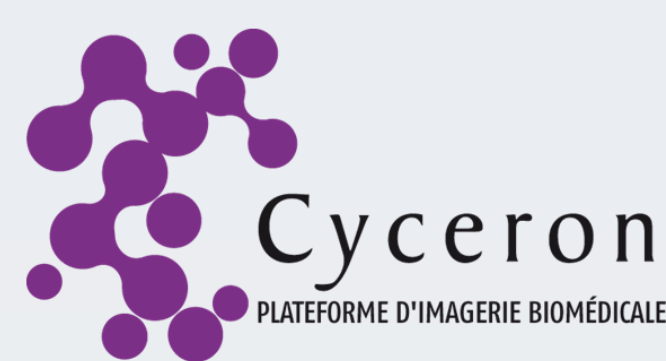


Control and correction of physiological variables in rs-fMRI across Human and anesthetized rodents



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Background

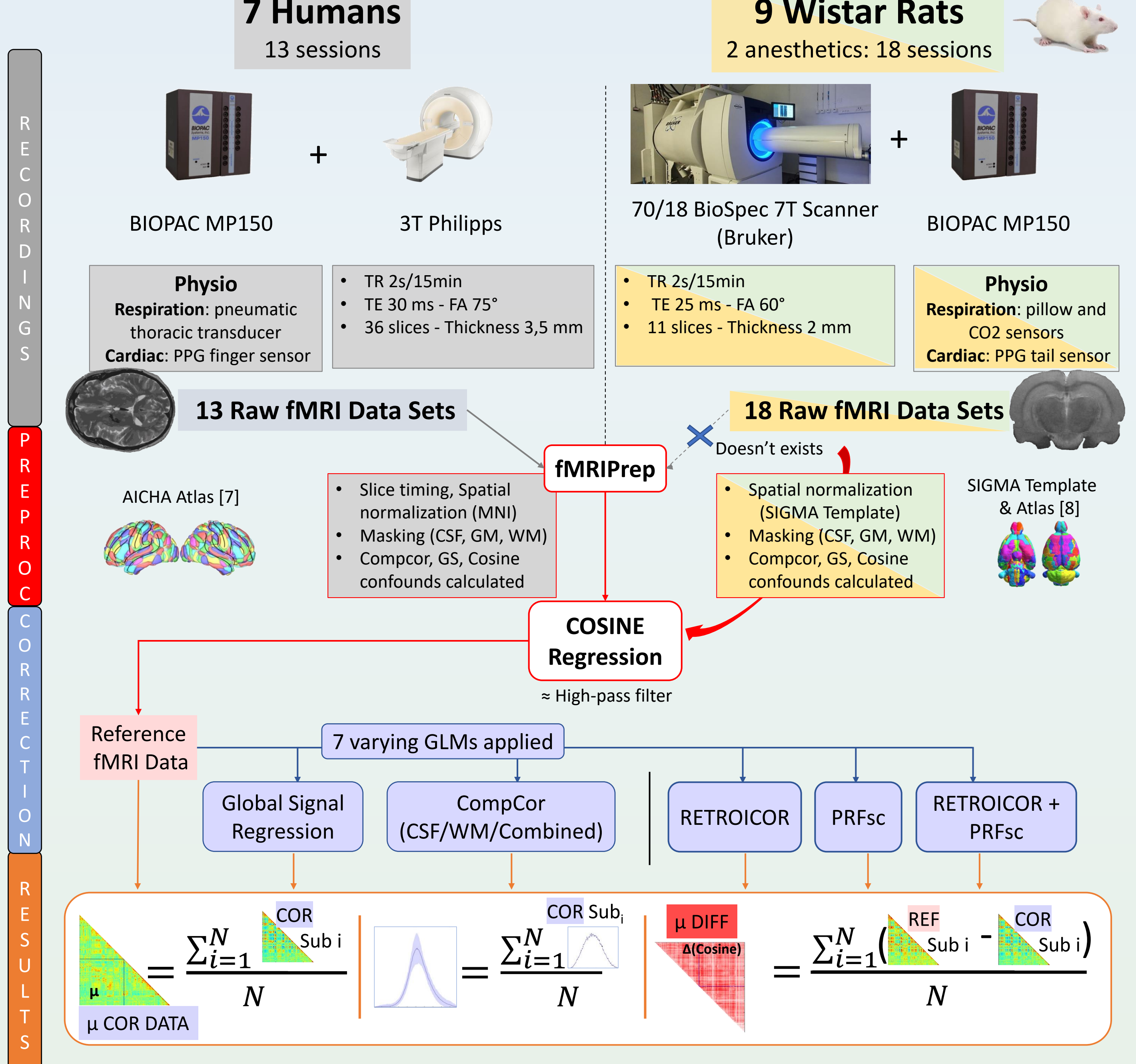
Resting-state functional Magnetic Resonance Imaging (rs-fMRI) is a common translational method to evaluate brain Functional Connectivity (FC) across human and animal. Recorded fMRI signal contains a neuronal component of interest based on **BOLD effect** but also **confounding factors** derived from movement, scanner noise and physiological non-BOLD effect among other things.

In particular, **physiological noise**, linked to **cardiorespiratory** processes, is described modifying FC [1]. Precedent work aims to characterize impact of cardiac and respiratory cycles on fMRI in spatial and temporal domain. [2]

Multiple strategies have been developed to "clean" rs-fMRI signal [3] : **Global Signal Regression (GSR)**, **CompCor** [4], **Retroicor** [5], **Physiological Response Function** [6] and others. GSR & CompCor – called "**data-driven**" approaches – only use fMRI data to estimate noise while the last two need physio recordings during MRI acquisition. Frequently used in human rs-fMRI studies, these techniques weren't developed for preclinical ones whose **anaesthetized** subjects has **specific cardiac & respiratory rates**. Thus correction effects needs to be explored.

This study **compares** these 4 correction methods: GSR, CompCor, RETROICOR and PRF by evaluating their impact on FC across human and rodents brain. **To produce 2 different physiological state**, rats has undergone 2 randomized sessions with 2 different anesthetics: subcutaneous **Medetomidine (MED)** and inhaled **Isoflurane (ISO)**.

Methods



Results

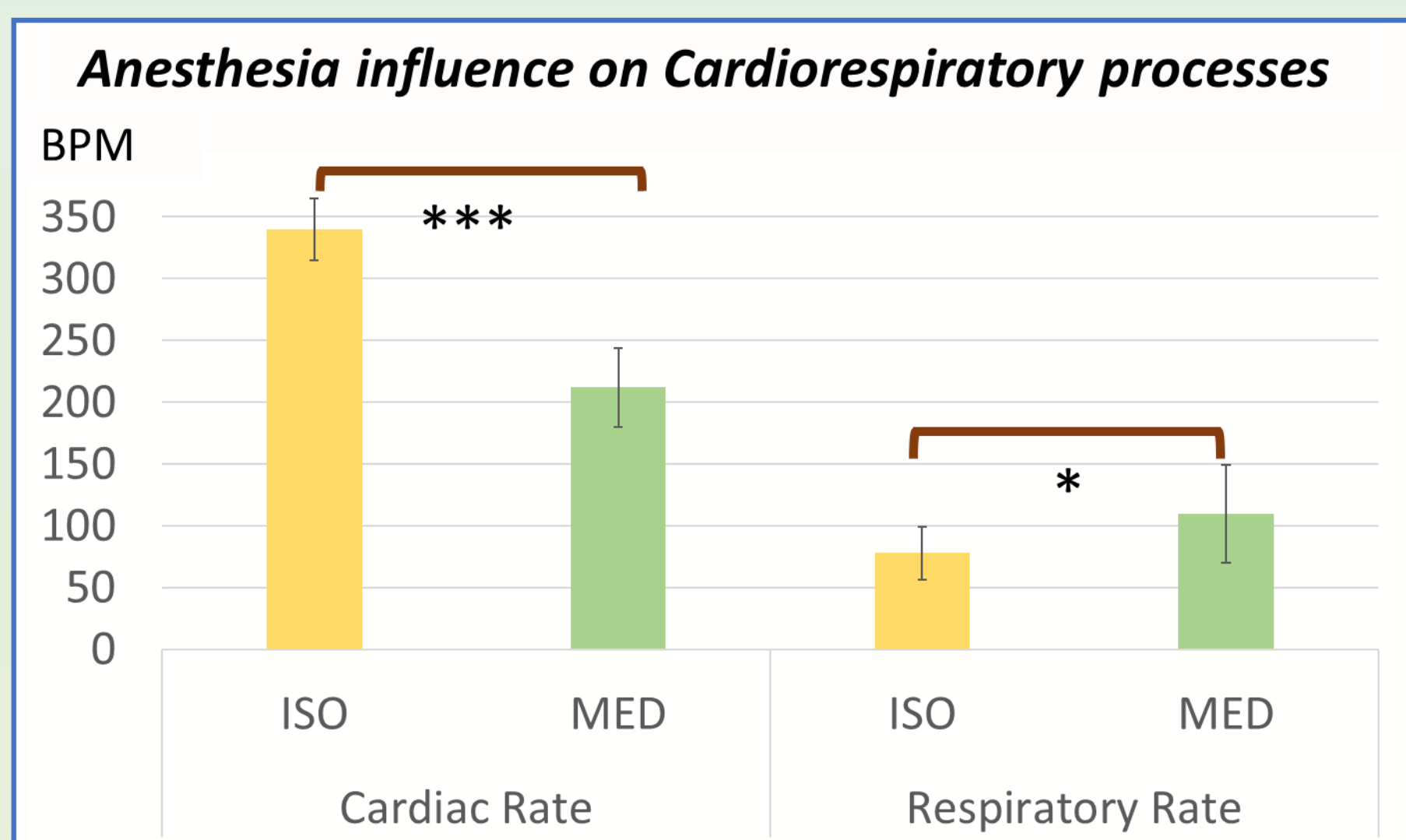


Figure 1: Impact of Isoflurane & Medetomidine on cardiac and respiratory rates; Mean cardiac rate is significantly lower under subcutaneous medetomidine (p-value <0,01); On the contrary, respiration frequency is globally higher under Inhaled Isoflurane (p-value <0,05);

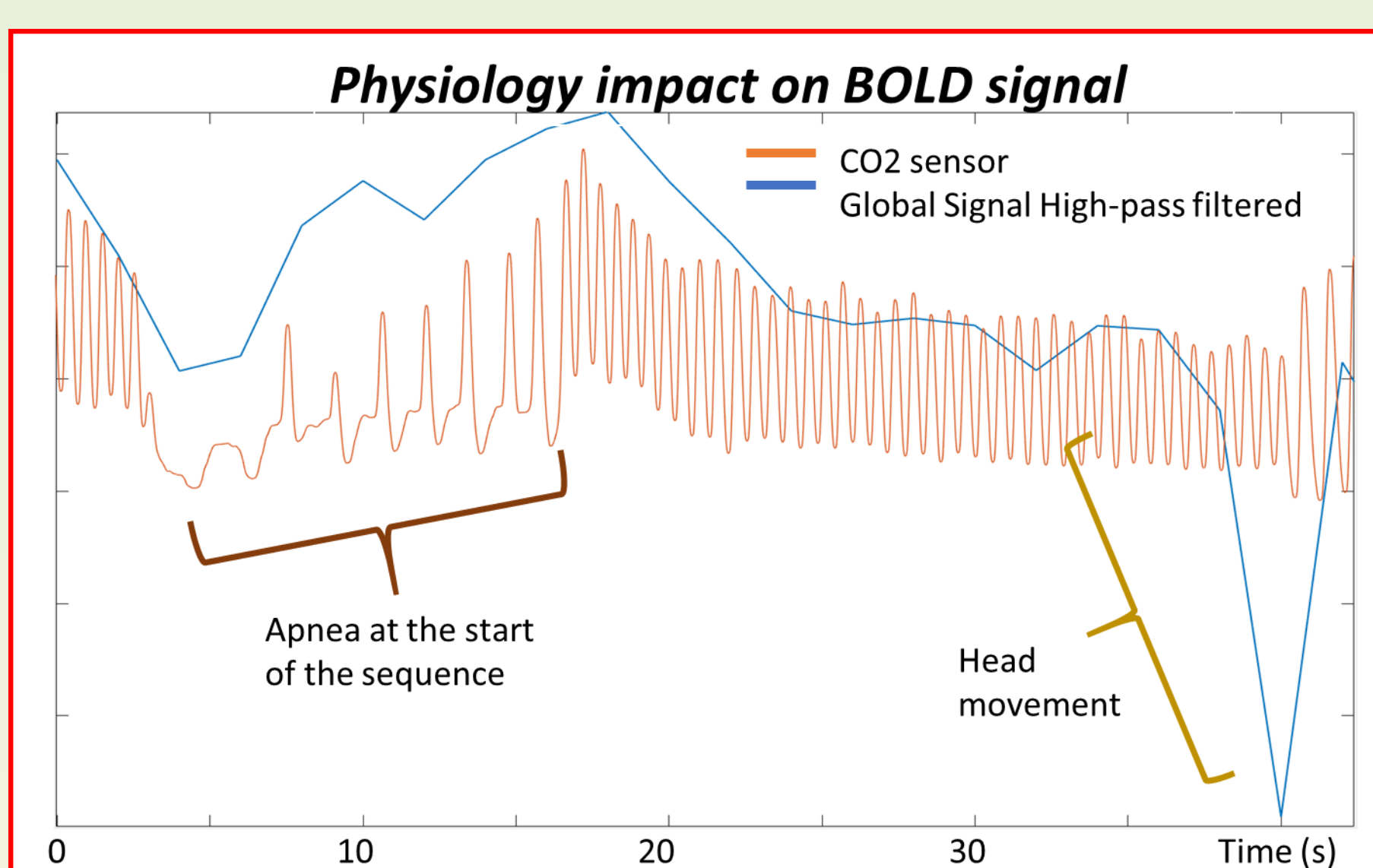
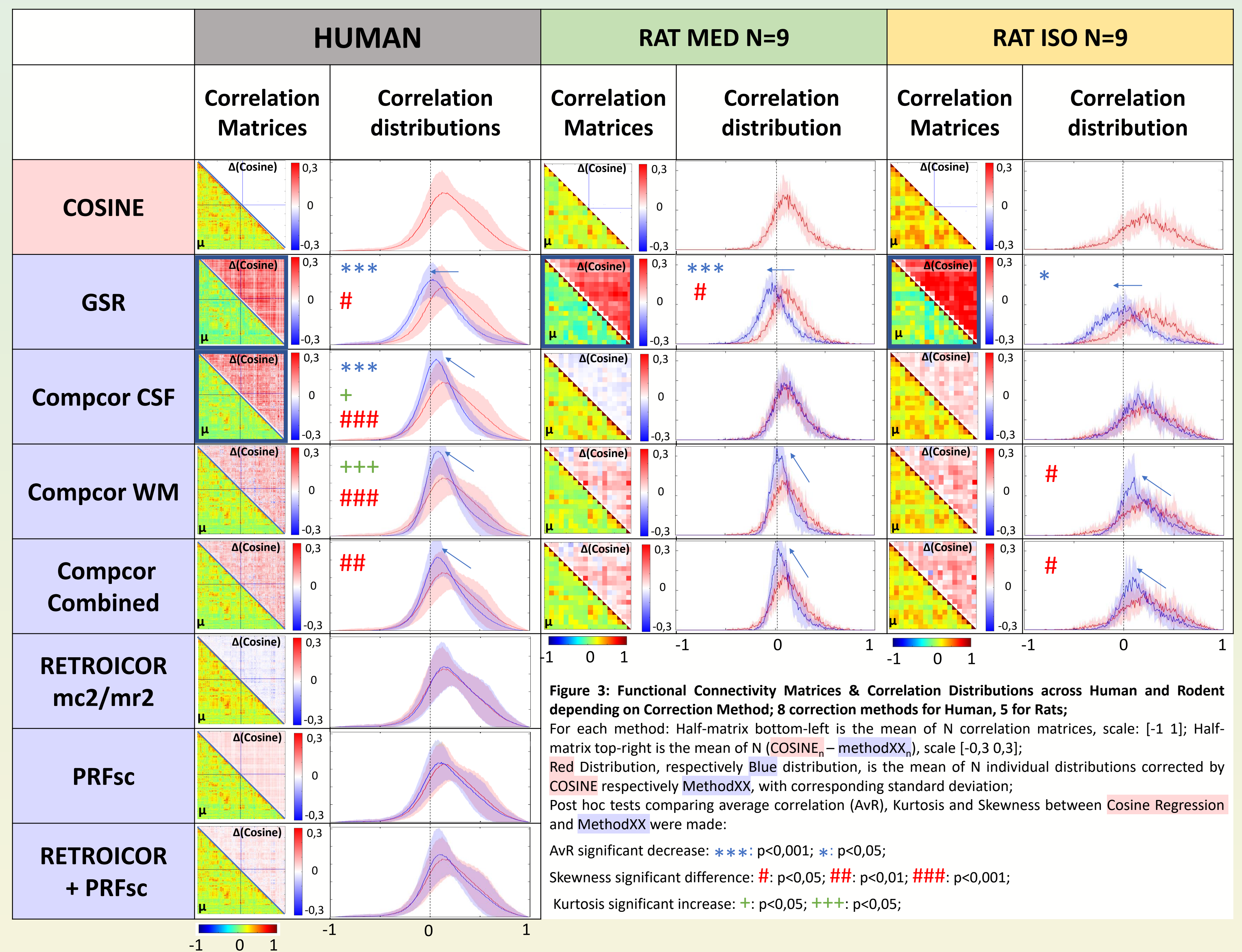


Figure 2: Impact of end-tidal CO2 level on BOLD signal; These signals are registered at the start of MRI sequence. Respiratory cycles are irregular and varying CO2 level seems affect BOLD signal; On the right, artefact of head movement impact BOLD signal before any correction;



Discussion

Functional Connectivity is affected by the choice of correction strategy. Methods significantly impact shape and mass-center of correlation distribution. Data-driven methods (CompCor & GSR) would change FC more than physio dependent methods (RETROICOR & PRF). Corrections methods seem to compensate the different physiological states of the animals between the two anesthetics. Furthermore, corrections between Human and rodents are consistent in the sense that they have the same effect on the FC distribution over the brain. It reinforces validity of these analysis and we can assume that Human fMRI correction strategies can be applied to preclinical studies.

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