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# Does Gender Matter in Motor Imagery BCIs?

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**Introduction:** A major issue in application of Motor Imagery Brain-computer interfaces (MI-BCI) is BCI inefficiency, which affects 15-30% of the population [1]. Several studies have tried to examine the effect of gender on MI-BCI performance [2,3], however the reports remain inconsistent due to small sample sizes and unequal gender distribution in past research. Hence, this study aimed to address this gap by collecting a large sample of female and male BCI users and investigating the role of gender in MI-BCIs in a reliable and generalizable manner.

**Methods and Results:** Using openly available datasets [1,2,4,5], we gathered a large EEG dataset including 248 subjects (123 females, 125 males,  $M_{age} = 23.86$ ) who completed a similar two-class (left vs. right hand) MI protocol. Our analysis consisted of extracting Mu Suppression Index, which is indicative of mu-band (8-13 Hz) suppression in contralateral hemisphere compared to the ipsilateral one [1]. The Mu Suppression Index was calculated separately for each task (left and right-hand imagery) and then compared between gender groups. The results indicated no significant difference in the Mu Suppression Index of left ( $t(246) = -1.69, p = .09$ ) and right MI ( $t(246) = 1.26, p = .21$ ) between women and men.

**Discussion:** Contrary to the previous reports that suggest females can better modulate mu rhythm desynchronization during the MI task [1,6], our findings show no evidence for such superiority when the sample is sufficiently large and balanced to suppress the confounding effect of other variables such as an individual's personality and cognitive skills [2].

**Significance:** The findings shed light on the BCI inefficiency problem and guide development of future MI-BCI systems, e.g., by reconsidering gender-specific classification approaches [7].

## References

- [1] Alimardani, M., & Gherman, D. E. (2022, February). Individual Differences in Motor Imagery BCIs: a Study of Gender, Mental States and Mu Suppression. In *2022 10th International Winter Conference on Brain-Computer Interface (BCI)* (pp. 1-7). IEEE.
- [2] Leeuwis, N., Paas, A., & Alimardani, M. (2021). Vividness of visual imagery and personality impact motor-imagery brain computer interfaces. *Frontiers in Human Neuroscience*, *15*, 634748.
- [3] Pillette, L., Roc, A., N'Kaoua, B., & Lotte, F. (2021). Experimenters' influence on mental-imagery based brain-computer interface user training. *International Journal of Human-Computer Studies*, *149*, 102603.
- [4] Dreyer Pauline, Roc Aline, Rimbart Sébastien, Pillette Léa, & Lotte Fabien. (2023). A large database of motor imagery EEG signals and users' demographic, personality and cognitive profile information for Brain-Computer Interface research (Version 1) [Data set]. *Zenodo*. <https://doi.org/10.5281/zenodo.7516451>.
- [5] Cho, H., Ahn, M., Ahn, S., Kwon, M., & Jun, S. C. (2017). EEG datasets for motor imagery brain-computer interface. *GigaScience*, *6*(7), gix034.
- [6] Randolph, A. B. (2012, January). Not all created equal: individual-technology fit of brain-computer interfaces. In *2012 45th Hawaii International Conference on System Sciences* (pp. 572-578). IEEE.
- [7] Cantillo-Negrete, J., Gutierrez-Martinez, J., Carino-Escobar, R. I., Carrillo-Mora, P., & Elias-Vinas, D. (2014). An approach to improve the performance of subject-independent BCIs-based on motor imagery allocating subjects by gender. *Biomedical engineering online*, *13*(1), 1-15.