



## Editorial

## Event-related potentials as possible indicators of behavioral intervention outcome in tic disorders



See Article, pages 1041–1057

Tic disorders (TD), including the Gilles de la Tourette syndrome, are neuropsychiatric disorders, showing lifelong, fluctuating, multiple motor, vocal and sensory tics. These symptoms are characterized by non-voluntary and repetitive contractions of functionally related skeletal muscles in several body parts, including head or knee jerks, cheek twitches, simple forms of blinking, head slapping, teeth grinding, and tense-released hand gripping (Brandt et al., 2014). These symptoms of tics often show some stereotyped and goal-directed movements with longer duration, such as grooming-like movements and facial gestures. Furthermore, the vocal types of tics range from simple sounds, such as barking, sniffing, or coughing, to more complex vocalizations, such as coprolalia or echolalia. The symptoms of tics sometimes fluctuate over the long time course of weeks or months. Tics typically manifest during adolescence, prior to the age of 18 years, with a peak around 12 years (Walkup et al., 2010).

In this issue of *Clinical Neurophysiology*, Morand-Beaulieu and colleagues provide a comprehensive review on previous studies regarding cognitive and motor-related event-related potentials (ERPs) in TS patients and found that the results of early contingent-negative variation (CNV) studies are consistent in showing a reduction in both children and adults with TS (Morand-Beaulieu et al., 2018). Differences in motor-related potentials between healthy controls and TS patients are consistent and related to impairments in fine motor skills found in TS (Abramovitch et al., 2017). They suggest that motor-related and slow cortical potentials could constitute electrophysiological markers of TS (Morand-Beaulieu et al., 2018).

On the other hand, they report many discrepancies of the results of N2 and P3b studies (Morand-Beaulieu et al., 2018) and conclude that most studies lacked the necessary power and suffered from various confounding factors, such as comorbidity, age, or medication status to detect reliably significant findings. Discrepancies between studies might also be caused by the different paradigms used in these studies, or by the inclusion of patients with comorbid disorders or with varying levels of symptoms' severity (Morand-Beaulieu et al., 2018). Future studies should try to highlight the factors influencing P3b amplitude in TS patients.

Recently, non-pharmacological and behavioral interventions are often utilized as first choice of TD treatment. These approaches, which include occupational therapy (OT), cognitive behavior

therapy (CBT), exposure and response prevention, and habit reversal therapy, showed similar efficacy to pharmacological medication (McGuire et al., 2014), but with less side effects (Whittington et al., 2016).

Most of these behavioral treatments have primarily focused on the reduction of the frequency, number and intensity of tics rather than the occupational performance of the patients with TD. The occupational therapists are highly relevant in this field because of the characteristics of these behavioral treatments to reduce the severity of tic expression. The objective evaluation of the behavioral treatment effect on the occupational performance of TD patients may encourage the occupational therapists to improve the behavioral intervention and long-term outcomes (Rowe et al., 2013).

OT is defined as a behavioral and client-centered intervention to promote health and well-being through occupation by helping people to participate in the activities of everyday life. Occupational therapists accomplish this purpose by enhancing the patients' capability to modify the occupation or the environment for better support of their occupational engagement (Rowe et al., 2013). OT has the very clear purpose to help and support patients with any type of inability or performance deficits, and to express meaning through intentional and organized performance called as occupation (Crabtree, 1998).

CBT, used by mental health professionals including occupational therapists, is another type of behavioral intervention. CBT has a present-oriented therapy structure to teach skills for patients to modify dysfunctional thinking and behavior. OT and CBT share the cognitive-behavioral frame of reference. The main therapeutic outcome of behavioral interventions including OT and CBT focus on the assistance for the patients in managing tic expression and the improvement of their occupational performance in ordinary life (Rowe et al., 2013).

However, the response rate in TD patients to behavioral intervention is still partial and limited (O'Connor et al., 2016). Although predictive markers would be crucial to optimize the treatment modality before behavioral intervention, the potential of neuropsychological batteries as treatment outcome predictors seems relatively limited. Neuropsychological tests measuring inhibitory functions, working memory, and habit learning did not predict behavioral treatment outcomes in children with TD (Abramovitch et al., 2017).

On the other hand, Morand-Beaulieu and colleagues suggest that electrophysiological markers could offer new predictors for therapeutic outcome in TD patients with its high temporal precision to follow the stream of fast cognitive and motor processes in this first systematic review of ERPs in TS patients (Morand-Beaulieu et al., 2018). ERPs were useful to predict OT and CBT outcome in other psychiatric disorders, such as anxiety disorders, depression and obsessive-compulsive disorder (Krause et al., 2015; Burkhouse et al., 2016), but has yet to be tested in TD. They suggested that motor-related and slow cortical potentials could constitute electrophysiological markers of TS (Morand-Beaulieu et al., 2018).

In previous studies of these authors, they also reported the impact of behavioral intervention on TS patients' ERP, such as a normalization of ERP components related to motor preparation and execution, namely the onset and the peak amplitude of the stimulus-locked and response-locked lateralized readiness potentials, respectively (Morand-Beaulieu et al., 2015), and a reduced P3b amplitude during a visual counting oddball task in TS patients (Morand-Beaulieu et al., 2016). They concluded that the CBT allowed a parietally localized normalization of this component to the level of healthy controls. Resting-state EEG and functional connectivity measures could be other targets in future clinical studies to test the neurophysiological impact of behavioral intervention in TS patients.

#### Conflict of interest statement

None.

#### References

- Abramovitch A, Hallion LS, Reese HE, Woods DW, Peterson A, Walkup JT, et al. Neurocognitive predictors of treatment response to randomized treatment in adults with tic disorders. *Prog Neuro-Psychopharmacol Biol Psychiatry* 2017;74:9–14.
- Brandt VC, Niessen E, Ganos C, Kahl U, Bäumer T, Münchau A. Altered synaptic plasticity in Tourette's syndrome and its relationship to motor skill learning. *PLoS One* 2014;9:e98417.
- Burkhouse KL, Kujawa A, Kennedy AE, Shankman SA, Langenecker SA, Phan KL, et al. Neural reactivity to reward as a predictor of cognitive behavioral therapy response in anxiety and depression. *Depress Anxiety* 2016;33:281–8.
- Crabtree JL. The end of occupational therapy. *Am J Occup Ther* 1998;52:205–14.
- Krause D, Folkerts M, Karch S, Keeser D, Chrobok AI, Zaudig M, et al. Prediction of treatment outcome in patients with obsessive-compulsive disorder with low-resolution brain electromagnetic tomography: a prospective EEG study. *Front Psychol* 2015;6:1993.
- McGuire JF, Piacentini J, Brennan EA, Lewin AB, Murphy TK, Small BJ, et al. A meta-analysis of behavior therapy for Tourette Syndrome. *J Psychiatr Res* 2014;50:106–12.
- Morand-Beaulieu S, O'Connor KP, Sauvé G, Blanchet PJ, Lavoie ME. Cognitive-behavioral therapy induces sensorimotor and specific electrocortical changes in chronic tic and Tourette's disorder. *Neuropsychologia* 2015;79:310–21.
- Morand-Beaulieu S, O'Connor KP, Richard M, Sauvé G, Leclerc JB, Blanchet PJ, et al. The impact of a cognitive-behavioral therapy on event-related potentials in patients with tic disorders or body-focused repetitive behaviors. *Front Psychiatry* 2016;7:81.
- Morand-Beaulieu S, O'Connor KP, Blanchet PJ, Lavoie ME. Electrophysiological predictors of cognitive-behavioral therapy outcome in tic disorders. *J Psychiatr Res* 2018;105:113–22.
- O'Connor K, Lavoie M, Blanchet P, St-Pierre-Delorme ME. Evaluation of a cognitive psychophysiological model for management of tic disorders: an open trial. *Br J Psychiatry* 2016;209:76–83.
- Rowe J, Yuen HK, Dure LS. Comprehensive behavioral intervention to improve occupational performance in children with Tourette disorder. *Am J Occup Ther* 2013;67:194–200.
- Walkup JT, Ferrao Y, Leckman JF, Stein DJ, Singer H. Tic disorders: some key issues for DSM-V. *Depress Anxiety* 2010;27:600–10.
- Whittington C, Pennant M, Kendall T, Glazebrook C, Trayner P, Groom M, et al. Practitioner Review: treatments for Tourette syndrome in children and young people - a systematic review. *J Child Psychol Psychiatry* 2016;57:988–1004.

Ryouhei Ishii\*

Graduate School of Comprehensive Rehabilitation, Osaka Prefecture University, Osaka, Japan

Department of Psychiatry, Osaka University Graduate School of Medicine, Osaka, Japan

\* Corresponding author at: Graduate School of Comprehensive Rehabilitation, Osaka Prefecture University, Habikino 3-7-30, Habikino City, 583-8555 Osaka, Japan.

E-mail address: [ishii@psy.med.osaka-u.ac.jp](mailto:ishii@psy.med.osaka-u.ac.jp)

Masahiro Hata

Department of Psychiatry, Osaka University Graduate School of Medicine, Osaka, Japan

Accepted 2 April 2019

Available online 9 April 2019