

COMMENTARY TO HABILITATION THESIS¹

Brief characteristic of the investigated matter: In the presented habilitation thesis, higher brain functions and resting-state mental activity in human were investigated using electroencephalography (EEG). The overarching goal was to contribute to the knowledge on neuronal substrate of these processes which might be exploited to improve diagnostics and treatment in neuropsychiatry in future.

Objectives of the work: The first main objective was to investigate spatio-temporal characteristics of event-related electrophysiological activity, i.e. event-related potentials (ERP), with the aim to contribute to the knowledge on neuronal substrate of non-motor and movement-related cognitive functions. The second main objective was to explore the large-scale brain network dynamics during the resting-state with a special focus on the identification of abnormalities in affective disorders that might provide knowledge needed for deep brain stimulation (DBS) implementation in treatment of depression. Additionally, we aimed to provide reviews on some clinical aspects of ERP and DBS techniques.

Methodologies: We employed methods of the scalp and intracerebral EEG, both separately and simultaneously, during different cognitive tasks and in resting conditions. We used several analytical approaches including ERP investigations, microstate analysis, and functional and effective connectivity estimations.

Results: Concerning the first objective, we extended current knowledge in human neurophysiology by identifying brain regions within the temporal and frontal cortices that are involved in non-motor cognitive functions [1], we provided evidence that hippocampal activity is related to the evaluation of stimulus meaning rather than to the motor response during a simple sensorimotor task [2], and we first showed that the primary motor cortex is implicated in the executive control of actions that are not motor in nature [3]. One of the most studied ERP components is the P3 waveform that was traditionally viewed as reflecting orientation, attention, update of working memory, decision, and cognitive closure of stimulus identification. Nevertheless, our team brought the first intracerebral evidence that the P3 phenomenon might be related not only to these non-motor cognitive functions but also to the movement-related ones [4,5]. It is generally accepted that the control of intentional motor action involves brain

¹ The commentary must correspond to standard expectations in the field and must include a brief characteristic of the investigated matter, objectives of the work, employed methodologies, obtained results and, in case of co-authored works, a passage characterising the applicant's contribution in terms of both quality and content.

operations that select, plan, and execute the movement. Our research group extended the knowledge on this topic when we identified large-scale brain networks that might be involved in the process of movement execution [4,5] and in the process of comparison between the intended and actually performed motor action [6,7]. Besides its utility in disclosing electrophysiological correlates of mental operations the ERP phenomenon can also be considered with respect to its clinical utility. Attempts to exploit the ERP technique as a possible diagnostic tool for functional brain impairments following a mild traumatic brain injury were summarized in our recent review [8].

Concerning the second objective, our team provided the first evidence of hierarchical functional linkage in the cross-frequency domain between the resting-state electrophysiological activity of the subthalamic nucleus and cortex in human [9]. Moreover, our three high-density scalp EEG studies contributed to the understanding of resting-state large-scale brain network activity in affective disorders [10-12]. We demonstrated interindividual differences in large-scale brain network dynamics related to depressive symptomatology [10] and brought the first evidence for disruption of resting-state brain network dynamics in euthymic patients with bipolar disorder [11]. In the effective (directed functional) connectivity study we showed a higher-than-normal functional connectivity arising from the right amygdala in depressive patients supporting the view that the amygdala plays an important role in the neurobiology of depression [12].

DBS has proven effective in the treatment of pharmacoresistant Parkinson's disease, although it can be accompanied by various complications [13]. Furthermore, there is also preliminary evidence for the efficacy and safety of DBS for treating pharmacoresistant depression. In our recent review we provided updated knowledge substantiating the suitability of each of the current and potential future DBS targets for treating depression [14]. Despite myriad DBS targets for treating depression tested in human, the amygdala is not among them. From this perspective, our recent finding of higher-than-normal functional connectivity arising from the right amygdala in depressive patients [12] contributes to the knowledge that is needed to evaluate deep brain structures as possible candidates for DBS treatment in depression.

Significance: Our findings contribute to a better understanding of the neuronal substrate of both resting-state mental activity and higher brain functions in human. Additionally, the electrophysiological patterns discovered by our team that are associated with depression or related to bipolar disorder might help improve diagnostics and therapy of affective disorders in future.

[1]² **DAMBORSKA, A.**, M. BRAZDIL, I. REKTOR, E. JANOUSOVA, J. CHLADEK a M. KUKLETA. Late Divergence of Target and Nontarget ERPs in a Visual Oddball Task. *Physiological Research* [online]. 2012, **61**(3), 307–318. ISSN 0862-8408. Dostupné z: doi:[10.33549/physiolres.932237](https://doi.org/10.33549/physiolres.932237)

Document Type: Article; IF = 1,531; Quartile by IF: PHYSIOLOGY Q3; Quartile by AIS: PHYSIOLOGY Q4

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
70	0	95	40

[2] ROMAN, Robert, Milan BRAZDIL, Jan CHLADEK, Ivan REKTOR, Pavel JURAK, Miroslav SVETLAK, **Alena DAMBORSKA**, Daniel J. SHAW a Miloslav KUKLETA. Hippocampal Negative Event-Related Potential Recorded in Humans During a Simple Sensorimotor Task Occurs Independently of Motor Execution. *Hippocampus* [online]. 2013, **23**(12), 1337–1344. ISSN 1050-9631. Dostupné z: doi:[10.1002/hipo.22173](https://doi.org/10.1002/hipo.22173)

Document Type: Article; IF = 4,302; Quartile by IF: NEUROSCIENCES Q1; Quartile by AIS: NEUROSCIENCES Q1

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
0	0	5	5

[3] KUKLETA, Miloslav, **Alena DAMBORSKA** **(corresponding author)**, Robert ROMAN, Ivan REKTOR a Milan BRAZDIL. The primary motor cortex is involved in the control of a non-motor cognitive action. *Clinical Neurophysiology* [online]. 2016, **127**(2), 1547–1550. ISSN 1388-2457. Dostupné z: doi:[10.1016/j.clinph.2015.11.049](https://doi.org/10.1016/j.clinph.2015.11.049)

Document Type: Article; IF = 3,866; Quartile by IF: CLINICAL NEUROLOGY Q1+ NEUROSCIENCES Q2; Quartile by AIS: CLINICAL NEUROLOGY Q2 + NEUROSCIENCES Q2

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
0	0	50	30

[4] **DAMBORSKÁ, A.**, M. BRÁZDIL, P. JURÁK, R. ROMAN a M. KUKLETA. Steep U-shaped EEG potentials preceding the movement in oddball paradigm: Their role in movement triggering. *Homeostasis in Health and Disease*. 2001, **41**(1–2), 60–63.

Document Type: Article; SJR Category: PSYCHIATRY and MENTAL HEALTH Q3

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
70	0	90	30

[5] **DAMBORSKÁ, A.**, M. BRÁZDIL, I. REKTOR, R. ROMAN a M. KUKLETA. Correlation between stimulus-response intervals and peak amplitude latencies of visual P3 Waves. *Homeostasis in Health and Disease*. 2006, **44**(4), 165–168.

Document Type: Article; SJR Category: PSYCHIATRY and MENTAL HEALTH Q3

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
70	0	90	30

² Bibliographic record of a published scientific result, which is part of the habilitation thesis.

[6] DAMBORSKA, Alena, Robert ROMAN, Milan BRAZDIL, Ivan REKTOR a Miloslav KUKLETA. Post-movement processing in visual oddball task - Evidence from intracerebral recording. *Clinical Neurophysiology* [online]. 2016, **127**(2), 1297–1306. ISSN 1388-2457. Dostupné z: doi:[10.1016/j.clinph.2015.08.014](https://doi.org/10.1016/j.clinph.2015.08.014)

Document Type: Article; IF = 3,866; Quartile by IF: CLINICAL NEUROLOGY Q1 + NEUROSCIENCES Q2; Quartile by AIS: CLINICAL NEUROLOGY Q2 + NEUROSCIENCES Q2

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
70	0	95	100

[7] KUKLETA, Miloslav, Alena DAMBORSKA **(corresponding author)**, Baris TURAK a Jacques LOUVEL. Evoked potentials in final epoch of self-initiated hand movement: A study in patients with depth electrodes. *International Journal of Psychophysiology* [online]. 2017, **117**, 119–125. ISSN 0167-8760. Dostupné z: doi:[10.1016/j.ijpsycho.2017.05.004](https://doi.org/10.1016/j.ijpsycho.2017.05.004)

Document Type: Article; IF = 2,868; Quartile by IF: NEUROSCIENCES Q3 + PHYSIOLOGY Q2 + PSYCHOLOGY Q2; Quartile by AIS: NEUROSCIENCES Q2 + PHYSIOLOGY Q2 + PSYCHOLOGY Q2

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
0	0	50	20

[8] GOMES, J. a A. DAMBORSKÁ **(corresponding author)**. Event-Related Potentials as Biomarkers of Mild Traumatic Brain Injury. *Activitas Nervosa Superior* [online]. 2017, **59**(3–4), 87–90. Dostupné z: doi:[10.1007/s41470-017-0011-2](https://doi.org/10.1007/s41470-017-0011-2)

Document Type: Review; SJR Category: NEUROLOGY Q4

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
0	100	50	100

[9] DAMBORSKA, Alena, Martin LAMOS, Denis BRUNET, Serge VULLIEMOZ, Martina BOCKOVA, Barbora DEUTSCHOVA, Marek BALAZ a Ivan REKTOR. Resting-State Phase-Amplitude Coupling Between the Human Subthalamic Nucleus and Cortical Activity: A Simultaneous Intracranial and Scalp EEG Study. *Brain Topography* [online]. 2021, **34**(3), 272–282. ISSN 0896-0267. Dostupné z: doi:[10.1007/s10548-021-00822-8](https://doi.org/10.1007/s10548-021-00822-8)

Document Type: Article; IF = 4,275; Quartile by IF: CLINICAL NEUROLOGY Q2 + NEUROSCIENCES Q2; Quartile by AIS: CLINICAL NEUROLOGY Q2 + NEUROSCIENCES Q2

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
90	50	95	50

[10] DAMBORSKA, Alena, Miralena TOMESCU, Eliska HONZIRKOVA, Richard BARTECEK, Jana HORINKOVA, Sylvie FEDOROVA, Simon ONDRUS a Christoph M. MICHEL. EEG Resting-State Large-Scale Brain Network Dynamics Are Related to Depressive Symptoms. *Frontiers in Psychiatry* [online]. 2019, **10**, 548. ISSN 1664-0640. Dostupné z: doi:[10.3389/fpsyt.2019.00548](https://doi.org/10.3389/fpsyt.2019.00548)

Document Type: Article; IF = 2,849; Quartile by IF: PSYCHIATRY Q2; Quartile by AIS: PSYCHIATRY Q2

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
70	100	95	100

[11] DAMBORSKA, Alena, Camille PIGUET, Jean-Michel AUBRY, Alexandre G. DAYER, Christoph M. MICHEL a Cristina BERCHIO. Altered Electroencephalographic Resting-State Large-Scale Brain Network Dynamics in Euthymic Bipolar Disorder Patients. *Frontiers in Psychiatry* [online]. 2019, **10**, 826. ISSN 1664-0640. Dostupné z: doi:[10.3389/fpsyt.2019.00826](https://doi.org/10.3389/fpsyt.2019.00826)

Document Type: Article; IF = 2,849; Quartile by IF: PSYCHIATRY Q2; Quartile by AIS: PSYCHIATRY Q2

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
70	0	95	100

[12] DAMBORSKA, Alena, Eliska HONZIRKOVA, Richard BARTECEK, Jana HORINKOVA, Sylvie FEDOROVA, Simon ONDRUS, Christoph M. MICHEL a Maria RUBEGA. Altered directed functional connectivity of the right amygdala in depression: high-density EEG study. *Scientific Reports* [online]. 2020, **10**(1), 4398. ISSN 2045-2322. Dostupné z: doi:[10.1038/s41598-020-61264-z](https://doi.org/10.1038/s41598-020-61264-z)

Document Type: Article; IF = 4,380; Quartile by IF: MULTIDISCIPLINARY SCIENCES Q1; Quartile by AIS: MULTIDISCIPLINARY SCIENCES Q2

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
70	100	50	100

[13] LUDOVICO, I. a A. DAMBORSKÁ *(corresponding author)*. Deep Brain Stimulation in Parkinson's Disease: Overview and Complications. *Activitas Nervosa Superior* [online]. 2017, **59**(1), 4–11. Dostupné z: doi:[10.1007/s41470-017-0003-2](https://doi.org/10.1007/s41470-017-0003-2)

Document Type: Review; SJR Category: NEUROLOGY Q4

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
0	100	50	100

[14] DROBISZ, Dominik a Alena DAMBORSKA *(corresponding author)*. Deep brain stimulation targets for treating depression. *Behavioural Brain Research* [online]. 2019, 359, 266–273. ISSN 0166-4328. Dostupné z: doi:[10.1016/j.bbr.2018.11.004](https://doi.org/10.1016/j.bbr.2018.11.004)

Document Type: Review; IF = 2,977; Quartile by IF: BEHAVIORAL SCIENCES Q2 + NEUROSCIENCES Q3; Quartile by AIS: BEHAVIORAL SCIENCES Q2 + NEUROSCIENCES Q3

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
0	100	50	100