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# The potential of the 1/f EEG slope at rest for predicting BCI performance: a *brain criticality hypothesis for BCI use*

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*Introduction:* Recently, several studies have highlighted the influence of the *aperiodic*, *scale-free* component, i.e. the *1/f* slope, of the resting-state EEG on subsequent task performance. We investigated this relationship for subsequent BCI (brain-computer interface) performance [1]. We observed two opposing relationships. In a large cohort of healthy participants (n=55, recently reanalyzed in [2]), the BCI performance decreased with a steepening 1/f EEG slope at rest, whereas the opposite was observed in a single *locked-in* (LIS) patient with *amyotrophic lateral sclerosis* (ALS). To reconcile these conflicting results, we referred to the *brain criticality hypothesis* (see e.g., [3]). Brain criticality has been related to the 1/f EEG slope, where a flatter slope typically indicates greater criticality. According to the brain criticality hypothesis, cognitive processing capacity is optimal at the point of criticality, with reduced performance in subcritical and supercritical states. This nonlinear relationship helped us explain our findings and formulate *the brain criticality hypothesis for BCI use* that is presented here.

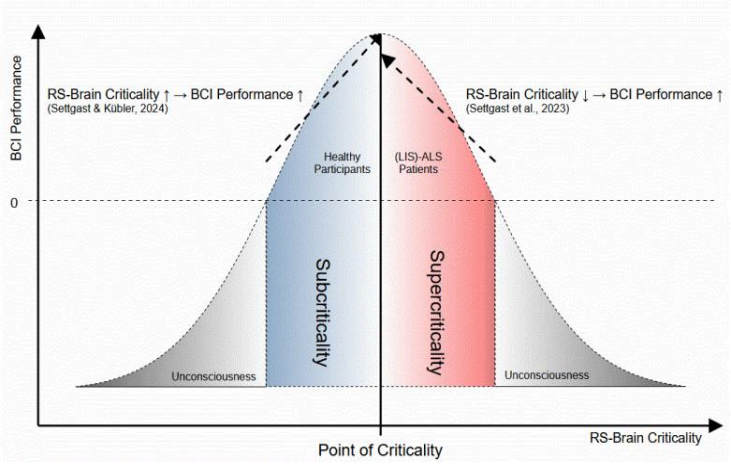


Figure 1: *Hypothetical relationship between resting-state (RS) brain criticality and BCI performance. The relationship is shown exemplarily for healthy participants (left; as found in [2]) and a LIS-ALS patient (right; as found in [1]).*

*Hypothesis*: Resting-state brain criticality predicts subsequent BCI performance. Performance improves as the brain approaches the point of criticality at rest, regardless of whether the starting point is subcritical or supercritical.

*Initial evidence*: Our results [1, 2] suggest that both healthy participants and a LIS-ALS patient benefit from approaching the point of criticality at rest for subsequent BCI performance. While BCI performance increases with increasing resting-state brain criticality in healthy participants (Figure 1, left), the opposite occurs in the LIS-ALS patient (Figure 1, right). In both cases, however, performance increases as one approaches the point of criticality at rest. The underlying assumption that brain criticality in ALS patients is generally elevated – eventually even being super-critical (Figure 1, right) – was recently supported by Trubshaw and colleagues [4] who showed the flattening of the 1/f EEG slope, consistent with increased criticality, in a large cohort of ALS patients.

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