

# Frontal EEG alpha asymmetry: Reference and site matter for convergent validity.

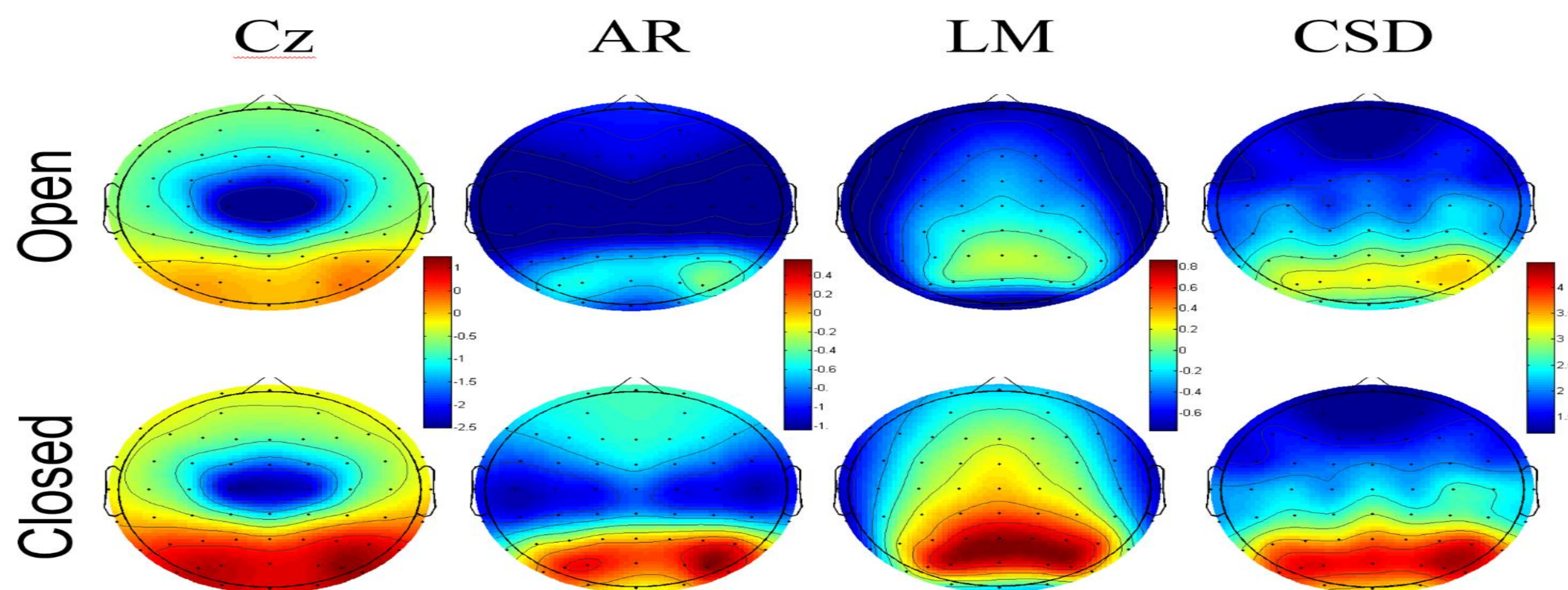
## Substantial method variance exists.

### Concordance of Frontal EEG Alpha Asymmetry Between Reference Montages

Jasmine S. Benjamin, John J.B. Allen

Department of Psychology, University of Arizona, Tucson, AZ, USA

#### Topography of Frontal Alpha Power: Reference Montage Effects



Natural-log transformed alpha power values at each site. The current source density transformation restricts occipital alpha to occipital leads while other montages show contamination of non-frontal alpha to frontal leads. (from Smith, Reznik, Stewart, and Allen, 2017).

#### Correlations Between Total Alpha (8-13 Hz) Asymmetry Scores by Reference Montage

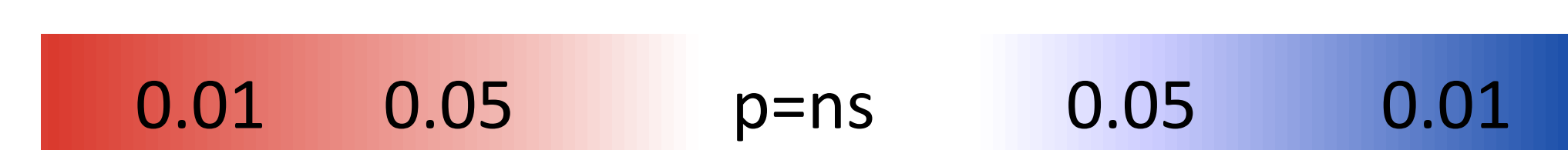
F2F1			
	LM	AVG	CZ
AVG	0.86		
CZ	-0.01	0.37	
CSD	0.38	0.29	-0.09

F4F3			
	LM	AVG	CZ
AVG	0.77		0.19 0.18 0.26
CZ	-0.26	0.26	
CSD	0.07	-0.01	0.06

F6F5			
	LM	AVG	CZ
AVG	0.68		
CZ	-0.28	0.37	
CSD	0.11	0.02	0.06

F8F7			
	LM	AVG	CZ
AVG	0.55		
CZ	-0.22	0.57	
CSD	0.04	0.19	0.31

Average Correlation ↑			
	LM	AVG	CZ
AVG	0.74		
CZ	-0.19	0.4	
CSD	0.15	0.12	0.09



↑ For average correlations, Pearson correlation coefficient  $r$  values were transformed using a Fisher  $z$  transformation. The  $z$ -values were averaged, and then converted back to an  $r$  value using the inverse Fisher transformation.

### INTRO

Frontal EEG asymmetry has been measured at a variety of sites using a variety of reference montages.

We examined the degree of concordance across four homologous electrode pairs: F2F1, F4F3, F6F5, and F8F7 using four reference montages, average of all EEG leads (AVG), current source density (CSD), Cz, and averaged ("linked") mastoids (LM).

### METHODS

This study's sample is reported in full in Stewart et al. (2010).

N= 306 right-handed individuals, aged 17-34  
143 with a lifetime history of major depressive disorder

### RESULTS

Correlations ranged from -0.28 to +0.86.

The AVG and LM references showed the greatest correspondence with one another (a replication of the previous findings, Reid et al 1998).

F2F1 was revealed to have the highest convergent validity across reference montages (average  $r=0.36$ ), followed by F8F7 (average  $r=0.26$ ). F4F3 and F6F5 trail with average  $r$ 's of 0.19 and 0.18, respectively.

### RESULTS CONT.

The AVG reference showed the greatest levels of correlation with other references, regardless of alpha band or channel pair.

CZ was an outlier, as might be expected, frequently demonstrating significant negative correlation with other reference montages, particularly LM.

Current source density transformed data showed intermediate levels of overlap with other references.

### DISCUSSION

These results suggest the presence of a high rate of unaddressed method variance in the frontal alpha asymmetry literature.

Effects on meta-analyses must be considered carefully, as results obtained utilizing different reference montages may be not be comparable. This was insufficiently accounted for in a recent meta-analysis (van der Vinne et al., 2017)

When inferences about source generators are made, use of the CSD transformation is highly recommended, (see Smith et al 2017). Further, F2F1 seems the most impervious to reference montage effects.

### REFERENCES

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- Smith, E.E., Reznik, S.J., Stewart, J.L., & Allen, J.J.B. (2017). Assessing and conceptualizing frontal EEG asymmetry: An updated primer on recording, processing, analyzing, and interpreting frontal alpha asymmetry. *International Journal of Psychophysiology*, 111, 98-114.
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- van der Vinne, N., Vollebregt, M.A., van Putten, M.J.A.M., & Arns, M. (2017). Frontal alpha asymmetry as a diagnostic marker in depression: Fact or fiction? A meta-analysis. *Neuroimage: Clinical*, 16, 79-87.

