

TAKEAWAYS

- The Adolescent Brain and Cognitive Development (ABCD) Study has publicly shared a large (~12,000 subjects), high-quality dataset collected on 21 different MRI scanners.
- Scans show variance across scanners that is similar in magnitude to age/sex effects.
- Empirical Bayes methods (ComBat) do a pretty good job of eliminating scanner variance, though it is not complete.



Detecting and harmonizing scanner and site differences in the ABCD study



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INTRODUCTION

- Our original question: Is it better to collect scans at one site or at lots of sites?
- As a way to start to answer that question, we pivoted to a more easily addressable question: Does the data from a study collected at many sites still contain information about scan collection site?
- ABCD is a great dataset:
 - Lots of subjects (11,875) and sites (21)
 - Resting state, task-based contrasts, task-based conditions
- Analysis of Release 1.0 on Bioarchive: www.biorxiv.org/content/10.1101/309260v1
- Preregistered analysis of Release 2.0

METHODS

- Site classification
 - Scikit-Learn multinomial logistic regression, L2 penalty, regularization strength of 1, SAGA solver, 10k max iterations, 3-fold cross-validation
 - Significance assessed via permutation
- Percent Variance explained
 - Subtract R2 for nested models predicting each metric
 - Significance assessed via permutations
- ComBat Correction
 - Scale and location correction for each metric at each scanner with empirical Bayes to improve estimates
 - Significance of uncorrected vs ComBat assessed with bootstraps

DATA

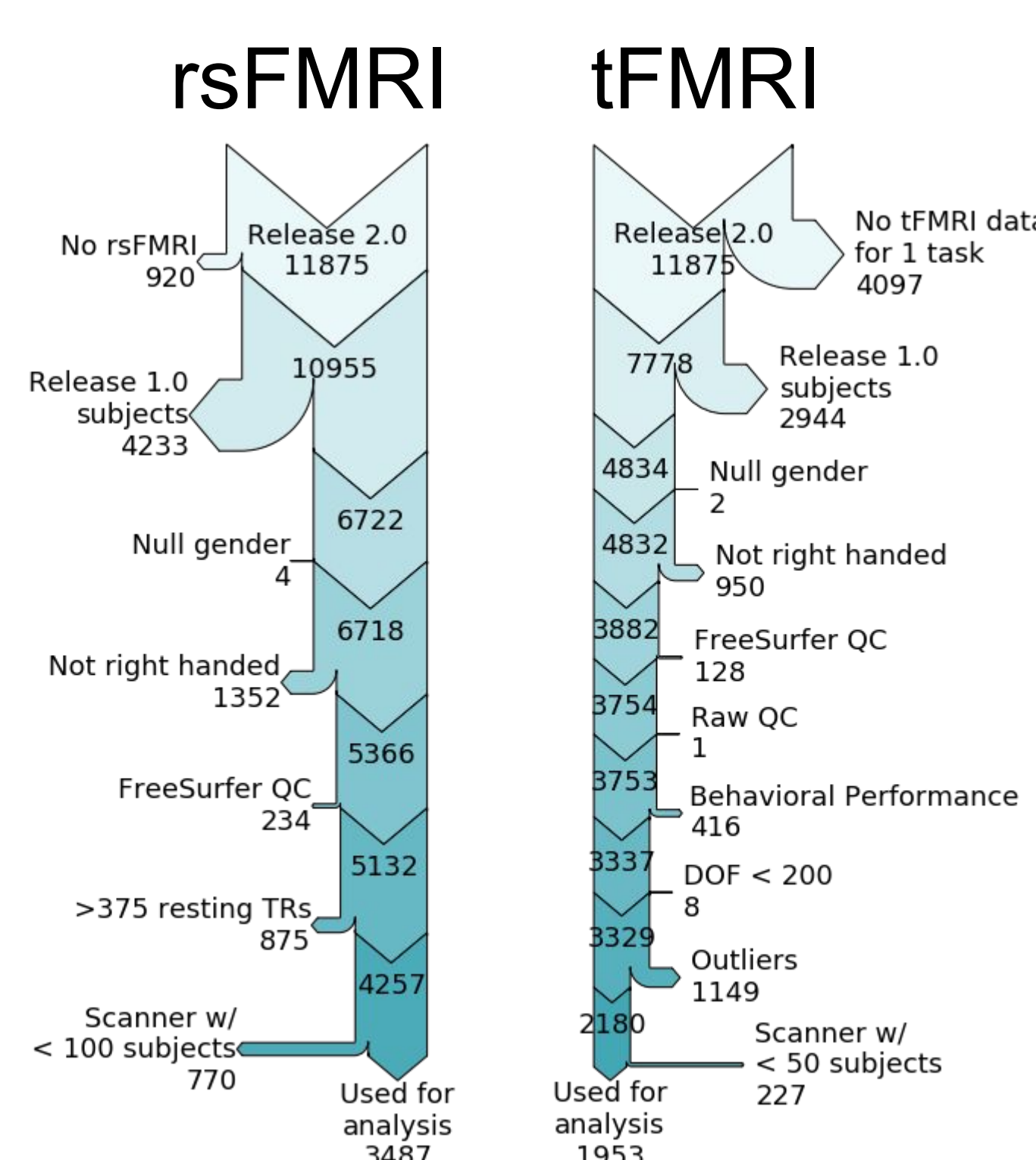


Figure 1: Exclusion Criteria

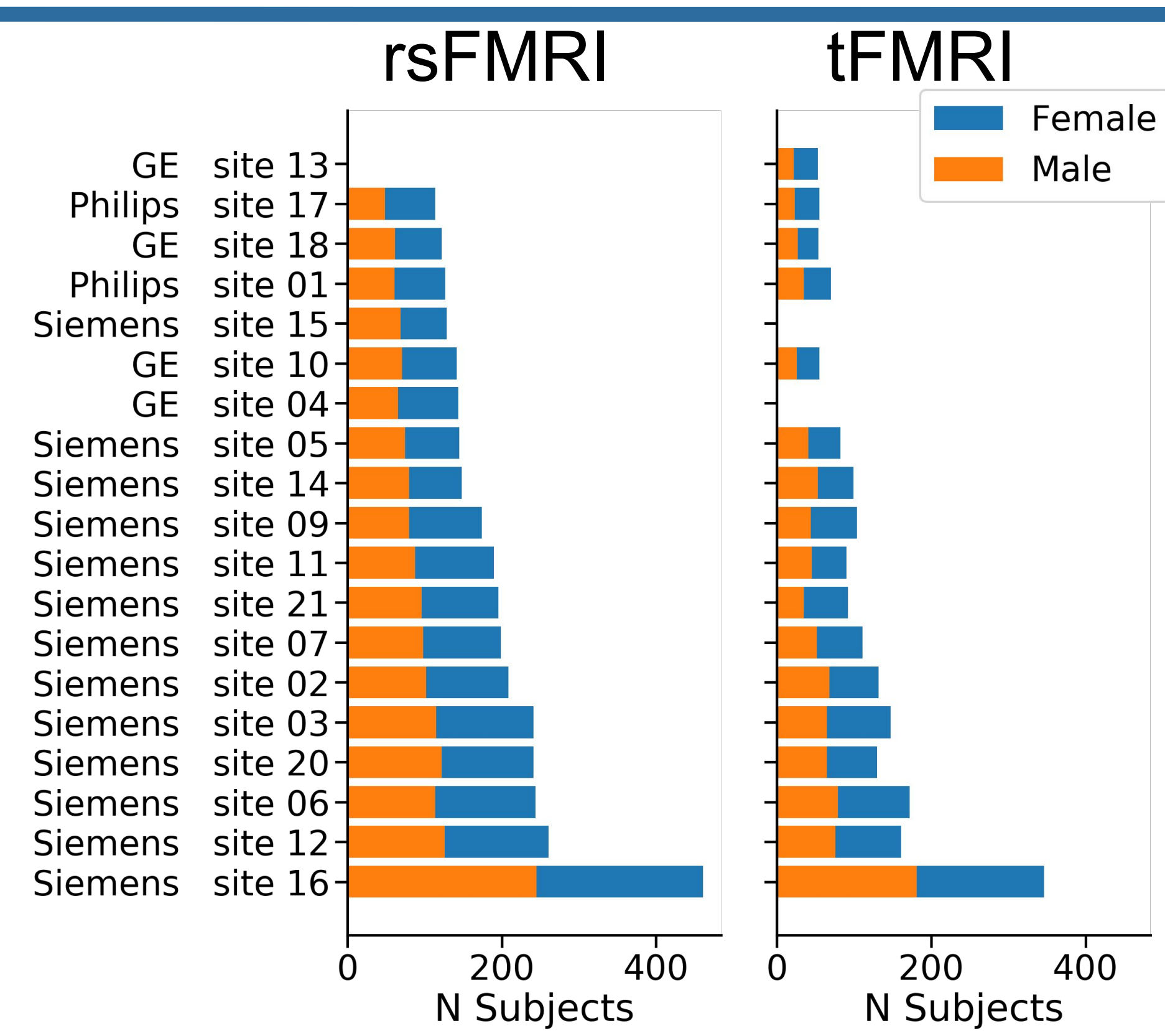


Figure 2: Scanner Manufacturer, Site, and Sex

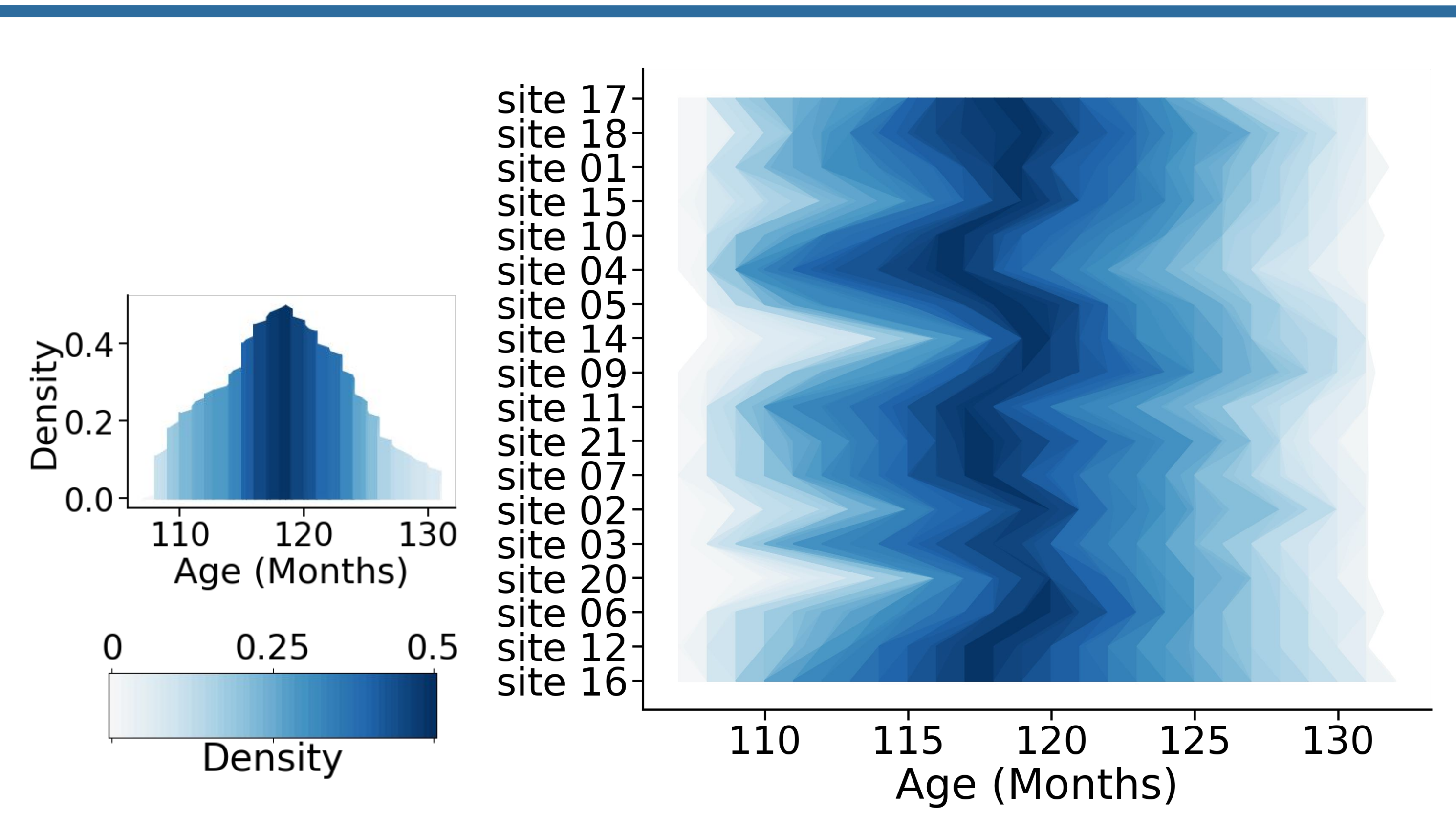


Figure 3: Age distributions for rsfMRI

RESULTS

SCANNER CLASSIFICATION

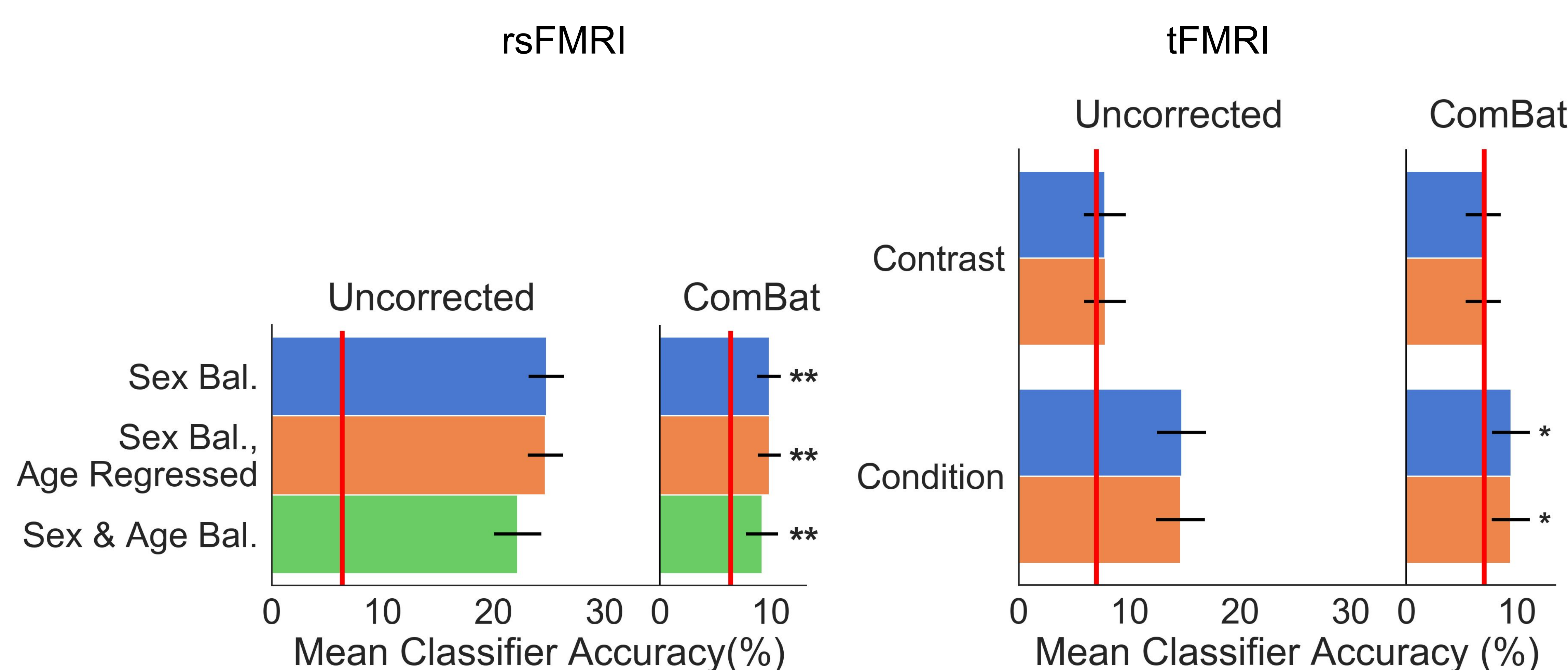


Figure 4: Classifier accuracy for predicting collection scanner

Bars show mean classifier performance across 3 fold cross-validation. Color indicates method used to control for Age and Sex. Red line indicates the multiple comparison corrected $p < 0.005$ threshold from 1,000 permutations. Aggregation of conditions and contrasts across tasks is an exploratory analysis. Asterisks indicate significant reduction in classifier accuracy after ComBat assessed by 10,000 bootstraps: ** $p < 0.005$ * $p < 0.05$.

PERCENT VARIANCE EXPLAINED

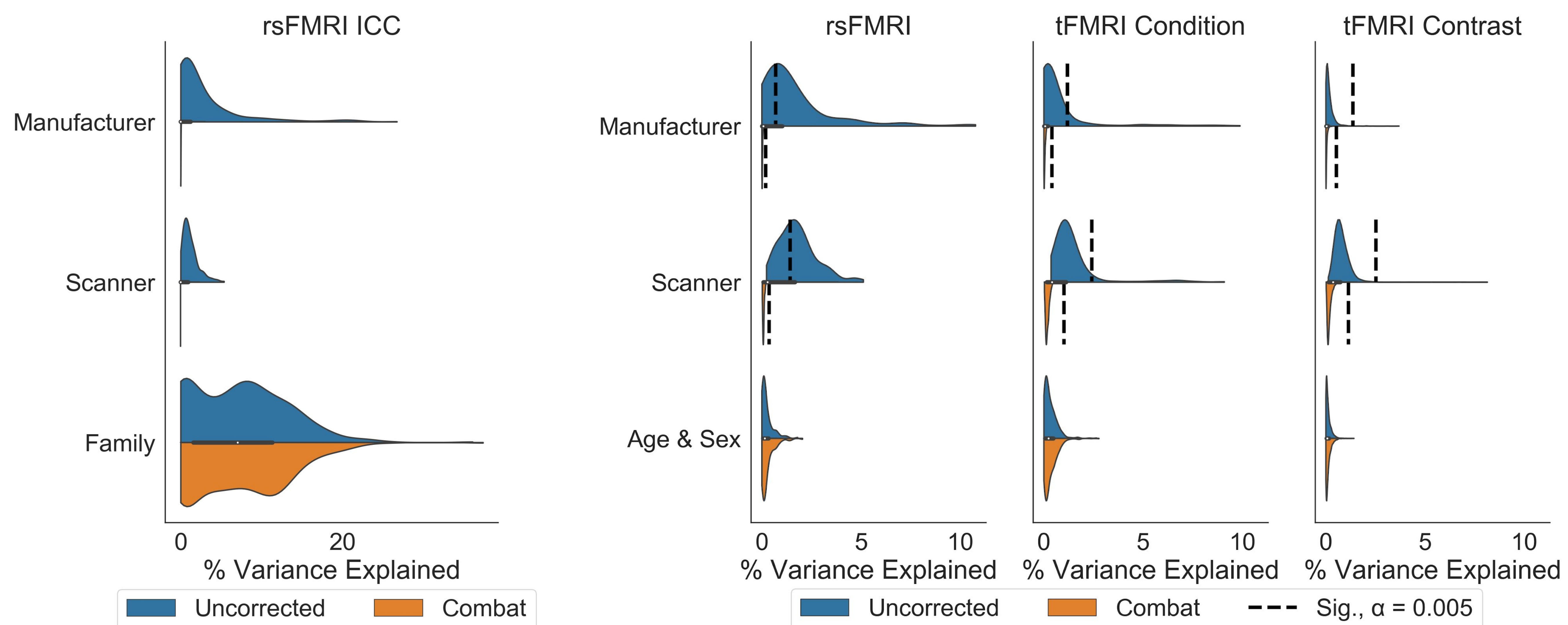


Figure 5: Percent variance explained
Exploratory analysis of percent variance explained by the participants' family. Percent variance explained was determined by intraclass correlation.

Figure 6: Percent variance explained
Distributions of the percent variance explained by site, scanner, and age & sex combined are shown with and without combat correction. Dashed lines indicate threshold for significant percent variance explained at $p = 0.005$ determined from 1,000 permutations. Percent variance explained calculated as difference in R^2 in nested models.

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