



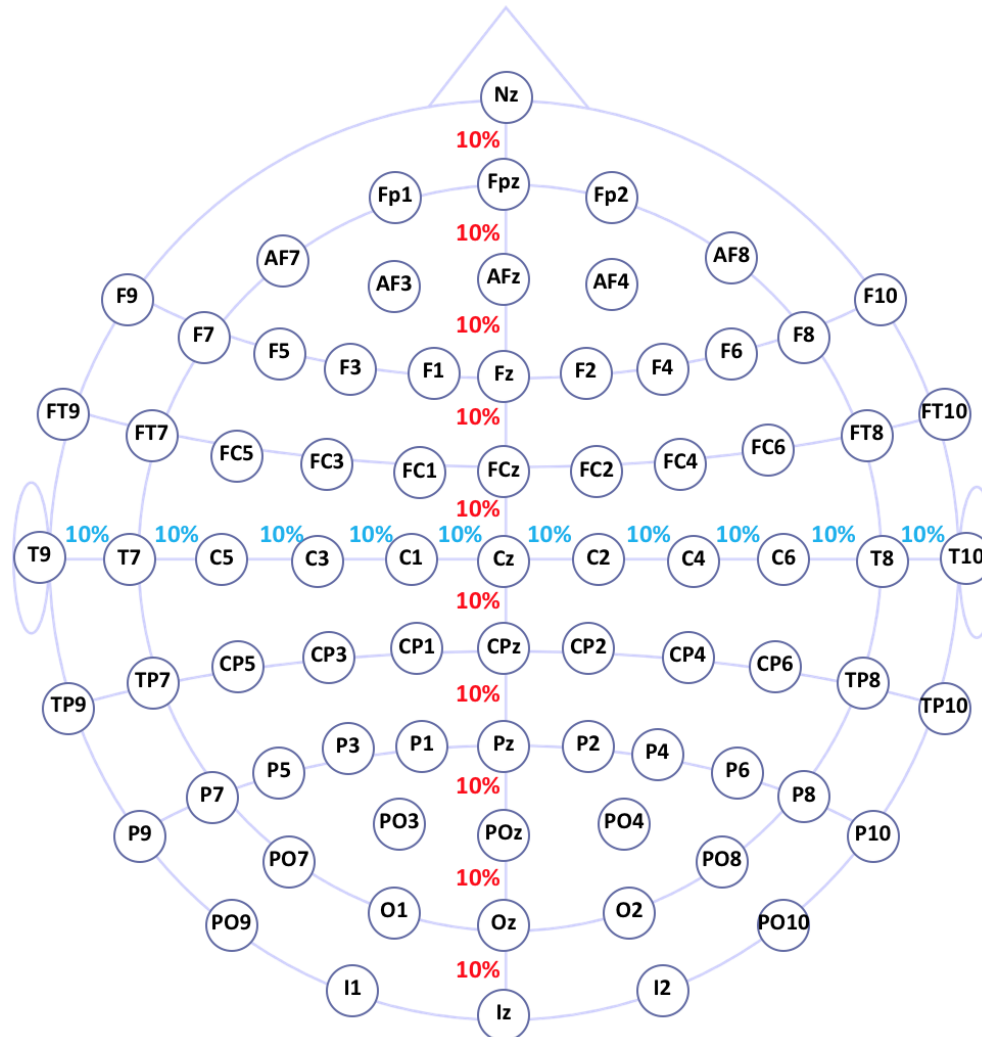
Discrepancy between real-world and standard EEG locations in NIRS

Gaëlle Leroux, N. Tzourio-Mazoyer, H. Keraudran,
E. Mellet, L. Zago, M. Joliot and B. Mazoyer

Joint Italian-French Workshop on "Cerebral oximetry and functional near infrared spectroscopy (fNIRS)"
14-15 June 2018, Milan, Italy

Oral session 1 – Data analysis

The standard 10/10 EEG positions

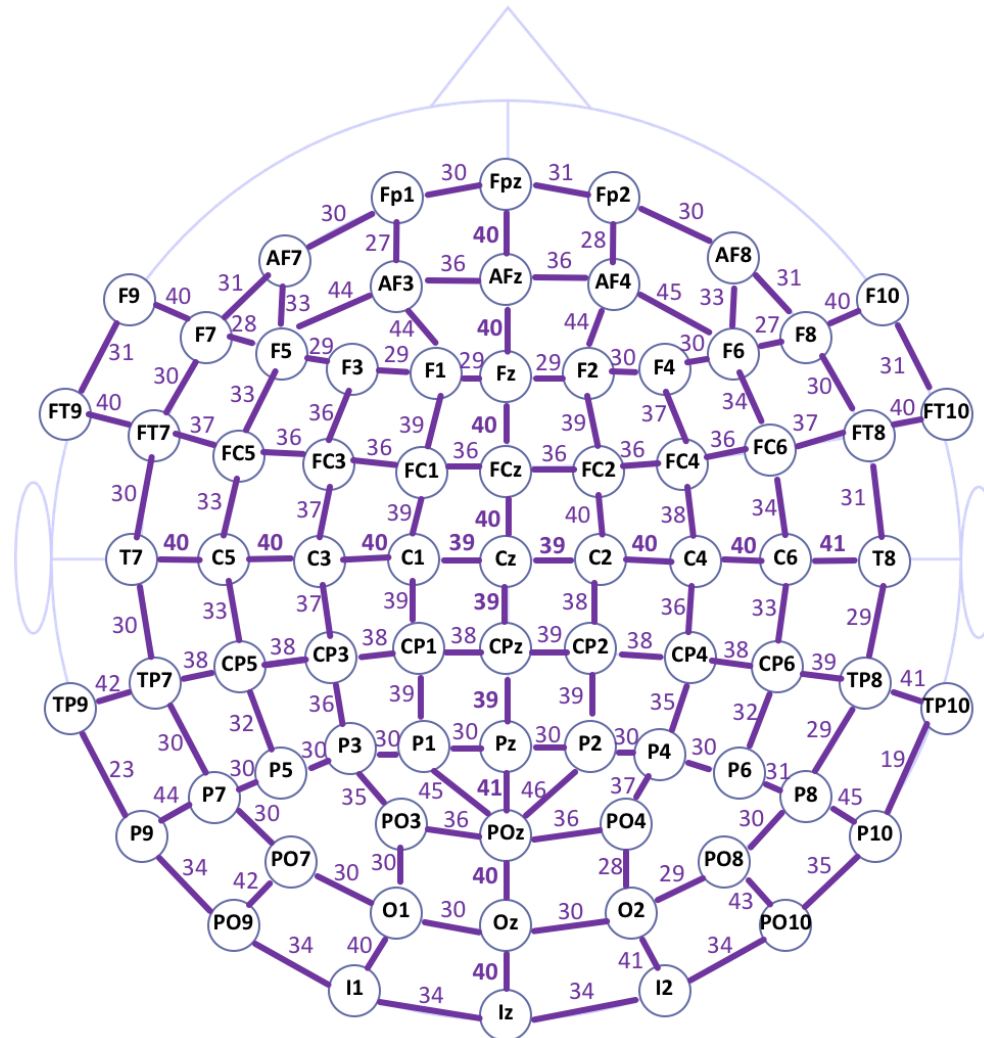


Jasper (1958) *Clin. Neurophysiol.* 10, 367.

Sharbrough et al. (1991) *J. Clin. Neurophysiol.* 8, 200-202.

Rationale

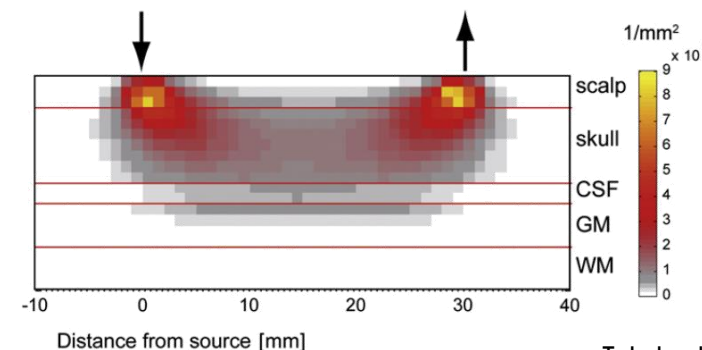
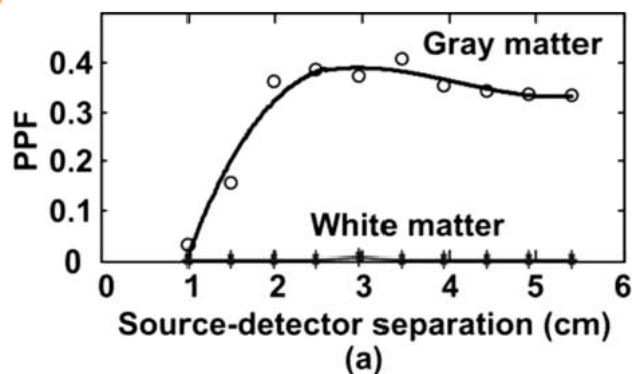
Conversion in mm of the standard 10/10 EEG positions



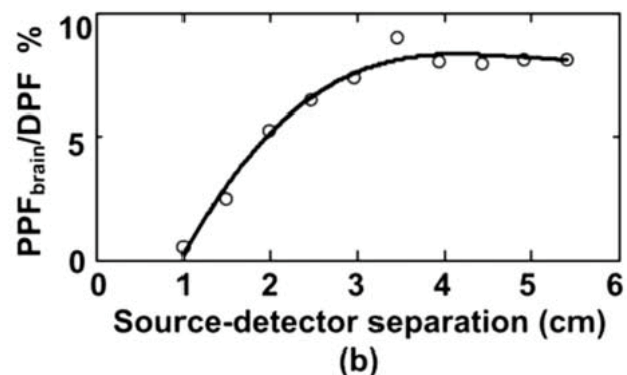
Distances in mm on the
Colin27 brain

Zimeo Morais et al. (2018) *Scientific Report*, 8, 3341.

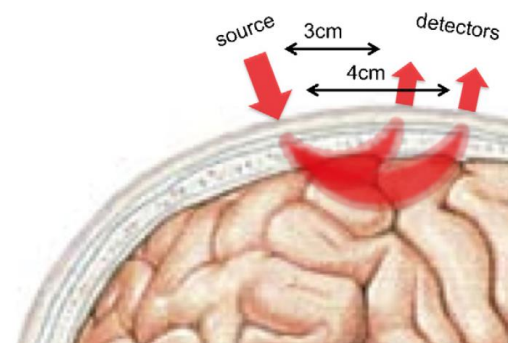
« It has been shown that, for the adult population, a source-detector distance of 30 mm is a good compromise between providing reasonable sensitivity to the cortex and enough detected light to provide an acceptable SNR » (Brigadoi & Cooper, 2015)



Takahashi et al. 2011



Li et al. 2011



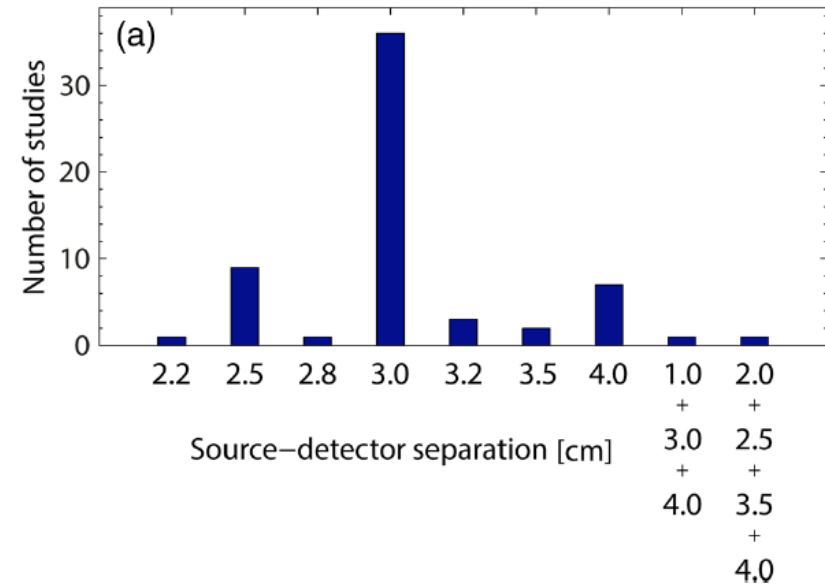
Gervain et al. 2011

Li et al. (2011) *J Biomed Optics*, 16, 045001.
 Takahashi et al. (2011) *NeuroImage*, 57, 991-1002.
 Gervain et al. (2011) *Dev Cogn Neurosci*, 1, 22-46.

Usage of the source-detector distance by manufacturers and scientists

Source-Distance Separation

Device	(Manufacturer), country	SDS [mm]
D1	OXYMON MkIII ^a (Artinis), Netherlands	a
D2	PortaLite (Artinis), Netherlands	20 + 25 / 30 + 35 + 40
D3	fNIR1100 (fNIR Devices), USA	20/25/25
D4	fNIR1100w (fNIR Devices), USA	20/25
D5	ETG-4000 (Hitachi), Japan	20/30
D6	ETG-7100 (Hitachi), Japan	20/30
D7	WOT ^b (Hitachi), Japan	30
D8	Genie (MARRA), USA	a
D9	NIRScout (NIRx), USA	a
D10	NIRScoutX (NIRx), USA	a
D11	NIRSport (NIRx), USA	a
D12	Brainsight NIRS (Rogue Research), Canada	a
D13	FOIRE-3000 (Shimadzu), Japan	a
D14	OEG-SpO2 (Spectratech), Japan	30/25/15-40
D15	CW6 (TechEn), USA	a
D16	UCL Optical Topography System ^c (University College London), UK	a
D17	Imagent (ISS), USA	a



"a: if SDS can be adjusted freely by the user, then (a)adjustable is written"

Herold et al. 2017

Scholkmann et al. 2014

Scholkmann et al. (2014) *NeuroImage*, 85, 6-27.
Herold et al. (2017) *Neurophotonics*, 4 (4), 041403.

Digitization of 42 locations 1 participant



Polaris Spectra
camera



Localite GmbH software



EasyCap & NIRx devices



"stiffening joints" to ensure a distance for
channels ≤ 30 mm

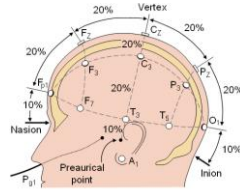
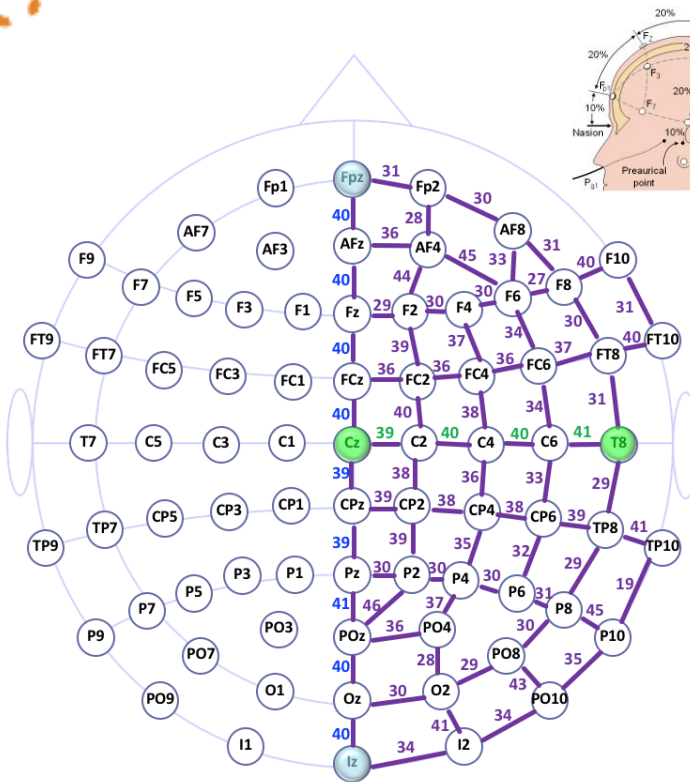
+ Brainstorm software for MNI coordinates of EEG locations.

Tadel et al. (2011) *Comput Intell Neurosci*; 2011, 879716 ; <http://neuroimage.usc.edu/brainstorm>

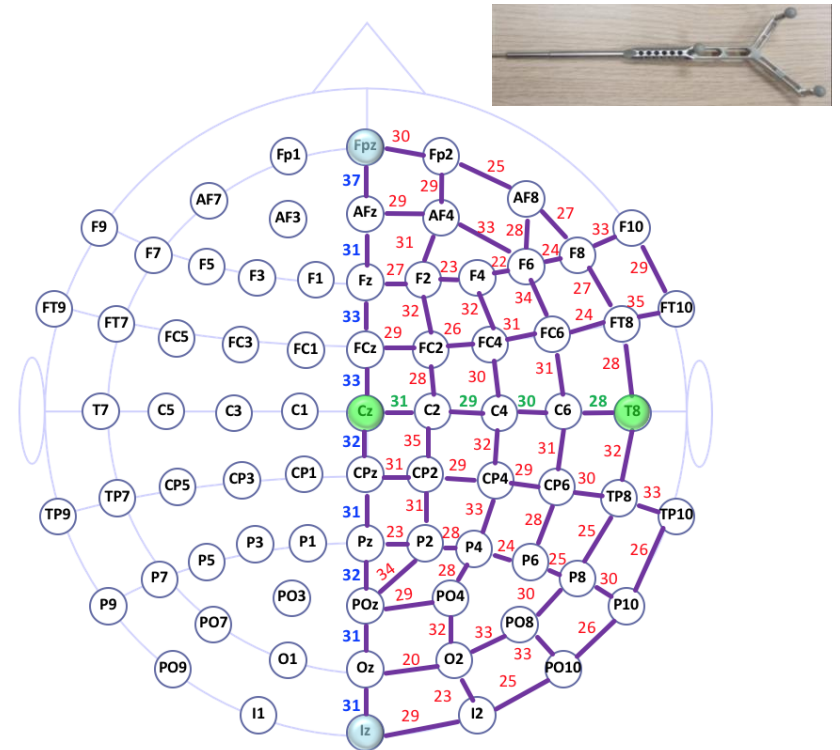
Results

Comparison of distances from Cz

Standard 10/10 EEG locations



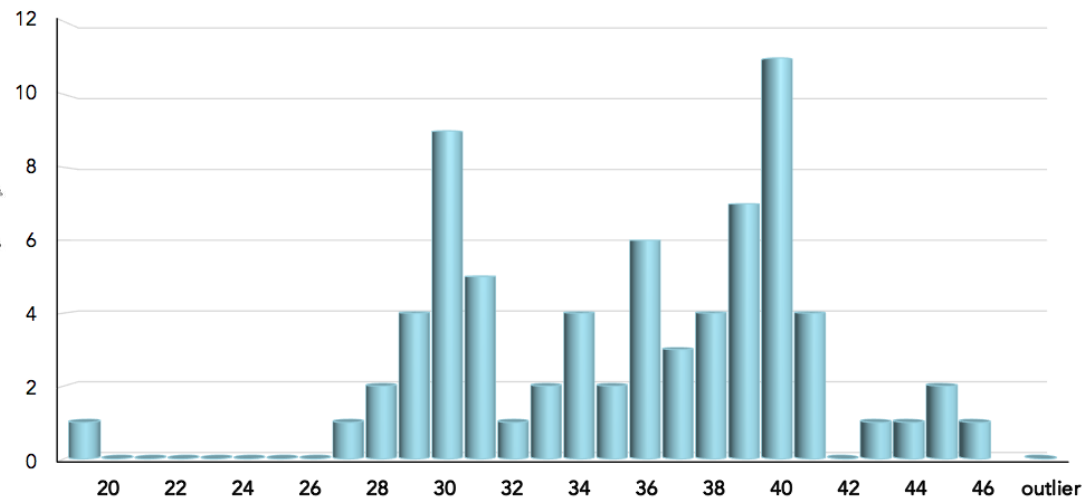
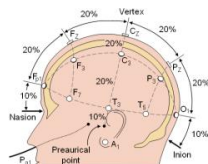
Real world locations



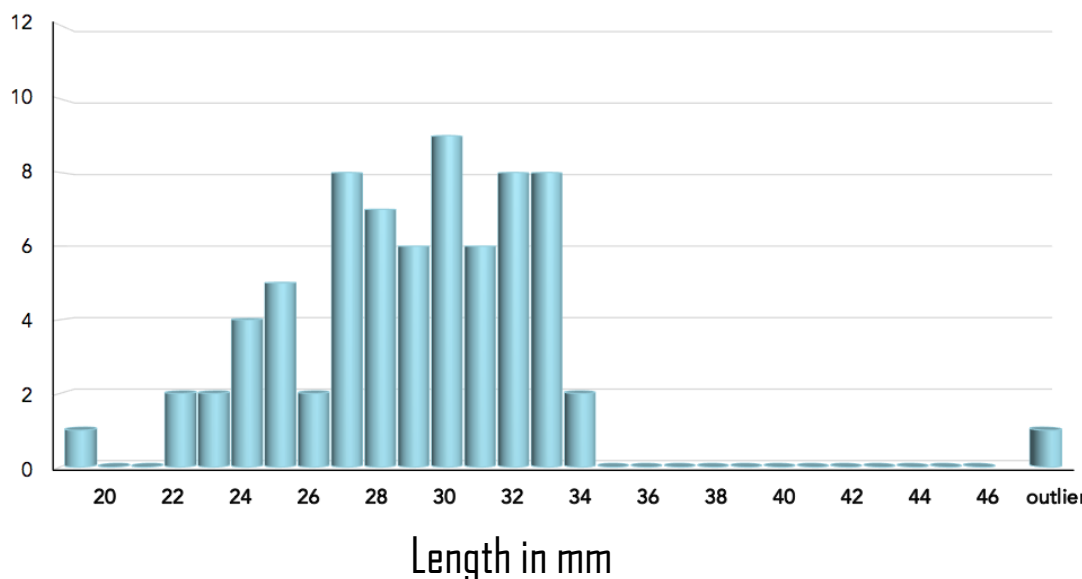
Cz to ...	10/10 EEG distances (mm)	Difference (mm)	Digitizer distances (mm)
Fpz	160	26	134
Iz	199	42	157
T8	160	42	118

Results

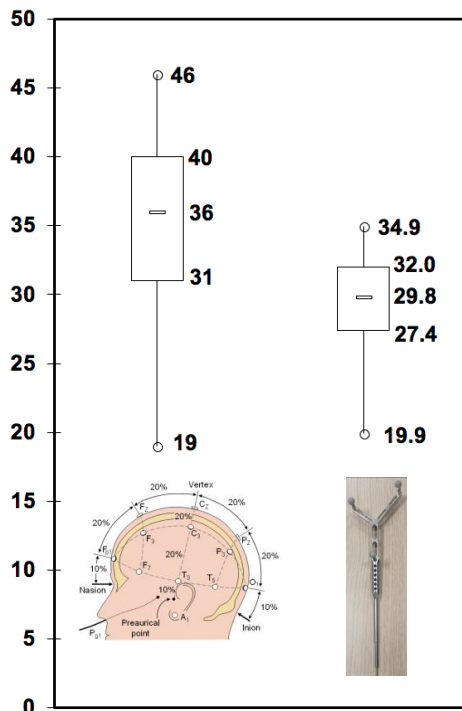
Comparisons of the lengths of 71 "channels"



channels

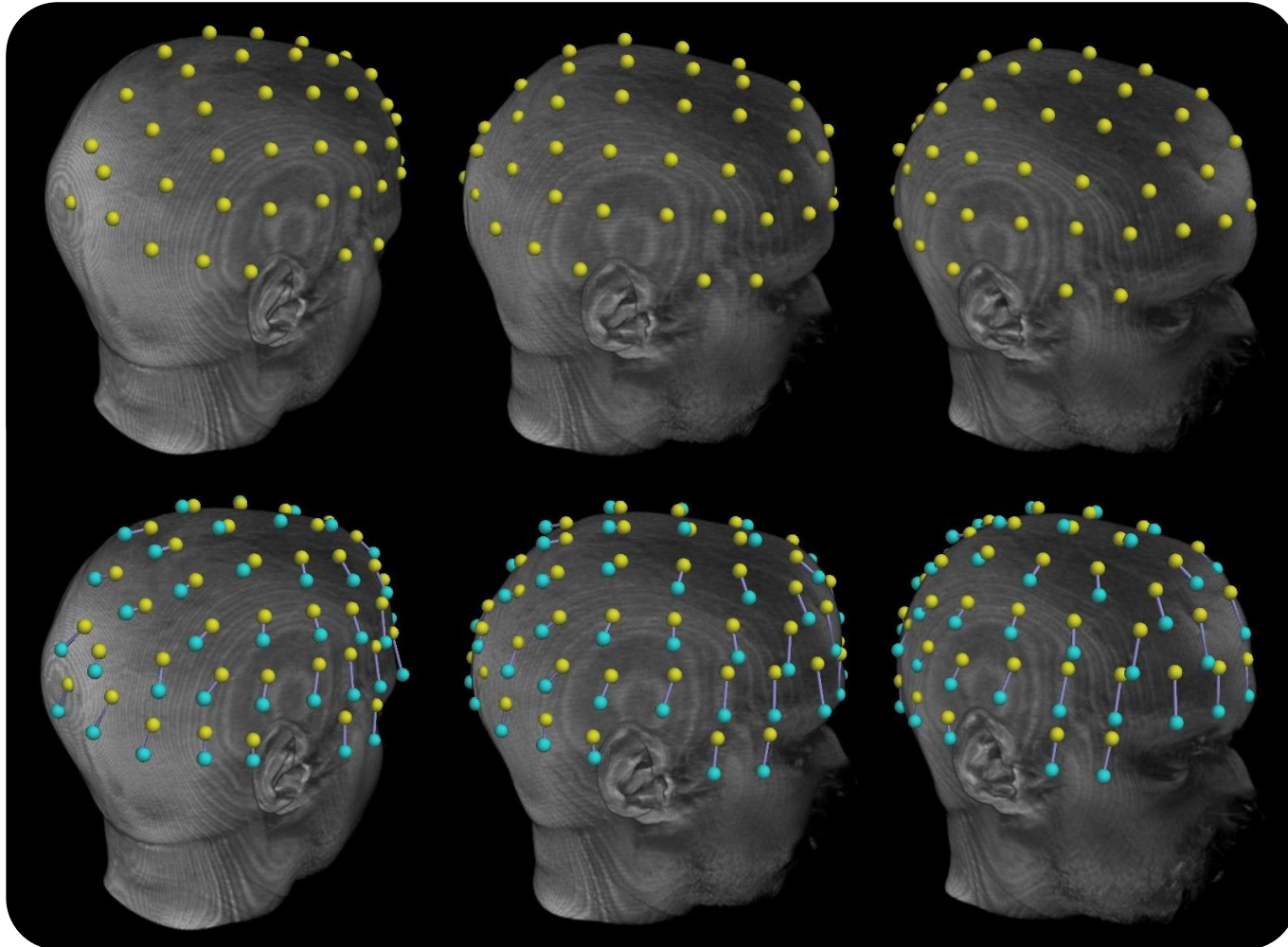


Length in mm



Results

Shift of 42 locations

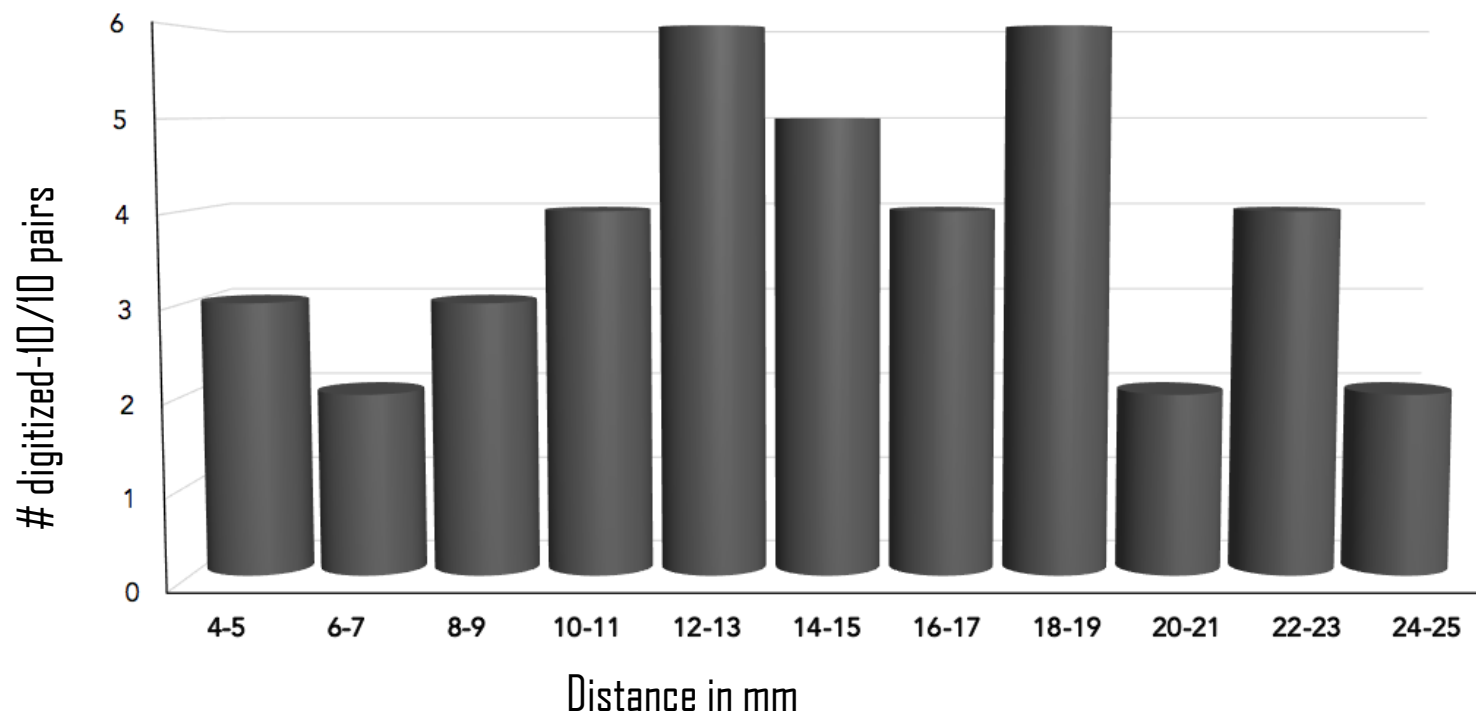
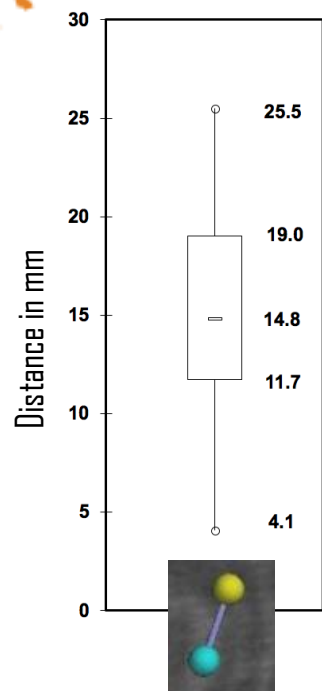
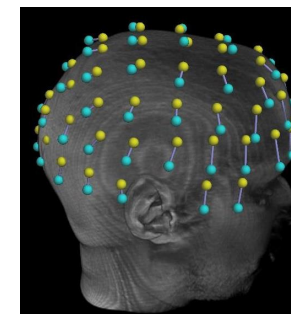


Yellow:
on the cap

Cyan:
10/10 EEG

Results

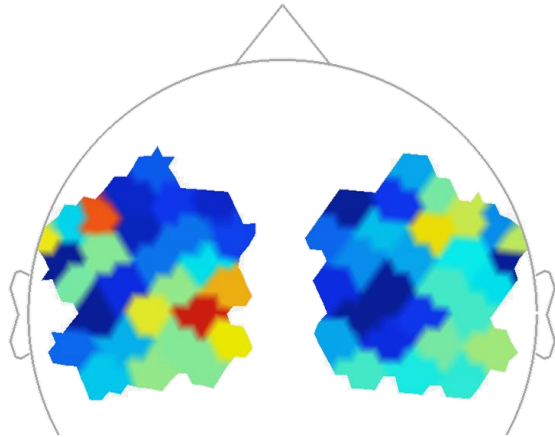
Distances between digitized locations and standard 10/10 EEG locations (n = 42)



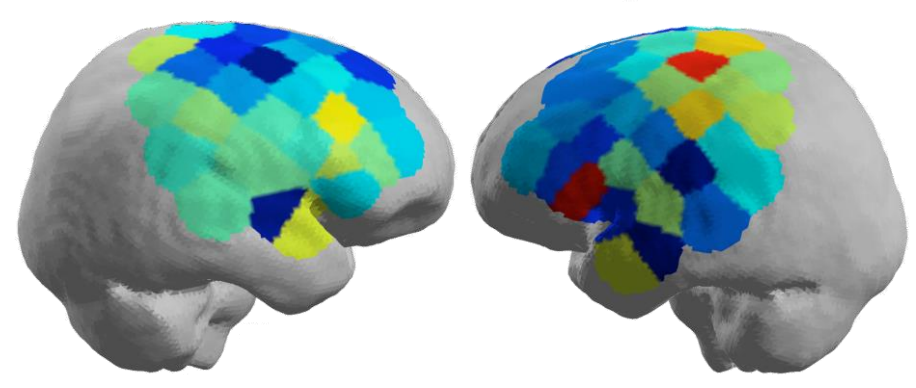
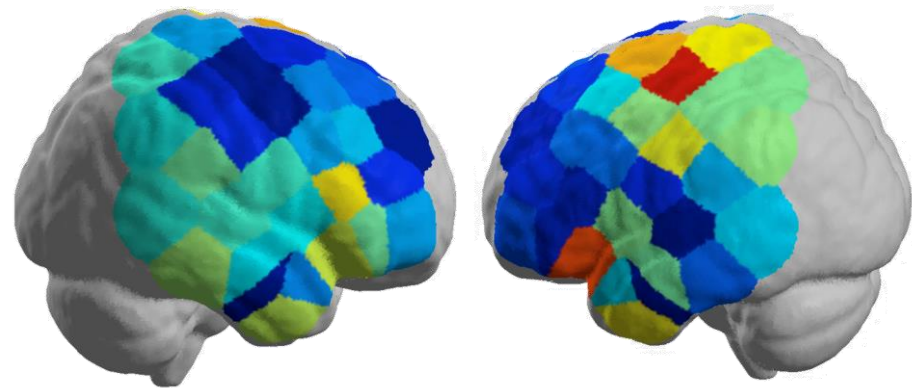
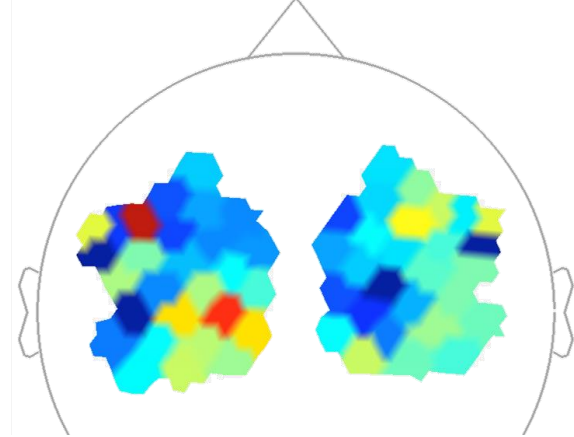
Results

Montage with 56 channels, symmetrical montage
Finger tapping task, 1 participant

Standard 10/10 EEG locations



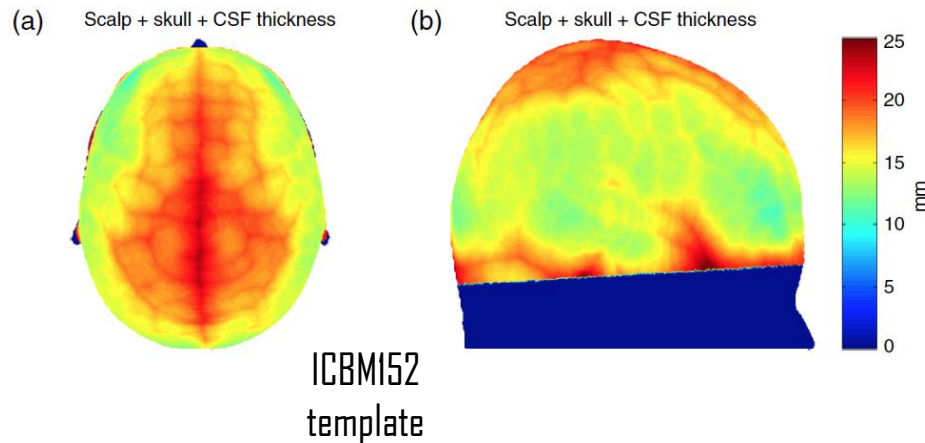
Real world locations



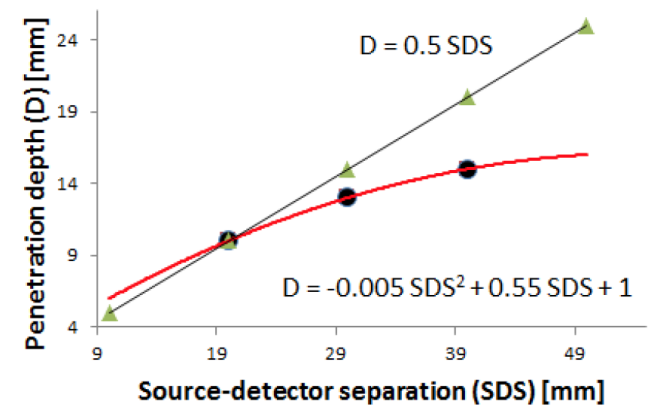
NIRSlab software, NIRx

When using standard EEG systems to define a montage in NIRS, digitization of the exact positions of the optodes is highly recommended in order to avoid erroneous conclusion about the cortical areas generating the NIRS signals.

Further considerations



Brigadoi & Cooper. 2015



From Scholkmann, 2f-NIRS 2016 citing Patil et al. 2011

Brigadoi & Cooper (2015) *Neurophotonics*, 2, 025005.

Patil et al. (2011) *Biomed. Opt. Express*, 2, 1478-1493.