A A note on the application of artefact rejection methods

ADJUST was used in this work for convenience, as it was available within the EEGLab toolbox framework. However, the removal of artefacts from the EEG is still a hot topic in the literature, and the "artefact-free" term should be interpreted accordingly.

In addition, it is important to keep in mind that results obtained with the cleaned data sets may be subject to optimistic bias. It is possible that, when there are errors present during artefact rejection, the EEG data is modified in unexpected ways other than noise removal. As we applied the artefact rejection techniques within each subject, these alterations would be specific to that subject, therefore biasing the results. The issue becomes more complicated when one assumes that the general accuracy of the system will logically improve with the removal of artefacts. We will see that this improvement indeed occurs. However, it is difficult (if at all possible) to asses the extend to which performance differences between raw and cleaned data sets are due to the removal of noise or due to erroneous alterations of the EEG.

Overall, results obtained with ADJUST processed data sets must be interpreted carefully.

B Convert from PRE to classification accuracy

In this work, we present our results as Percentage Reduction of Error (PRE) instead as the common classification accuracy. The conversion from PRE to classification accuracy can easily be done by rewriting eq. 10 as:

$$A_i = PRE_i + \frac{1 - PRE_i}{N_S}, \tag{12}$$

where A_i is the classification accuracy. Three examples of this conversion are:

- The maximum performance of the right panel of figure 6 is close to 72% of PRE. This panel corresponds to Keirn's database which, from table 1, has 5 subjects. Hence, replacing $N_S = 5$ and $PRE_i = .72$ in eq. 12 we obtain an accuracy rate of 78%.
- On table 6, the reported PRE of BCI2000-Baseline database (BB) with *Conf-2s* is 93.16%. From table 1, this database has 100 subjects. However, in the table's caption it is specified that "A maximum of 20 subjects was used in each experimental iteration". Hence, replacing $N_S = 20$ and $PRE_i = .9316$ in eq. 12 we obtain an accuracy rate of 93.50%. Note that a limit of 20 subjects is in place everywhere in the text except within section 6.3.
- On figure 17, the PRE of BCI2000-Tasks database with 60 subjects, when evaluated with the *r-Norm Conf-2s* system, was around 87%. Hence, replacing $N_S = 60$ and $PRE_i = .87$ in eq. 12 we obtain an accuracy rate of 87%.

C Supplementary results and statistical tests

To avoid cluttering the main text with figures and tables, we only inserted the most representative examples. Here, we provide supplementary results and statistical tests. A description of the figures and tables below, beyond that of their captions, can be found in the corresponding section of the main text.

On cases were statistical tests were performed, we always ran targeted independent t-tests. To adjust the p-value for the typical increase of Type I error in multiple testing, we applied the Benjamini-Hochberg False Discovery Rate (BHFDR) method across all the obtained values. This is, within an experiment (e.g. EEG montage evaluation), we simultaneously adjusted all the p-values obtained with all the considered databases, systems and conditions. This approach was preferred over analysis of variance (ANOVA) due to the high number of variables involved in the experiments and the strong n-way interactions exhibited – especially between the variables "database", "database mode" (raw or artefact free) and "system" –, which hindered the interpretation of the results.

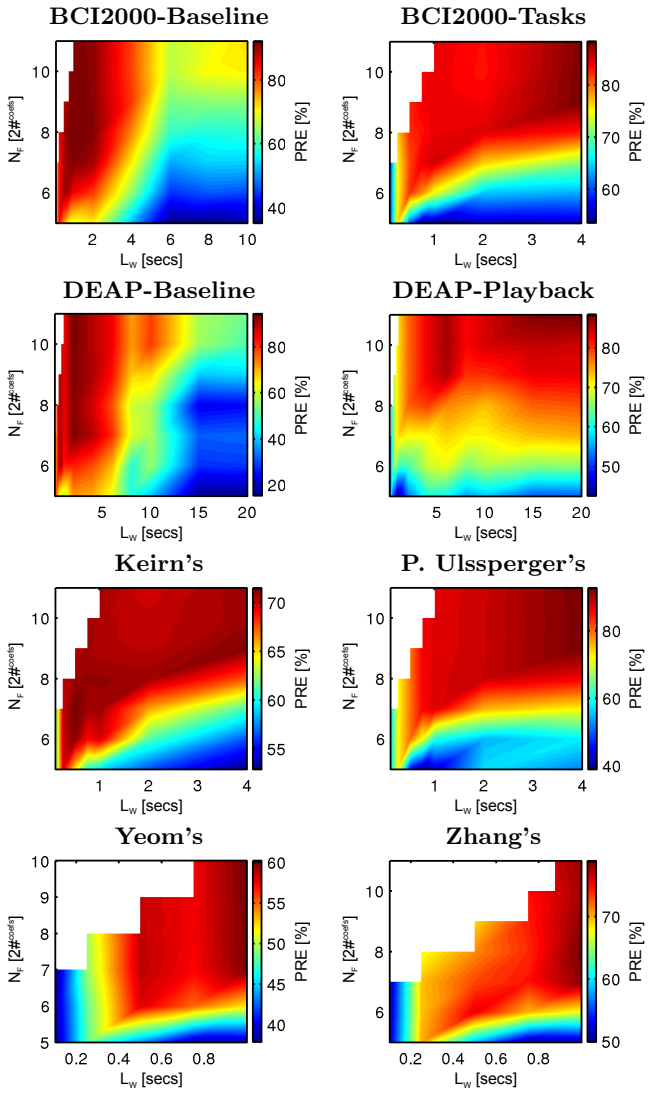

Figure C.1: **Mean PRE results obtained with each database on an L_W vs N_F grid.** L_G was set to the length of the available EEG on each database (table 1) and $\Theta = 0\%$. Results correspond to *full-fusion no-focus* experiments. A maximum of 20 subjects was used in each experimental iteration. Refer to section 4.1 for a description of the results, and to fig. 5 and C.2 for further related results.

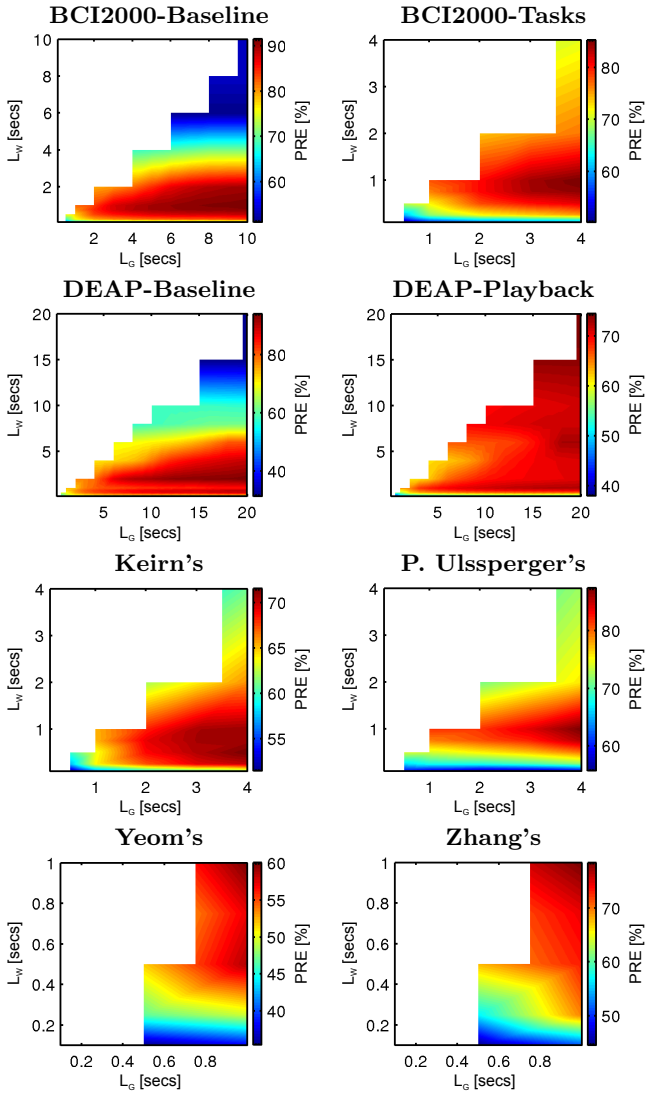

Figure C.2: **Mean PRE results obtained with each database on an L_G vs L_W grid.** In all cases, $N_F = 128$ coefficients and $\Theta = 0\%$. Results correspond to the *full-fusion no-focus* experiments. A maximum of 20 subjects was used in each experimental iteration. Refer to section 4.1 for a description of the results, and to fig. 5 and C.1 for further related results.

Table C.1: **Independent t-test analysis of the $N_F \approx L_W * F_s$ diagonal**. H_0: $\mu_{PRE}(A) = \mu_{PRE}(B)$. H_1: $\mu_{PRE}(A) > \mu_{PRE}(B)$. With A and B representing the conditions above and below the diagonal $N_F \approx L_W * F_s$ respectively. Refer to section 4.1 for a description of the results, and to fig. 5 and C.2 for further related results.

Raw data sets.

Dat.	**t**	**df**	**p-value**	**SE**	**r**
BB	20.65	598	$<$ **0.001**	1.05	1.00
BT	13.39	388	$<$ **0.001**	1.06	1.00
DB	18.93	738	$<$ **0.001**	1.27	1.00
DP	2.07	738	$<$ **0.05**	0.86	1.00
K	18.13	388	$<$ **0.001**	0.41	1.00
P	17.16	388	$<$ **0.001**	1.24	1.00
Y	6.66	238	$<$ **0.001**	1.19	1.00
Z	7.80	248	$<$ **0.001**	1.44	1.00

ADJUST processed data sets.

Dat.	**t**	**df**	**p-value**	**SE**	**r**
BB	17.75	598	$<$ **0.001**	1.07	1.00
BT	10.52	388	$<$ **0.001**	0.71	1.00
DB	16.80	738	$<$ **0.001**	1.35	1.00
DP	7.33	738	$<$ **0.001**	0.60	1.00
P	12.23	388	$<$ **0.001**	0.83	1.00
Z	8.95	248	$<$ **0.001**	1.39	1.00

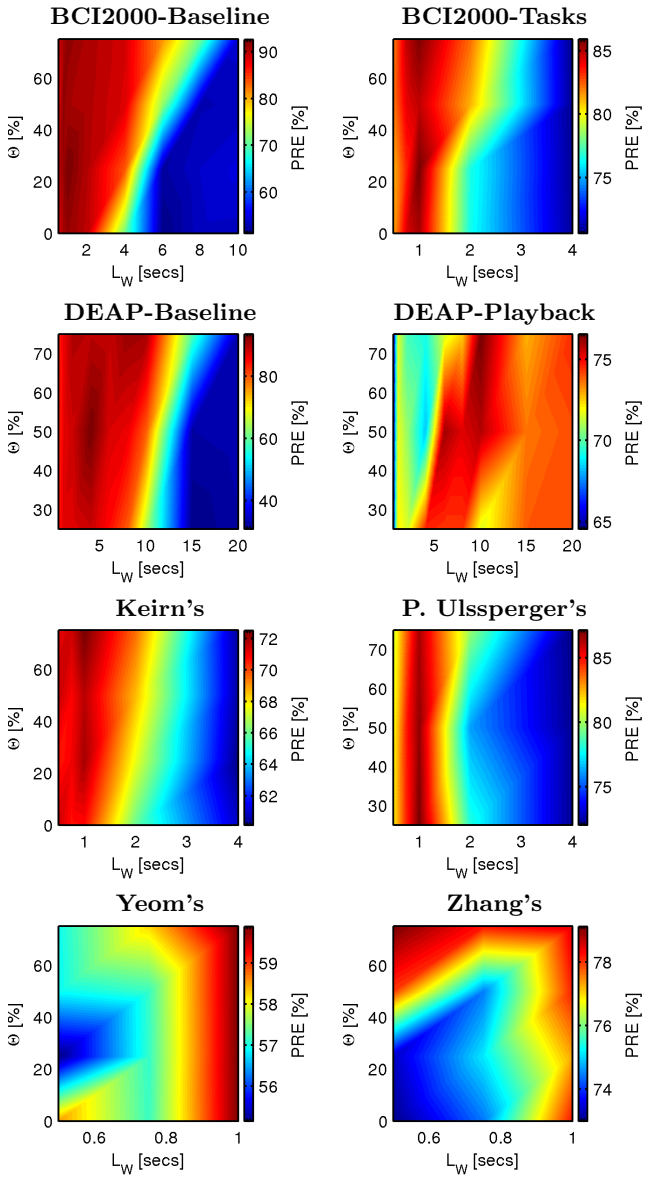

Figure C.3: ***μPRE* results obtained with each database on an L_W vs Θ grid.** L_G was set to the length of the available EEG on each database (table 1) and $N_F = 128$ coefficients. Results correspond to *full-fusion no-focus* experiments. A maximum of 20 subjects was used in each experimental iteration. Refer to section 4.1 for a description of the results, and to fig. 6 for further related results.

Table C.2: **Independent t-test analysis of F_{max} and F_{min} with the *Conf-HalfLen* system**. H_0: $\mu_{PRE}(A) = \mu_{PRE}(B)$. H_1: $\mu_{PRE}(A) \neq \mu_{PRE}(B)$. With A and B conditions specified on top of each cell as $(A) - (B)$.

Dat.	t	df	p-value	SE	r	t	df	p-value	SE	r
	$(F_{max} = 30Hz) - (F_{max} = 20Hz)$					$(F_{max} = 40Hz) - (F_{max} = 30Hz)$				
BB	3.75	18	**< 0.01**	1.39	0.64	-0.05	18	0.97	1.14	-0.01
BT	3.99	18	**< 0.01**	1.53	0.67	0.42	18	0.71	1.28	0.09
DB	12.02	18	**< 0.001**	0.52	0.94	-8.66	18	**< 0.001**	0.49	-0.89
DP	-4.85	18	**< 0.001**	0.08	-0.74	-22.14	18	**< 0.001**	0.12	-0.98
K	10.31	18	**< 0.001**	0.64	0.92	0.84	18	0.44	0.72	0.18
P	77.62	18	**< 0.001**	0.07	1.00	15.74	18	**< 0.001**	0.07	0.96
Y	123.21	18	**< 0.001**	0.02	1.00	232.71	18	**< 0.001**	0.02	1.00
Z	26.22	18	**< 0.001**	0.74	0.99	8.44	18	**< 0.001**	1.01	0.88
	$(F_{min} = 10Hz) - (F_{min} = 20Hz)$									
BB	2.63	18	**< 0.05**	1.78	0.51					
BT	2.79	18	**< 0.05**	1.95	0.53					
DB	14.14	18	**< 0.001**	0.57	0.95					
DP	53.59	18	**< 0.001**	0.16	1.00					
K	15.17	18	**< 0.001**	0.59	0.96					
P	48.32	18	**< 0.001**	0.13	1.00					
Y	191.48	18	**< 0.001**	0.03	1.00					
Z	3.33	18	**< 0.01**	1.83	0.60					

Table C.3: **Independent t-test analysis of F_{max} and F_{min} with the *Conf-FullLen* system**. H_0: $\mu_{PRE}(A) = \mu_{PRE}(B)$. H_1: $\mu_{PRE}(A) \neq \mu_{PRE}(B)$. With A and B conditions specified on top of each cell as $(A) - (B)$.

Dat.	t	df	p-value	SE	r	t	df	p-value	SE	r
	$(F_{max} = 30Hz) - (F_{max} = 20Hz)$					$(F_{max} = 40Hz) - (F_{max} = 30Hz)$				
BB	3.78	18	**< 0.01**	2.31	0.65	-0.04	18	0.97	2.59	-0.01
BT	2.57	18	**< 0.05**	2.36	0.50	1.11	18	0.31	2.53	0.24
DB	9.42	18	**< 0.001**	0.95	0.90	-1.50	18	0.17	1.12	-0.32
DP	11.21	18	**< 0.001**	0.11	0.93	-14.68	18	**< 0.001**	0.11	-0.96
K	21.00	18	**< 0.001**	0.28	0.98	2.38	18	**< 0.05**	0.33	0.47
P	33.49	18	**< 0.001**	0.09	0.99	4.49	18	**< 0.001**	0.06	0.71
Y	-8.85	18	**< 0.001**	0.02	-0.89	146.21	18	**< 0.001**	0.02	1.00
Z	6.11	18	**< 0.001**	2.51	0.81	3.84	18	**< 0.01**	2.21	0.65
	$(F_{min} = 10Hz) - (F_{min} = 20Hz)$									
BB	4.71	18	**< 0.001**	1.20	0.73					
BT	6.14	18	**< 0.001**	1.49	0.81					
DB	26.76	18	**< 0.001**	0.99	0.99					
DP	62.45	18	**< 0.001**	0.14	1.00					
K	19.48	18	**< 0.001**	0.42	0.97					
P	44.72	18	**< 0.001**	0.14	1.00					
Y	232.57	18	**< 0.001**	0.03	1.00					
Z	3.41	18	**< 0.01**	2.03	0.61					

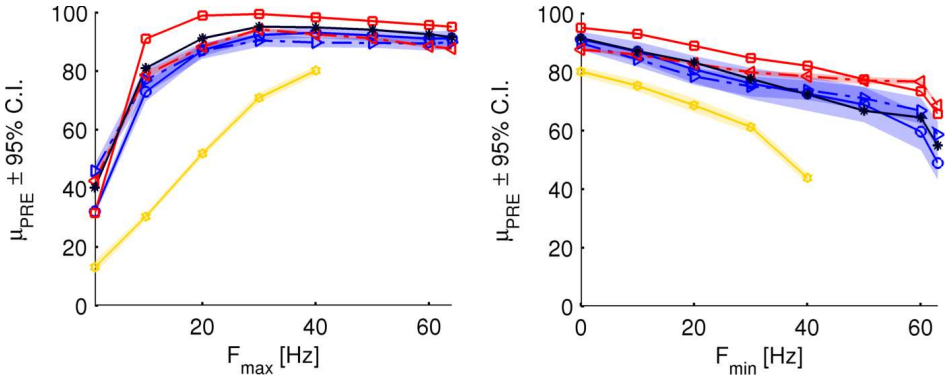

Figure C.4: **Quantitative analysis of the maximum (F_{max}) and minimum (F_{min}) cut-off frequencies with artefact free data sets.** Mean and 95% CI of PRE results obtained in *full-fusion no-focus* experiments with different F_{max} (top) and F_{min} (bottom) values. Results correspond to ADJUST processed databases, tested with the *Conf-HalfLen* system. A maximum of 20 subjects was used in each experimental iteration. Refer to figure 7 for details on the legend and for further related results, and to section 4.3 for a description of the results.

Table C.4: **Independent t-test analysis of F_{max} and F_{min} with ADJUST processed data sets**. H_0: $\mu_{PRE}(A) = \mu_{PRE}(B)$. H_1: $\mu_{PRE}(A) \neq \mu_{PRE}(B)$. With A and B conditions specified on top of each cell as $(A) - (B)$.

Dat.	t	df	p-value	SE	r	t	df	p-value	SE	r
	$(F_{max} = 30Hz) - (F_{max} = 20Hz)$					$(F_{max} = 40Hz) - (F_{max} = 30Hz)$				
BB	2.23	18	**< 0.05**	1.55	0.45	-0.56	18	0.61	1.23	-0.12
BT	3.65	18	**< 0.01**	1.50	0.63	1.08	18	0.32	1.17	0.24
DB	12.74	18	**< 0.001**	0.46	0.94	-3.87	18	**< 0.01**	0.44	-0.65
DP	8.61	18	**< 0.001**	0.06	0.89	-23.23	18	**< 0.001**	0.05	-0.98
P	70.43	18	**< 0.001**	0.06	1.00	-4.47	18	**< 0.001**	0.06	-0.71
Z	20.87	18	**< 0.001**	0.91	0.98	9.14	18	**< 0.001**	1.02	0.90
	$(F_{min} = 10Hz) - (F_{min} = 20Hz)$									
BB	3.48	18	**< 0.01**	1.68	0.61					
BT	2.73	18	**< 0.05**	2.08	0.52					
DB	9.44	18	**< 0.001**	0.32	0.90					
DP	32.97	18	**< 0.001**	0.12	0.99					
P	29.35	18	**< 0.001**	0.13	0.99					
Z	4.82	18	**< 0.001**	1.38	0.73					

Table C.5: **Independent t-test analysis of F_{max} and F_{min} with *Conf-FullLen* system and ADJUST processed data sets**. H_0: $\mu_{PRE}(A) = \mu_{PRE}(B)$. H_1: $\mu_{PRE}(A) \neq \mu_{PRE}(B)$. With A and B conditions specified on top of each cell as $(A) - (B)$.

Dat.	t	df	p-value	SE	r	t	df	p-value	SE	r
	$(F_{max} = 30Hz) - (F_{max} = 20Hz)$					$(F_{max} = 40Hz) - (F_{max} = 30Hz)$				
BB	2.58	18	**< 0.05**	2.63	0.50	0.04	18	0.97	2.85	0.01
BT	4.23	18	**< 0.001**	2.16	0.69	0.77	18	0.48	2.46	0.17
DB	12.31	18	**< 0.001**	1.00	0.94	3.31	18	**< 0.01**	1.05	0.60
DP	11.92	18	**< 0.001**	0.08	0.94	-26.73	18	**< 0.001**	0.04	-0.99
P	41.59	18	**< 0.001**	0.07	0.99	-18.49	18	**< 0.001**	0.06	-0.97
Z	11.71	18	**< 0.001**	1.29	0.93	6.96	18	**< 0.001**	1.17	0.84
	$(F_{min} = 10Hz) - (F_{min} = 20Hz)$									
BB	3.07	18	**< 0.01**	2.28	0.57					
BT	2.56	18	**< 0.05**	2.57	0.50					
DB	15.76	18	**< 0.001**	0.89	0.96					
DP	27.13	18	**< 0.001**	0.13	0.99					
P	46.62	18	**< 0.001**	0.08	1.00					
Z	8.56	18	**< 0.001**	0.93	0.89					

Table C.6: **Independent t-test analysis of L_W.** H_0: $\mu_{PRE}(A) = \mu_{PRE}(B)$. H_1: $\mu_{PRE}(A) \neq \mu_{PRE}(B)$. With A and B conditions specified on top of each cell as $(A) - (B)$.

Raw data sets.

Dat.	t	df	p-value	SE	r	t	df	p-value	SE	r
	$(L_W = 1s) - (L_W = 0.5s)$					$(L_W = 2s) - (L_W = 1s)$				
BB	3.36	18	**< 0.01**	1.58	0.60	0.21	18	0.84	1.01	0.05
BT	3.09	18	**< 0.05**	1.68	0.57	1.09	18	0.35	1.39	0.24
DB	14.32	18	**< 0.001**	0.51	0.95	4.12	18	**< 0.01**	0.43	0.68
DP	54.50	18	**< 0.001**	0.16	1.00	40.22	18	**< 0.001**	0.17	0.99
K	14.80	18	**< 0.001**	0.10	0.96	2.15	18	0.08	0.34	0.43
P	31.59	18	**< 0.001**	0.07	0.99	16.51	18	**< 0.001**	0.06	0.97
Y	198.11	18	**< 0.001**	0.02	1.00	-	-	-	-	-
Z	-2.00	18	0.09	0.85	-0.41	-	-	-	-	-

ADJUST processed data sets

Dat.	t	df	p-value	SE	r	t	df	p-value	SE	r
	$(L_W = 1s) - (L_W = 0.5s)$					$(L_W = 2s) - (L_W = 1s)$				
BB	1.96	18	0.09	1.21	0.40	-1.33	18	0.25	0.67	-0.29
BT	2.53	18	**< 0.05**	1.00	0.49	0.56	18	0.64	0.92	0.12
DB	5.84	18	**< 0.001**	0.45	0.79	-0.97	18	0.40	0.44	-0.21
DP	39.95	18	**< 0.001**	0.08	0.99	16.18	18	**< 0.001**	0.09	0.96
P	21.10	18	**< 0.001**	0.17	0.98	12.40	18	**< 0.001**	0.08	0.94
Z	-0.24	18	0.83	1.31	-0.05	-	-	-	-	-

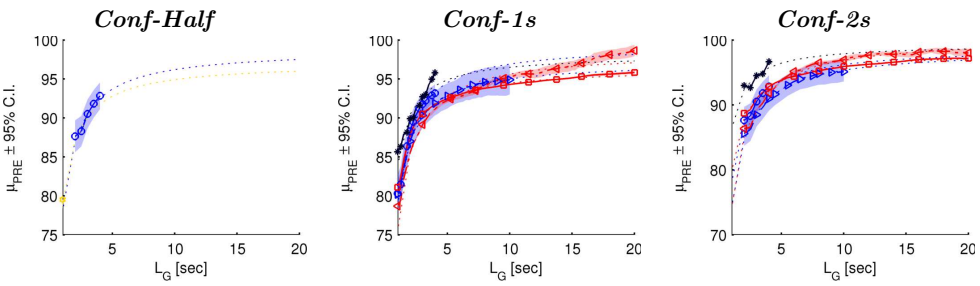

Figure C.5: **Quantitative analysis of the EEG segment length (L_G) with artefact free data sets.** Mean PRE and 95% CI (shaded area) obtained with different L_G. Data corresponds to *full-fusion* set-up on *no-focus* experiments using *Conf-1s* (left) and *Conf-2s* (right) systems. A maximum of 20 subjects was used in each experimental iteration. Refer to figure 9 for details on the legend, to section 4.5 for a description of the results, and to fig. 9 for further related results.

Table C.7: **Quantitative results for different configurations with ADJUST processed data sets.** Mean PRE and 95% CI obtained with different configurations. Data corresponds *full-fusion no-focus* experiments. Within data sets, performances statistically different than the maximum are pointed by * (single tail t-tests with BHFDR adjusted $p > 0.05$). A maximum of 20 subjects was used in each experimental iteration. Refer to table 1 for details on databases' code names, to section 4.6 for a description of the results, and to table 6 for further related results.

Conf	**BB**	**BT**	**DB**	**DP**
Conf-FullLen	70.74*	68.26*	70.42*	**98.06**
	[67.62, 73.85]	[63.24, 73.29]	[68.28, 72.56]	**[97.96, 98.16]**
Conf-1s	94.89	**94.37**	**98.63**	95.83*
	[93.02, 96.77]	**[93.16, 95.57]**	**[97.92, 99.35]**	[95.66, 96.01]
Conf-2s	**95.11**	89.32*	98.00	97.16*
	[93.62, 96.59]	[86.69, 91.94]	[97.34, 98.66]	[97.05, 97.27]

Conf	**K**	**P**	**Y**	**Z**
Conf-HalfLen	-	-	-	**79.51**
	-	-	-	**[78.31, 80.71]**
Conf-FullLen	-	96.01*	-	78.30
	-	[95.90, 96.13]	-	[76.93, 79.67]
Conf-1s	-	95.79*	-	-
	-	[95.63, 95.95]	-	-
Conf-2s	-	**96.65**	-	-
	-	**[96.61, 96.69]**	-	-

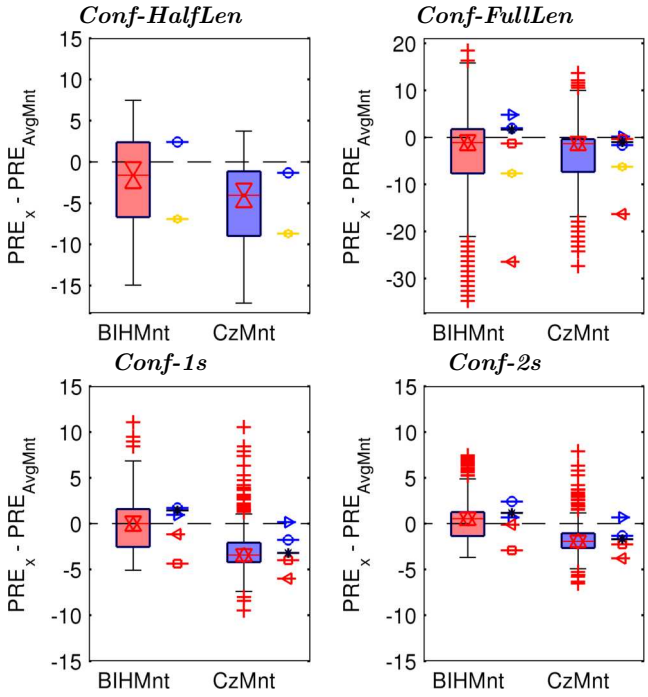

Figure C.6: **Quantitative analysis of EEG montages with ADJUST processed data sets.** Relative PRE values between *BIHMnt-AvgMnt* and between *CzMnt-AvgMnt*. Results are stacked across databases. Refer to caption of figure 11 for details about the meaning of symbols within the image, to section 5.1 for a description of the results, and to fig. 11 for further related results.

Table C.8: **Independent t-test analysis of EEG montages with *Conf-HalfLen* system**. H_0: $\mu_{PRE}(A) - \mu_{PRE}(B) \geq 10$. H_1: $\mu_{PRE}(A) - \mu_{PRE}(B) < 10$. With A and B montages specified on top of each cell as $(A) - (B)$.

Raw data sets.

Dat.	**t**	**df**	**p-value**	**SE**	**r**	**t**	**df**	**p-value**	**SE**	**r**
	(BIHMnt) - (AvgMnt)					(CzMnt) - (AvgMnt)				
BT	5.94	18	**< 0.001**	1.92	0.80	4.51	18	**< 0.001**	1.99	0.71
K	13.09	18	**< 0.001**	0.52	0.95	-	-	-	-	-
Y	137.44	18	**< 0.001**	0.02	1.00	703.62	18	**< 0.001**	0.02	1.00
Z	1.14	18	0.15	1.91	0.25	-2.10	18	1.00	1.89	-0.42

ADJUST processed data sets

Dat.	**t**	**df**	**p-value**	**SE**	**r**	**t**	**df**	**p-value**	**SE**	**r**
	(BIHMnt) - (AvgMnt)					(CzMnt) - (AvgMnt)				
BT	8.59	18	**< 0.001**	1.40	0.89	5.81	18	**< 0.001**	1.45	0.79
Z	2.69	18	**< 0.01**	1.15	0.51	0.93	18	0.20	1.41	0.20

Table C.9: **Independent t-test analysis of EEG montages with *Conf-FullLen* system**. H_0: $\mu_{PRE}(A) - \mu_{PRE}(B) \geq 10$. H_1: $\mu_{PRE}(A) - \mu_{PRE}(B) < 10$. With A and B montages specified on top of each cell as $(A) - (B)$.

Raw data sets.

Dat.	**t**	**df**	**p-value**	**SE**	**r**	**t**	**df**	**p-value**	**SE**	**r**
	(BIHMnt) - (AvgMnt)					(CzMnt) - (AvgMnt)				
BB	6.64	18	**< 0.001**	2.36	0.83	4.12	18	**< 0.001**	2.50	0.68
BT	4.38	18	**< 0.001**	1.79	0.70	3.41	18	**< 0.01**	2.32	0.61
DB	-16.43	18	1.00	1.02	-0.96	1.58	18	0.07	0.93	0.33
DP	50.58	18	**< 0.001**	0.14	1.00	70.95	18	**< 0.001**	0.13	1.00
K	17.27	18	**< 0.001**	0.40	0.97	-	-	-	-	-
P	144.91	18	**< 0.001**	0.06	1.00	165.98	18	**< 0.001**	0.06	1.00
Y	59.51	18	**< 0.001**	0.02	1.00	493.04	18	**< 0.001**	0.02	1.00
Z	1.68	18	0.06	1.50	0.35	0.22	18	0.45	1.28	0.05

ADJUST processed data sets

Dat.	**t**	**df**	**p-value**	**SE**	**r**	**t**	**df**	**p-value**	**SE**	**r**
	(BIHMnt) - (AvgMnt)					(CzMnt) - (AvgMnt)				
BB	6.16	18	**< 0.001**	2.40	0.81	4.62	18	**< 0.001**	2.20	0.72
BT	4.81	18	**< 0.001**	2.77	0.73	3.28	18	**< 0.01**	2.49	0.59
DB	-14.48	18	1.00	1.13	-0.96	-4.48	18	1.00	1.41	-0.71
DP	142.71	18	**< 0.001**	0.06	1.00	138.50	18	**< 0.001**	0.07	1.00
P	194.77	18	**< 0.001**	0.06	1.00	108.34	18	**< 0.001**	0.08	1.00
Z	2.84	18	**< 0.01**	0.82	0.54	2.87	18	**< 0.01**	1.31	0.54

Table C.10: **Independent t-test analysis of EEG montages with *Conf-1s* system**. H_0: $\mu_{PRE}(A) - \mu_{PRE}(B) \geq 5$. H_1: $\mu_{PRE}(A) - \mu_{PRE}(B) < 5$. With A and B montages specified on top of each cell as $(A) - (B)$.

Raw data sets.

Dat.	**t**	**df**	**p-value**	**SE**	**r**	**t**	**df**	**p-value**	**SE**	**r**
	(BIHMnt) - (AvgMnt)					(CzMnt) - (AvgMnt)				
BB	4.64	18	**< 0.001**	1.45	0.72	3.89	18	**< 0.001**	1.53	0.66
BT	3.95	18	**< 0.001**	1.29	0.66	3.29	18	**< 0.01**	1.32	0.59
DB	3.40	18	**< 0.01**	0.60	0.61	0.39	18	0.38	0.67	0.09
DP	21.96	18	**< 0.001**	0.17	0.98	11.44	18	**< 0.001**	0.16	0.93
K	25.27	18	**< 0.001**	0.11	0.98	-	-	-	-	-
P	77.75	18	**< 0.001**	0.08	1.00	96.16	18	**< 0.001**	0.06	1.00

ADJUST processed data sets

Dat.	**t**	**df**	**p-value**	**SE**	**r**	**t**	**df**	**p-value**	**SE**	**r**
	(BIHMnt) - (AvgMnt)					(CzMnt) - (AvgMnt)				
BB	5.48	18	**< 0.001**	1.09	0.77	4.84	18	**< 0.001**	1.06	0.73
BT	7.05	18	**< 0.001**	0.83	0.84	3.17	18	**< 0.01**	1.06	0.58
DB	9.79	18	**< 0.001**	0.39	0.91	-1.42	18	0.97	0.70	-0.30
DP	6.42	18	**< 0.001**	0.10	0.82	10.87	18	**< 0.001**	0.09	0.92
P	83.94	18	**< 0.001**	0.08	1.00	16.99	18	**< 0.001**	0.11	0.97

Table C.11: **Independent t-test analysis of EEG montages with *Conf-2s* system**. H_0: $\mu_{PRE}(A) - \mu_{PRE}(B) \geq 5$. H_1: $\mu_{PRE}(A) - \mu_{PRE}(B) < 5$. With A and B montages specified on top of each cell as $(A) - (B)$.

Raw data sets.

Dat.	**t**	**df**	**p-value**	**SE**	**r**	**t**	**df**	**p-value**	**SE**	**r**
	(BIHMnt) - (AvgMnt)					(CzMnt) - (AvgMnt)				
BB	5.62	18	**< 0.001**	1.19	0.78	5.22	18	**< 0.001**	1.06	0.76
BT	3.33	18	**< 0.01**	1.92	0.60	2.00	18	**< 0.05**	1.99	0.41
DB	20.34	18	**< 0.001**	0.32	0.98	4.83	18	**< 0.001**	0.32	0.73
DP	-0.04	18	0.55	0.14	-0.01	17.33	18	**< 0.001**	0.16	0.97
K	3.45	18	**< 0.01**	0.52	0.61	-	-	-	-	-
P	62.72	18	**< 0.001**	0.08	1.00	86.75	18	**< 0.001**	0.06	1.00

ADJUST processed data sets

Dat.	**t**	**df**	**p-value**	**SE**	**r**	**t**	**df**	**p-value**	**SE**	**r**
	(BIHMnt) - (AvgMnt)					(CzMnt) - (AvgMnt)				
BB	7.10	18	**< 0.001**	0.80	0.85	6.81	18	**< 0.001**	0.83	0.84
BT	5.01	18	**< 0.001**	1.40	0.75	2.36	18	**< 0.05**	1.45	0.47
DB	16.79	18	**< 0.001**	0.29	0.97	2.62	18	**< 0.05**	0.46	0.50
DP	28.49	18	**< 0.001**	0.07	0.99	32.24	18	**< 0.001**	0.08	0.99
P	121.33	18	**< 0.001**	0.05	1.00	62.62	18	**< 0.001**	0.05	1.00

Table C.12: **Independent t-test analysis of PSD normalization with *Conf-HalfLen* system**. H_0: $\mu_{PRE}(A) = \mu_{PRE}(B)$. H_1: $\mu_{PRE}(A) \neq \mu_{PRE}(B)$. With A and B normalization methods (table 3) specified on top of each cell as $(A) - (B)$.

Dat.	**t**	**df**	**p-value**	**SE**	**r**	**t**	**df**	**p-value**	**SE**	**r**
	(iqrNorm) - (Raw)					(normNorm) - (Raw)				
BT	1.74	18	0.12	1.72	0.36	-6.13	18	**< 0.001**	2.14	-0.81
K	54.42	18	**< 0.001**	0.38	1.00	42.65	18	**< 0.001**	0.40	0.99
Y	-128.03	18	**< 0.001**	0.02	-1.00	-527.09	18	**< 0.001**	0.02	-1.00
Z	-0.78	18	0.47	2.17	-0.17	-3.17	18	**< 0.01**	2.28	-0.58
	(powNorm) - (Raw)					(prcNorm) - (Raw)				
BT	-2.18	18	0.05	2.00	-0.44	-3.46	18	**< 0.01**	2.19	-0.61
K	57.44	18	**< 0.001**	0.37	1.00	41.62	18	**< 0.001**	0.41	0.99
Y	-160.27	18	**< 0.001**	0.02	-1.00	-621.81	18	**< 0.001**	0.02	-1.00
Z	-0.81	18	0.45	2.16	-0.18	-4.07	18	**< 0.01**	2.34	-0.67
	(rNorm) - (Raw)					(zNorm) - (Raw)				
BT	2.40	18	**< 0.05**	1.71	0.47	-5.41	18	**< 0.001**	2.06	-0.77
K	55.04	18	**< 0.001**	0.38	1.00	48.90	18	**< 0.001**	0.36	1.00
Y	-106.26	18	**< 0.001**	0.02	-1.00	-460.96	18	**< 0.001**	0.02	-1.00
Z	-1.56	18	0.15	2.31	-0.33	-4.32	18	**< 0.001**	2.65	-0.69

Table C.13: **Independent t-test analysis of PSD normalization with *Conf-FullLen* system**. H_0: $\mu_{PRE}(A) = \mu_{PRE}(B)$. H_1: $\mu_{PRE}(A) \neq \mu_{PRE}(B)$. With A and B normalization methods (table 3) specified on top of each cell as $(A) - (B)$.

Dat.	t	df	p-value	SE	r	t	df	p-value	SE	r
	(iqrNorm) - (Raw)					(normNorm) - (Raw)				
BB	3.47	18	**< 0.01**	2.44	0.61	-6.53	18	**< 0.001**	2.05	-0.83
BT	4.44	18	**< 0.001**	2.10	0.70	-6.19	18	**< 0.001**	2.39	-0.81
DB	4.70	18	**< 0.001**	0.99	0.72	-22.92	18	**< 0.001**	0.88	-0.98
DP	-4.09	18	**< 0.01**	0.11	-0.67	-57.68	18	**< 0.001**	0.13	-1.00
K	109.22	18	**< 0.001**	0.19	1.00	49.84	18	**< 0.001**	0.32	1.00
P	-10.61	18	**< 0.001**	0.05	-0.92	-132.35	18	**< 0.001**	0.07	-1.00
Y	74.08	18	**< 0.001**	0.01	1.00	-536.16	18	**< 0.001**	0.02	-1.00
Z	-2.24	18	**< 0.05**	1.33	-0.45	-7.47	18	**< 0.001**	1.16	-0.86
	(powNorm) - (Raw)					(prcNorm) - (Raw)				
BB	-0.78	18	0.47	2.44	-0.17	-3.56	18	**< 0.01**	2.28	-0.62
BT	-2.00	18	0.07	2.34	-0.41	-4.94	18	**< 0.001**	2.34	-0.74
DB	-10.41	18	**< 0.001**	0.82	-0.92	-12.12	18	**< 0.001**	0.88	-0.94
DP	-23.69	18	**< 0.001**	0.12	-0.98	-37.80	18	**< 0.001**	0.11	-0.99
K	103.00	18	**< 0.001**	0.20	1.00	84.94	18	**< 0.001**	0.20	1.00
P	-81.67	18	**< 0.001**	0.07	-1.00	-94.12	18	**< 0.001**	0.06	-1.00
Y	-105.72	18	**< 0.001**	0.02	-1.00	-378.87	18	**< 0.001**	0.03	-1.00
Z	-1.82	18	0.10	1.24	-0.38	-7.51	18	**< 0.001**	1.15	-0.86
	(rNorm) - (Raw)					(zNorm) - (Raw)				
BB	5.21	18	**< 0.001**	2.30	0.76	-0.29	18	0.79	2.20	-0.06
BT	5.62	18	**< 0.001**	2.07	0.78	-1.95	18	0.08	2.24	-0.40
DB	10.76	18	**< 0.001**	1.01	0.92	-10.49	18	**< 0.001**	0.82	-0.92
DP	-1.59	18	0.15	0.11	-0.34	-48.75	18	**< 0.001**	0.17	-1.00
K	113.23	18	**< 0.001**	0.19	1.00	56.26	18	**< 0.001**	0.29	1.00
P	-19.76	18	**< 0.001**	0.04	-0.98	-153.96	18	**< 0.001**	0.07	-1.00
Y	56.61	18	**< 0.001**	0.02	1.00	-440.68	18	**< 0.001**	0.02	-1.00
Z	-2.48	18	**< 0.05**	1.35	-0.48	-8.79	18	**< 0.001**	1.49	-0.89

Table C.14: **Independent t-test analysis of PSD normalization with *Conf-1s* system**. H_0: $\mu_{PRE}(A) = \mu_{PRE}(B)$. H_1: $\mu_{PRE}(A) \neq \mu_{PRE}(B)$. With A and B normalization methods (table 3) specified on top of each cell as $(A) - (B)$.

Dat.	t	df	p-value	SE	r	t	df	p-value	SE	r
	(iqrNorm) - (Raw)					(normNorm) - (Raw)				
BB	-1.02	18	0.35	1.59	-0.22	-2.01	18	0.07	1.94	-0.41
BT	1.36	18	0.21	1.45	0.29	-4.44	18	**< 0.001**	1.45	-0.70
DB	11.77	18	**< 0.001**	0.46	0.93	7.70	18	**< 0.001**	0.59	0.86
DP	87.60	18	**< 0.001**	0.16	1.00	57.31	18	**< 0.001**	0.18	1.00
K	59.29	18	**< 0.001**	0.38	1.00	54.63	18	**< 0.001**	0.39	1.00
P	15.49	18	**< 0.001**	0.06	0.96	-16.68	18	**< 0.001**	0.09	-0.97
	(powNorm) - (Raw)					(prcNorm) - (Raw)				
BB	-0.80	18	0.45	1.70	-0.18	-2.43	18	**< 0.05**	1.86	-0.48
BT	-0.95	18	0.38	1.49	-0.21	-2.93	18	**< 0.05**	1.43	-0.55
DB	12.85	18	**< 0.001**	0.45	0.94	8.57	18	**< 0.001**	0.52	0.89
DP	106.52	18	**< 0.001**	0.13	1.00	73.02	18	**< 0.001**	0.14	1.00
K	60.89	18	**< 0.001**	0.38	1.00	49.64	18	**< 0.001**	0.41	1.00
P	-6.99	18	**< 0.001**	0.07	-0.84	-21.10	18	**< 0.001**	0.09	-0.98
	(rNorm) - (Raw)					(zNorm) - (Raw)				
BB	-1.06	18	0.33	1.64	-0.23	-1.16	18	0.29	2.05	-0.25
BT	2.23	18	**< 0.05**	1.29	0.45	-3.33	18	**< 0.01**	1.80	-0.60
DB	10.61	18	**< 0.001**	0.50	0.92	-1.65	18	0.13	0.58	-0.35
DP	103.14	18	**< 0.001**	0.14	1.00	66.51	18	**< 0.001**	0.15	1.00
K	54.98	18	**< 0.001**	0.41	1.00	48.76	18	**< 0.001**	0.41	1.00
P	13.20	18	**< 0.001**	0.07	0.95	-81.67	18	**< 0.001**	0.07	-1.00

Table C.15: **Independent t-test analysis of PSD normalization with *Conf-2s* system.** H_0: $\mu_{PRE}(A) = \mu_{PRE}(B)$. H_1: $\mu_{PRE}(A) \neq \mu_{PRE}(B)$. With A and B normalization methods (table 3) specified on top of each cell as $(A) - (B)$.

Dat.	t	df	p-value	SE	r	t	df	p-value	SE	r
	(iqrNorm) - (Raw)					(normNorm) - (Raw)				
BB	-0.73	18	0.49	0.93	-0.16	-2.51	18	**< 0.05**	1.17	-0.49
BT	1.74	18	0.12	1.72	0.36	-6.13	18	**< 0.001**	2.14	-0.81
DB	11.13	18	**< 0.001**	0.32	0.93	-4.31	18	**< 0.001**	0.39	-0.69
DP	79.21	18	**< 0.001**	0.11	1.00	49.56	18	**< 0.001**	0.13	1.00
K	54.42	18	**< 0.001**	0.38	1.00	42.65	18	**< 0.001**	0.40	0.99
P	-2.83	18	**< 0.05**	0.07	-0.53	-57.83	18	**< 0.001**	0.07	-1.00
	(powNorm) - (Raw)					(prcNorm) - (Raw)				
BB	-1.18	18	0.28	1.21	-0.25	-2.12	18	0.06	1.14	-0.43
BT	-2.18	18	0.05	2.00	-0.44	-3.46	18	**< 0.01**	2.19	-0.61
DB	10.47	18	**< 0.001**	0.29	0.92	5.67	18	**< 0.001**	0.32	0.78
DP	70.37	18	**< 0.001**	0.12	1.00	55.76	18	**< 0.001**	0.13	1.00
K	57.44	18	**< 0.001**	0.37	1.00	41.62	18	**< 0.001**	0.41	0.99
P	-38.51	18	**< 0.001**	0.07	-0.99	-25.39	18	**< 0.001**	0.08	-0.98
	(rNorm) - (Raw)					(zNorm) - (Raw)				
BB	-0.28	18	0.79	0.94	-0.06	-1.98	18	0.08	1.15	-0.40
BT	2.40	18	**< 0.05**	1.71	0.47	-5.41	18	**< 0.001**	2.06	-0.77
DB	13.50	18	**< 0.001**	0.28	0.95	-5.48	18	**< 0.001**	0.38	-0.77
DP	76.17	18	**< 0.001**	0.12	1.00	47.22	18	**< 0.001**	0.12	1.00
K	55.04	18	**< 0.001**	0.38	1.00	48.90	18	**< 0.001**	0.36	1.00
P	3.63	18	**< 0.01**	0.07	0.63	-117.75	18	**< 0.001**	0.08	-1.00

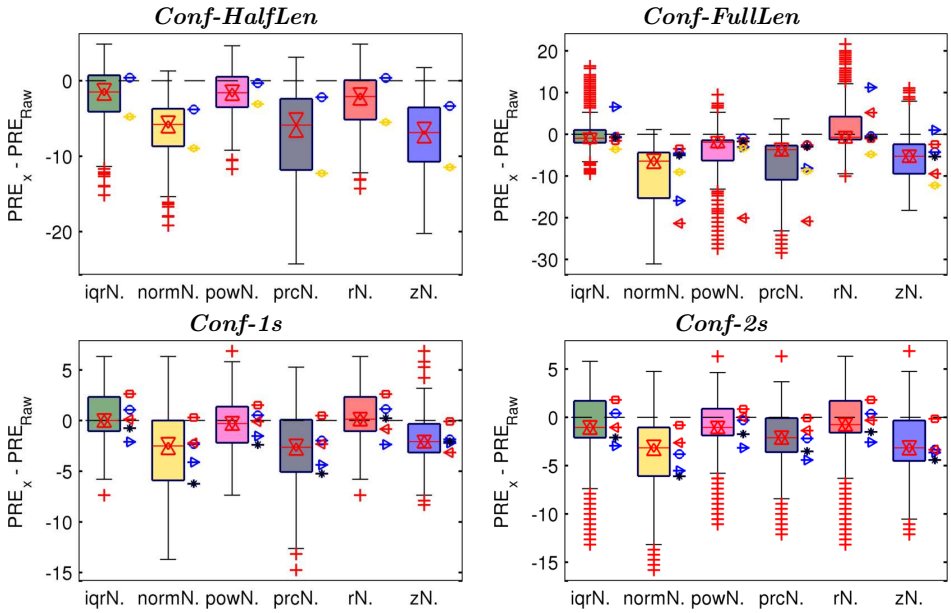

Figure C.7: **Quantitative analysis of PSD normalization with ADJUST processed data sets.** Relative PRE values between the PSD normalized by each of the methods in table 3 and the raw PSD. Results are stacked across databases. A maximum of 20 subjects was used in each experimental iteration. Refer to caption of figure 11 for details about the meaning of symbols within the image, to section 5.2 for a description of the results, and to fig. 13 for further related results.

Table C.16: **Independent t-test analysis of PSD normalization with *Conf-HalfLen* system and ADJUST processed data sets**. H_0: $\mu_{PRE}(A) = \mu_{PRE}(B)$. H_1: $\mu_{PRE}(A) \neq \mu_{PRE}(B)$. With A and B normalization methods (table 3) specified on top of each cell as $(A)-(B)$.

Dat.	**t**	**df**	**p-value**	**SE**	**r**	**t**	**df**	**p-value**	**SE**	**r**
	(iqrNorm) - (Raw)					(normNorm) - (Raw)				
BT	0.27	18	0.80	1.37	0.06	-5.47	18	**< 0.001**	1.29	-0.77
Z	-3.46	18	**< 0.01**	1.38	-0.61	-6.70	18	**< 0.001**	1.34	-0.83
	(powNorm) - (Raw)					(prcNorm) - (Raw)				
BT	-1.02	18	0.35	1.39	-0.22	-3.05	18	**< 0.01**	1.31	-0.56
Z	-2.87	18	**< 0.05**	1.08	-0.54	-7.67	18	**< 0.001**	1.60	-0.86
	(rNorm) - (Raw)					(zNorm) - (Raw)				
BT	1.01	18	0.35	1.25	0.22	-2.84	18	**< 0.05**	1.56	-0.54
Z	-4.79	18	**< 0.001**	1.15	-0.73	-9.09	18	**< 0.001**	1.26	-0.90

Table C.17: **Independent t-test analysis of PSD normalization with *Conf-FullLen* system and ADJUST processed data sets**. H_0: $\mu_{PRE}(A) = \mu_{PRE}(B)$. H_1: $\mu_{PRE}(A) \neq \mu_{PRE}(B)$. With A and B normalization methods (table 3) specified on top of each cell as $(A)-(B)$.

Dat.	**t**	**df**	**p-value**	**SE**	**r**	**t**	**df**	**p-value**	**SE**	**r**
	(iqrNorm) - (Raw)					(normNorm) - (Raw)				
BB	3.54	18	**< 0.01**	1.86	0.62	-7.36	18	**< 0.001**	2.17	-0.85
BT	5.04	18	**< 0.001**	2.41	0.75	-4.28	18	**< 0.001**	2.51	-0.69
DB	-0.69	18	0.52	1.07	-0.15	-18.95	18	**< 0.001**	1.13	-0.97
DP	-20.92	18	**< 0.001**	0.07	-0.98	-39.00	18	**< 0.001**	0.09	-0.99
P	-12.40	18	**< 0.001**	0.06	-0.94	-56.39	18	**< 0.001**	0.09	-1.00
Z	-4.69	18	**< 0.001**	0.77	-0.72	-10.62	18	**< 0.001**	0.85	-0.92
	(powNorm) - (Raw)					(prcNorm) - (Raw)				
BB	-1.50	18	0.17	2.03	-0.32	-3.75	18	**< 0.01**	2.17	-0.64
BT	1.44	18	0.19	2.34	0.31	-2.02	18	0.07	2.46	-0.41
DB	-18.84	18	**< 0.001**	1.07	-0.97	-20.05	18	**< 0.001**	1.04	-0.98
DP	-21.97	18	**< 0.001**	0.08	-0.98	-32.30	18	**< 0.001**	0.08	-0.99
P	-29.46	18	**< 0.001**	0.06	-0.99	-37.19	18	**< 0.001**	0.08	-0.99
Z	-3.67	18	**< 0.01**	0.92	-0.63	-10.24	18	**< 0.001**	0.86	-0.92
	(rNorm) - (Raw)					(zNorm) - (Raw)				
BB	6.04	18	**< 0.001**	1.86	0.80	0.50	18	0.64	2.01	0.11
BT	5.30	18	**< 0.001**	2.48	0.76	1.29	18	0.24	2.57	0.28
DB	4.13	18	**< 0.001**	1.25	0.68	-9.22	18	**< 0.001**	1.03	-0.90
DP	-11.79	18	**< 0.001**	0.09	-0.93	-31.06	18	**< 0.001**	0.08	-0.99
P	-11.80	18	**< 0.001**	0.07	-0.94	-61.42	18	**< 0.001**	0.09	-1.00
Z	-6.33	18	**< 0.001**	0.76	-0.82	-13.28	18	**< 0.001**	0.92	-0.95

Table C.18: **Independent t-test analysis of PSD normalization with *Conf-1s* system and ADJUST processed data sets**. H_0: $\mu_{PRE}(A) = \mu_{PRE}(B)$. H_1: $\mu_{PRE}(A) \neq \mu_{PRE}(B)$. With A and B normalization methods (table 3) specified on top of each cell as $(A) - (B)$.

Dat.	t	df	p-value	SE	r	t	df	p-value	SE	r
	(iqrNorm) - (Raw)					(normNorm) - (Raw)				
BB	-2.24	18	**< 0.05**	0.94	-0.45	-3.09	18	**< 0.01**	1.33	-0.57
BT	-1.77	18	0.11	0.77	-0.37	-5.23	18	**< 0.001**	0.82	-0.76
DB	0.30	18	0.78	0.35	0.07	-4.90	18	**< 0.001**	0.45	-0.74
DP	27.89	18	**< 0.001**	0.09	0.99	2.52	18	**< 0.05**	0.12	0.49
P	-8.26	18	**< 0.001**	0.09	-0.88	-60.10	18	**< 0.001**	0.10	-1.00
	(powNorm) - (Raw)					(prcNorm) - (Raw)				
BB	-1.56	18	0.15	0.98	-0.33	-3.24	18	**< 0.01**	1.35	-0.59
BT	-1.94	18	0.08	0.71	-0.40	-3.75	18	**< 0.01**	0.86	-0.64
DB	-0.27	18	0.80	0.39	-0.06	-5.46	18	**< 0.001**	0.42	-0.77
DP	17.57	18	**< 0.001**	0.09	0.97	5.66	18	**< 0.001**	0.09	0.78
P	-27.35	18	**< 0.001**	0.09	-0.99	-56.75	18	**< 0.001**	0.09	-1.00
	(rNorm) - (Raw)					(zNorm) - (Raw)				
BB	-2.57	18	**< 0.05**	0.92	-0.50	-2.23	18	**< 0.05**	0.99	-0.45
BT	-1.69	18	0.13	0.66	-0.35	-3.08	18	**< 0.01**	0.90	-0.57
DB	-2.53	18	**< 0.05**	0.33	-0.49	-7.07	18	**< 0.001**	0.45	-0.85
DP	30.71	18	**< 0.001**	0.09	0.99	-0.90	18	0.41	0.11	-0.20
P	2.74	18	**< 0.05**	0.08	0.52	-24.44	18	**< 0.001**	0.09	-0.98

Table C.19: **Independent t-test analysis of PSD normalization with *Conf-2s* system and ADJUST processed data sets**. H_0: $\mu_{PRE}(A) = \mu_{PRE}(B)$. H_1: $\mu_{PRE}(A) \neq \mu_{PRE}(B)$. With A and B normalization methods (table 3) specified on top of each cell as $(A) - (B)$.

Dat.	t	df	p-value	SE	r	t	df	p-value	SE	r
	(iqrNorm) - (Raw)					(normNorm) - (Raw)				
BB	-2.28	18	**< 0.05**	1.29	-0.45	-3.71	18	**< 0.01**	1.49	-0.64
BT	0.27	18	0.80	1.37	0.06	-5.47	18	**< 0.001**	1.29	-0.77
DB	-3.03	18	**< 0.01**	0.35	-0.56	-6.50	18	**< 0.001**	0.40	-0.82
DP	33.11	18	**< 0.001**	0.05	0.99	-10.53	18	**< 0.001**	0.08	-0.92
P	-52.40	18	**< 0.001**	0.04	-1.00	-119.74	18	**< 0.001**	0.05	-1.00
	(powNorm) - (Raw)					(prcNorm) - (Raw)				
BB	-2.58	18	**< 0.05**	1.23	-0.50	-3.28	18	**< 0.01**	1.35	-0.59
BT	-1.02	18	0.35	1.39	-0.22	-3.05	18	**< 0.01**	1.31	-0.56
DB	0.00	18	1.00	NaN	0.00	-3.24	18	**< 0.01**	0.42	-0.59
DP	12.77	18	**< 0.001**	0.07	0.94	-1.17	18	0.28	0.07	-0.25
P	-33.15	18	**< 0.001**	0.05	-0.99	-81.89	18	**< 0.001**	0.04	-1.00
	(rNorm) - (Raw)					(zNorm) - (Raw)				
BB	-1.90	18	0.09	1.36	-0.39	-2.54	18	**< 0.05**	1.43	-0.49
BT	1.01	18	0.35	1.25	0.22	-2.84	18	**< 0.05**	1.56	-0.54
DB	-0.80	18	0.45	0.39	-0.18	-7.64	18	**< 0.001**	0.44	-0.86
DP	32.45	18	**< 0.001**	0.06	0.99	-2.18	18	0.05	0.07	-0.44
P	-36.44	18	**< 0.001**	0.04	-0.99	-113.20	18	**< 0.001**	0.04	-1.00

Table C.20: **Independent t-test of permanence.** H_0: $\mu_{PRE}(A) = \mu_{PRE}(B)$. H_1: $\mu_{PRE}(A) > \mu_{PRE}(B)$. With A the regular CV procedure (no *sess-CV*) and B the *sess-CV* procedure. Note that for Keirn's data set, *Conf-HalfLen* is equivalent to *Conf-2s*.

Conf-HalfLen system

Dat.	**t**	**df**	**p-value**	**SE**	**r**	**t**	**df**	**p-value**	**SE**	**r**
	Raw PSD					*rNorm* PSD				
K	2.99	18	**< 0.01**	1.69	0.56	20.13	18	**< 0.001**	0.68	0.98
Y	45.01	18	**< 0.001**	0.39	1.00	66.52	18	**< 0.001**	0.12	1.00

Conf-FullLen system

Dat.	**t**	**df**	**p-value**	**SE**	**r**	**t**	**df**	**p-value**	**SE**	**r**
	Raw PSD					*rNorm* PSD				
K	3.70	18	**< 0.01**	1.01	0.64	24.94	18	**< 0.001**	0.62	0.98
Y	59.98	18	**< 0.001**	0.36	1.00	72.95	18	**< 0.001**	0.15	1.00

Conf-1s system

Dat.	**t**	**df**	**p-value**	**SE**	**r**	**t**	**df**	**p-value**	**SE**	**r**
	Raw PSD					*rNorm* PSD				
K	-0.09	18	0.54	1.09	-0.02	27.00	18	**< 0.001**	0.30	0.99

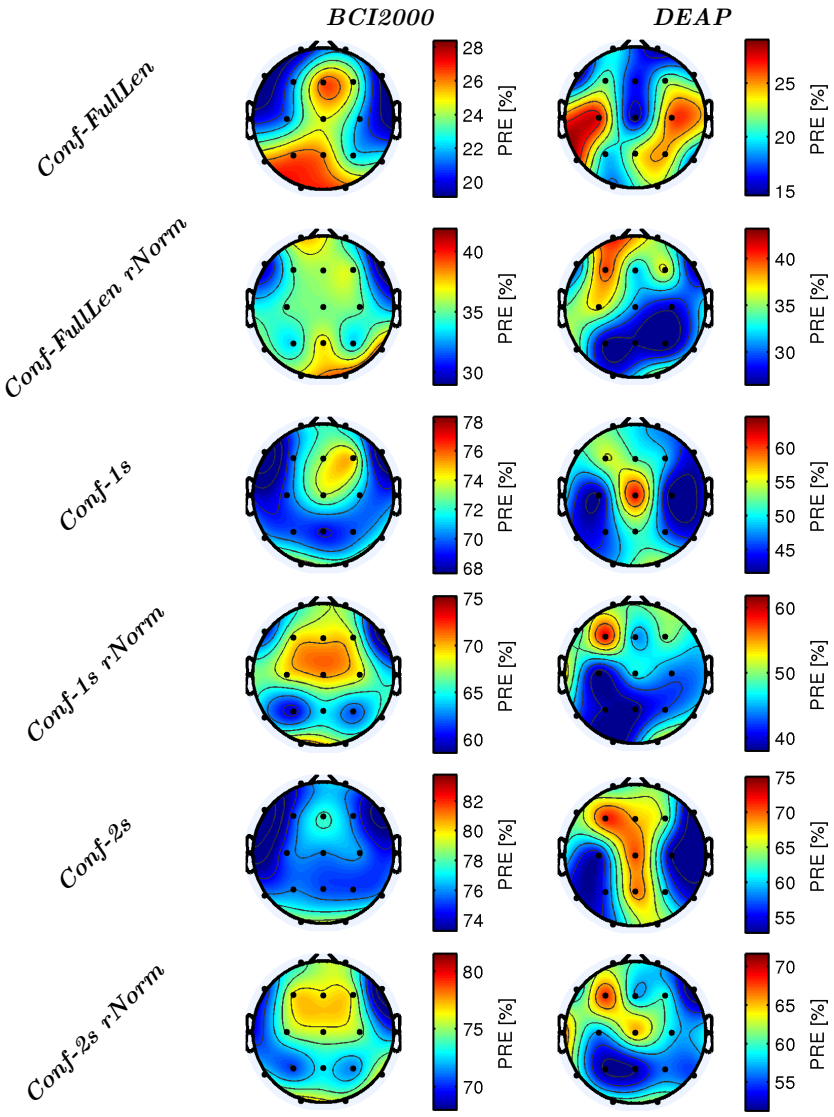

Figure C.8: **Quantitative analysis of the spatial distribution of the discriminant information.** Mean PRE values obtained at each location with the REO condition of BCI2000 (left) and DEAP (right) data sets when applying each system with and without *rNorm*. Results correspond to *freq-fusion ch-focus* experiments, with a maximum of 20 subjects used in each experimental iteration. Refer to section 6.1 for a description of the results, and to fig. 14 for further related results.

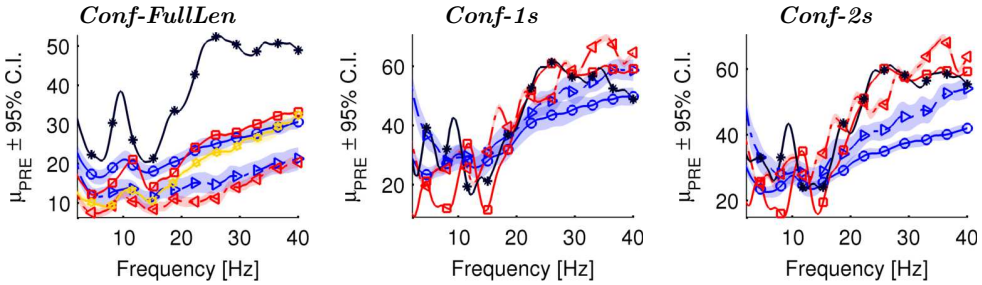

Figure C.9: **Quantitative analysis of the discrimination power frequency distribution with artefact free data sets.** Mean PRE and 95% CI (shaded area) obtained with each frequency (*ch-fusion* experiments). Curves where smoothed by local regression, using weighted linear least squares and a first degree polynomial model with a 3 Hz span. Graphs correspond to results obtained with the raw PSD of ADJUST processed databases. A maximum of 20 subjects was used in each experimental iteration. Refer to figure 7 for details on the legend, to section 6.2 for a description of the results, and to fig. 15 for further related results.

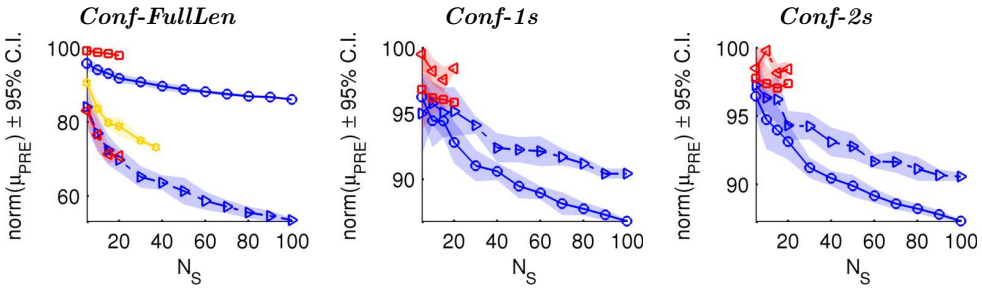

Figure C.10: **Quantitative analysis of uniqueness with artefact free data sets.** Mean PRE and 95% CI (shaded area) for different numbers of subjects (N_S) in the system and each database (refer to figure 7 for details on the legend). Graphs correspond to results obtained with the raw PSD of ADJUST processed databases. Refer to figure 7 for details on the legend, to section 6.3 for a description of the results, and to fig. 17 for further related results.