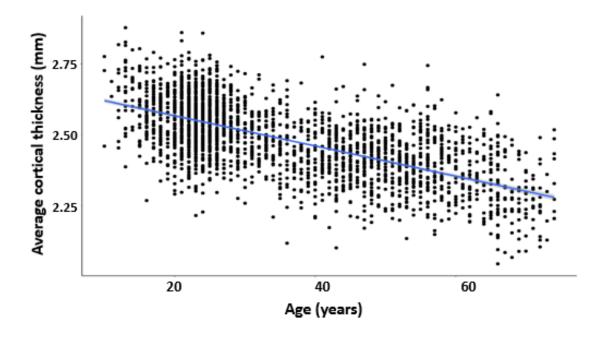
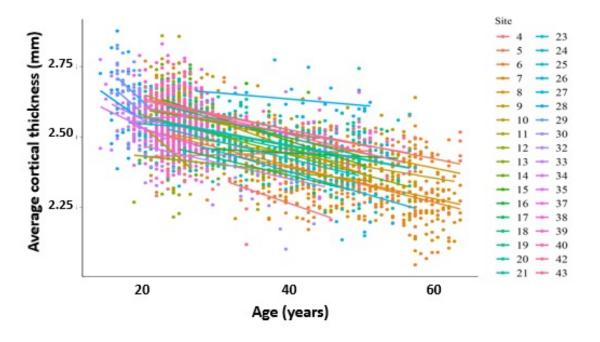
# SITE EFFECT CORRECTION USING NORMATIVE MODELLING

Normative modelling educational course OHBM 2024, Seoul



# THE SITE EFFECT PROBLEM





### **ORIGINS OF SITE EFFECTS**

## 'Sites' may differ in

### Scanner platform

- Contrast-to-noise ratio
- Coil inhomogeneity

### Sequence

- Sensitivity to tissue difference
- Sensitivity to motion

# Acquisition

### Procedure

- Task Details
- Instructions
- Circadianity
- Motion | Immobilisation

## Image Postprocessing

Despite pipeline harmonization

### Neurobiological (co-)factors

Severity of a condition of interest (e.g., a psychiatric disease)

Ag

Sex | Gender

Age-by-disease interaction

Neurological and medical comorbidity

Past psychiatric disease

Life events

Past and current medication

Background population

(e.g., ethnicity, genetic background)

Definition of healthy controls

Definition of clinical inclusion criteria

Other diagnostic instruments

Study protocol differences

Bayer et al. 2022



### METHODS TO CORRECT FOR SITE EFFETCS



### **OPEN ACCESS**

EDITED BY

Maxime Descoteaux, Université de Sherbrooke, Canada

### REVIEWED BY

Paul Gerson Unschuld, Université de Genève, Switzerland Muhamed Barakovic, University of Basel, Switzerland

\*CORRESPONDENCE
Johanna M. M. Bayer
bayeri@student.unimelb.edu.au

†These authors share last auti

SPECIALTY SECTION

This article was submitted to

Site effects how-to and when: An overview of retrospective techniques to accommodate site effects in multi-site neuroimaging analyses

Johanna M. M. Bayer<sup>1,2\*</sup>, Paul M. Thompson<sup>3</sup>,

### Review

Image harmonization: A review of statistical and deep learning methods for removing batch effects and evaluation metrics for effective harmonization



Fengling Hu<sup>a,\*</sup>, Andrew A. Chen<sup>a</sup>, Hannah Horng<sup>a</sup>, Vishnu Bashyam<sup>b</sup>, Christos Davatzikos<sup>b</sup>, Aaron Alexander-Bloch<sup>c,d,e</sup>, Mingyao Li<sup>f</sup>, Haochang Shou<sup>a,b</sup>, Theodore D. Satterthwaite<sup>c,d,g</sup>, Meichen Yu<sup>h,#</sup>, Russell T. Shinohara<sup>a,b,#</sup>



a Penn Statistics in Imaging and Visualization Endeavor (PennSIVE), Department of Biostatistics, Epidemiology, and Informatics, Perelman School of Medicine, University

### NOMRATIVE MODELLING FOR SITE EFFECT CORRECTION

# Accommodating site variation in neuroimaging data using normative and hierarchical Bayesian models

Johanna M M Bayer Thomas Wolfers 4,

Affiliations + expan

PMID: 36272672 F







Estimating cortical thickness trajectories in children across different scanners using transfer learning from normative models

C. Gaiser, P. Berthet, S. M. Kia, M. A. Frens, C. F. Beckmann, R. L. Muetzel, Andre F. Marguand

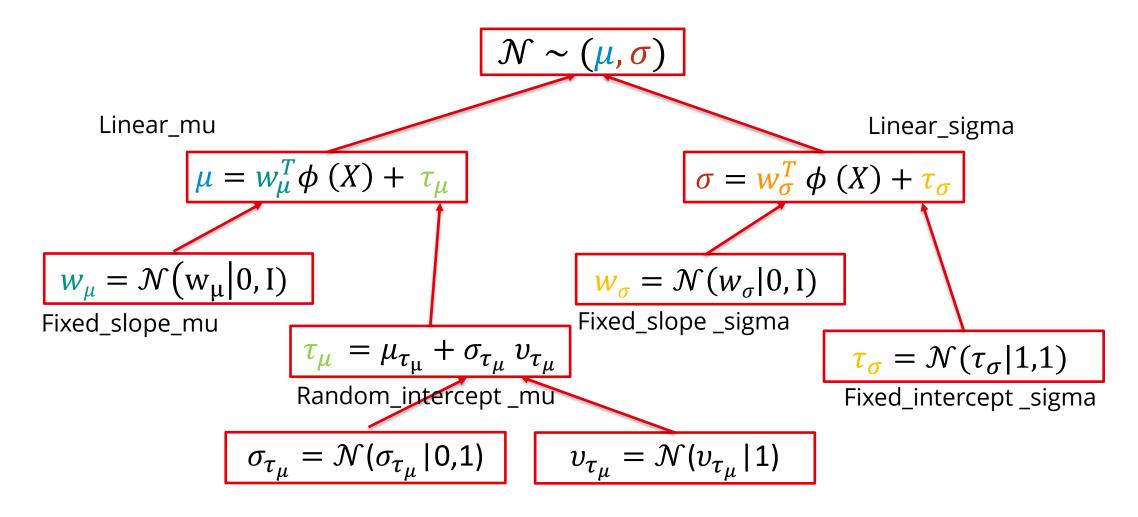
First published: 05 February 2024 | https://doi.org/10.1002/hbm.26565



### **USE CASES FOR NORMATIVE MODELLING FOR SITE EFFECT CORRECTION**

- 1. Making predictions for a site that is already in the training set.
- 2. "Translating" values between sites.
- 3. Adjusting the site effect difference to data (sites) that are not in the training set.
  - Posterior of fitted data set will be used as priors for fitting new (unseen) sites.

### **HIERARCHICAL BAYESIAN MODEL**



Spoiler: linear\_delta and linear\_epsilon for skewness and kurtosis also possible

