Preparation and Motor Potentials in Chronic Tic and Tourette Syndromes

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Many studies have found that people with tic disorder show more difficulty when inhibiting an automated than a controlled response. Furthermore, although normal motor threshold and excitability are present, but reduced or impaired, motor inhibition seems manifest in patients with tic. In order to localize this inhibition impairment in tic disorder the present study examine two response-locked ERPs: the Bereitschaft (preparation BP) and the motor potentials (MP). The simple tic group showed faster BP latency and smaller amplitude than control and complex tic group and did not show a corresponding change in values with practice or with automated or controlled condition. The MP amplitudes revealed that whereas both controls and complex tic disorder showed a decrease in amplitude during control condition for both blocks, simple tic showed larger amplitude. Our ERP results are in agreement with RT results of a previous study. The explanation could lie with modulation in motor excitation inhibition circuits and seems worse in simple tics where the movements are more automatic and nonvoluntary.

Introduction

Tics are recurrent nonrhythmic series of muscle movements that can be classified as simple or complex. There are two principal tic disorders: chronic multiple tic (CMT) and Gilles de Tourette syndrome (TS) which involves vocal as well as motor tic. Despite some initial research showing nonspecific EEG abnormalities—there has been little electrophysiological research in tics (Silverman & Loychick, 1990).

Previous studies on impulsive disorder have shown these people to be hyperactive and over aroused and prone to startle reflexes (Sachder et al., 1997; Commander et al., 1991). Using a countermanding paradigm, O’Connor et al. (1999) adapted to be an analogue of a high risk situation found no difference in psychomotor speed between those with CMT and non-tic controls. The authors did find that participants with tic showed more difficulty when inhibiting an automated than a controlled response and showed no practice effect in performance over trial blocks. Zieman et al. (1997) reports evidence of normal motor threshold and excitability but reduced or impaired motor inhibition in TS. The finding relates to inhibition but not to excitability, and likewise Georgiou et al. (1997) found no impairment in TS with fast, goal-directed movements. In order to better pinpoint the inhibition impairment in tic disorder the present study report response-locked ERPs recorded in relation to RT foreperiod. Our hypotheses were that people with tic disorders show less efficient and adaptive preparatory and response strategies and this would be reflected in amplitude and latency effects of the BP (readiness potential) and motor potentials (MP).

Method

Participants. Twenty-four complex tic, 18 simple, and 24 controls originally participated in our study. After elimination due to artifact or technical problems, 43 subjects remained (14 controls, 17 complex, and 12 simple). The majority of the subjects were tested pretreatment but 21 were recorded posttreatment.

EEG recording and data extraction. Electrodes were placed according to the 10/20 system at Fz, C3, C4, and Pz to give a topographical and lateral view of the distribution. The signal was fed through GRASS preamps model 12C with 4-s time constant at a sampling rate of 250 Hz. The ISI was constant at 4000 ms. EOG artifact
was corrected offline in the frequency domain (Woestenburg method InstEP-TALO). The raw EEG-normalized signal was averaged offline, time locked to the response in two blocks of 52 trials for each of the two conditions (automatic and controlled processing) taken separately. The Bereitschaft potential (BP) was measured as the baseline-to-peak amplitude within a window of 300 ms prior to the response onset and the motor potentials (MP) was taken as the maximum negative peak occurring between 50 and 200 ms after response onset. Both peak amplitude and latency were submitted to a repeated measure MANOVA with a Greenhouse–Geisser correction for degrees of freedom where necessary.

Procedure: The traffic light tests. The ‘‘traffic light test’’ or foreperiod paradigm allowed us to compare the time to initiate a simple and complex response. Two sets of three lights appeared side by side on a computer screen in the form of traffic lights. One set signaled an automated and the other a controlled response sequence. Each trial began with one of the two yellow READY lights signaling that in four seconds the green GO light would come on and the subject would have to make either a controlled or a automated response. The automated response was three taps on a lever with the two fingers of the dominant hand. The controlled response was three taps of Morse code using another lever made with the same fingers. The levers were part of the same box assembly and permitted continuous analogue recording to monitor the response. The GO reaction time was calculated automatically by the computer. After a period of acclimatization, all subjects received two replications of 52 trials, with a short rest period between replications. Conditions were presented in random order.

Results

There were no main group or condition effects for BP latency but a group × condition × electrodes effect for BP latency was present (F(4.75, 94.93) = 2.78, p < .05). The simple tic group showed faster latency than the other two groups especially in the automated condition over the frontal regions, but did not show a corresponding change in values with practice.

The most significant findings concerned the MPs amplitude where there was a clear topographical effect over the central and frontal regions across all blocks and conditions (F(2.55, 102.06) = 9.80, p < .001) (Fig. 1). The MP amplitudes revealed a group × block effect (F(2, 40) = 4.12, p < .05) as well as a group × condition interaction (F(2, 40) = 3.17, p = .05). The latency also showed a group × condition × block interaction (F(2, 40) = 5.05, p < .05). Essentially, the controls showed a faster latency to the second block of trials. The control latency was longer than the tic groups for the first block but not for the second block of stimuli. Whereas both controls and complex tic showed a decrease in amplitude during the controlled response condition for both blocks, simple tic showed an increase in amplitude.

Discussion

The ERP results agree with RT results of a previous study (O’Connor et al., 1999) where people with tic had difficulty regulating their level of activation. The results seem to suggest no absolute differences in motor activation levels between simple or complex tic and control subjects. Rather there seems a problem in adapting motor activation levels to new complex tasks and profiting from practice effects especially with simple tic. This could be explained via modulation effects in motor excitation inhibition circuits and seems worse in simple tics where the movements are more
FIG. 1. Motor potential amplitude for control, simple, and complex tic disorders groups averaged over automated and controlled response conditions.

automatic and nonvoluntary. We suggest that future research focus on aspects of motor control and how this control is regulated under changing task demand.

REFERENCES


The Isomorphic Mapping Hypothesis: Evidence from Korean

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This paper evaluates the relative merits of the trace deletion hypothesis, which attributes agrammatic comprehension difficulties to the loss of traces, and the isomorphic mapping hypothesis, which proposes that agrammatics have difficulty understanding sentences in which there is a nonisomorphic mapping between the syntactic representation and the corresponding event in the real world. (The two are isomorphic if the order of NPs reflects the place of entities in the event’s ‘action chain.’ Since agents act on themes and transmit them to goals, the agent–theme–goal order is isomorphic with the corresponding event but the agent–goal–theme order is not.) The two hypotheses contrast in the predictions they make concerning goal–theme and theme–goal patterns in Korean: the TDH predicts degraded performance on