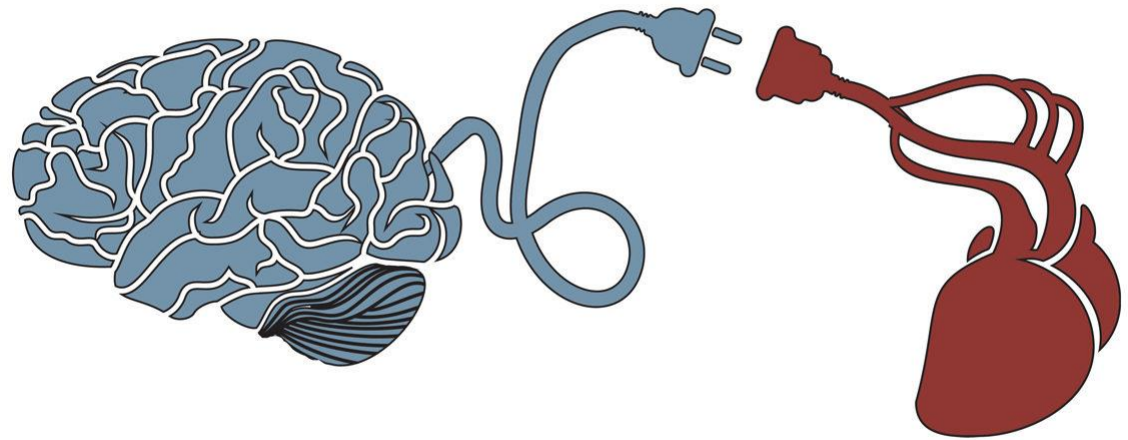
- In recent years, psychopathological disturbances have become a health emergency, leading to a great effort to understand the **underlying physiological mechanisms**
- In this scenario, the **autonomic nervous system (ANS)** plays a critical role
- We investigated the association between ANS, social skills, and psychopathological functioning in children. As an ANS status proxy, we measured **heart rate variability (HRV)**.

**PSYCHOLOGY <--> BIOLOGY**

# Aim

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- Can heart rate variability be an instrument to assess psychological weaknesses?





# The problem

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- Small sample size (n=50) children (mean age 7.4+1.4 years) with and without risk factors for developing neuropsychiatric disorders due to pre-/perinatal insults without major sequelae
- Wide number of intercorrelated variables coming from the psychological and ANS evaluation:
  - HRV measurements (4 bands: VLF, LF, HF, and %HF)
  - Social Skills Task (NEPSY-II)
  - Psychopathology (K-SADS-PL, CBCL)
  - Cognitive, Neuropsychological, and Psychosocial Assessment (WISC-IV, PSI-SF, SES, ...)

# Methods - Full Bayesian approach



- **Power.**

We simulated 1000 distributions deriving from the comparison of a continuous variable (%HF of HRV) in impaired/not-impaired children. We then counted how many simulations did not contain zero in their 95%CI. Acceptable “score” was >80% of simulations with non-zero interval, corresponding to an 80% “power”, if calculated in a classical way.

- **Initial Group Comparisons.**

Group comparison (similar to ANOVA in a classical framework) was conducted using a Bayesian linear regression model with Student’s t-distribution to render it robust to outliers

- **Exploratory Correlations.**

We evaluated simple, direct correlations between social skills tasks, cognitive, neuropsychological, psychosocial assessment with HRV bands (VLF, LF, HF, and %HF) and among each evaluated score. We used LKJ =4 prior distribution on the correlation’s parameters. Such a prior distribution, highly concentrated around zero, minimizes the risk of observing non-zero correlations that may arise only by random chance, as often occurs with small sample sizes.

# Methods - Full Bayesian approach

$$P(A|B) = \frac{P(B|A) \cdot P(A)}{P(B)}$$

- **Multiple Linear Regression.**

We used multivariable regression to assess the ability of HRV bands to predict affect recognition and theory of mind total scores controlling for age, Cognitive Index, and risk group (premature, HIE, and healthy children). We used a Student's t-distribution with a gamma prior distribution ( $k = 4$ ,  $\Theta = 1$ ) on the degrees of freedom parameter. This prior gives a higher probability of degrees of freedom values between 2 and 5, which corresponds to a Student's t-distribution with heavier tails than a normal distribution, thus more robust to outliers.

- **Comparison of Impaired/Not-impaired Children.**

For consistent analysis, we performed group comparison between impaired/not-impaired patients (like the classical "t-test") using a robust linear model with Student's t-distribution and flat priors. Bayesian estimation for the two groups comprises distributions of CI for the effect size, group means and their difference, standard deviations and their difference, and the normality of the data.


# Results

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Social task scores were associated with HRV components, with high frequency (HF) the most consistent.



HRV bands were also correlated with the psychopathological questionnaire.



All HRV components were **reduced** in children with **impairments in social skills**, but only normalized HF was able to distinguish impaired children in the affect recognition task

# Conclusion

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HRV parameters may reflect a **neurobiological vulnerability** to psychopathology.



A full Bayesian analysis can be easily implemented in this kind of studies to obtain robust and **easily interpretable results**, even with a small sample size, typical of pediatric clinical settings.