1. Introduction

The purpose of this article is to investigate how PD affects the configuration and activation of a selective motor set. The process of establishing links between stimuli and their corresponding motor responses is believed to be implemented by a network of circuits interconnecting the prefrontal cortex, motor cortex, and basal ganglia (the frontostriatal system, Alexander & Crutcher, 1990). More specifically, a circuit connecting the supplementary motor area with the basal ganglia has been repeatedly associated with the planning of complex motor functions such as bimanual coordination, movement planning, or self-generated motor set activation (e.g., Cunnington, Bradshaw, & Iansik, 1996; Hoshi & Tanji, 2004).

PD is a neurodegenerative syndrome linked to selective loss of dopaminergic neurons in the substantia nigra pars compacta, one of the subcortical nuclei that compose the basal ganglia. This type of lesion produces a number of clinical symptoms including slow movements, tremors, and rigidity. More importantly for our purposes is that vol-
According to the Grouping Model, the processing advantage of hand-cues simply reflects the natural, strong grouping of the two left-most and two right-most stimulus-response elements that leads to a fast, automatic priming or activation of fingers on the same hand. The co-activation of adjacent areas of the motor cortex corresponding to fingers from the same hand could be at the basis of this grouping. Finger- and neither-cues, on the other hand, are more difficult to process because they require slow, controlled modulation to break-up the default, left-right spatial organization and to create a new organization based on the characteristics of the cue. Hence, according to the Grouping Model, hand-cues are “easy” cues, inducing automatic, bottom-up control, whereas finger- and neither-cues are “difficult” cues, requiring slower, effortful, top-down processes to select and prepare the cued responses (Adam et al., 2005; Moresi et al., 2008; Posner, 1980).

The aim of the present study was to investigate the integrity of response preparation in individuals with PD in comparison to a group of healthy control subjects, matched for age, sex, and education. Of particular interest was whether PD would affect preparation efficiency differentially for cues prompting (automatic) within-hand preparatory processes vs. cues prompting (controlled) between-hands preparatory processes. Based on the processing assumption of the Grouping Model, we expected relatively small effects of PD on the more automatic preparatory effects associated with hand-cues (within-hand preparation), but a strong negative effect of PD on the more controlled preparatory effects associated with finger- and neither-cues (between-hands preparation). To investigate the temporal aspects of response preparation, we used a short (500 ms) and a long (2000 ms) preparation interval.

2. Method

2.1. Participants

The study was approved by the Institutional Review Board of Maastricht University Hospital. Participants gave written informed consent. Twenty PD patients were included. They were recruited from the neurological outpatient departments of the Maastricht University Hospital and the Atrium Medical Center. All patients were diagnosed with PD, according to the United Kingdom Parkinson’s Disease Society Brain Bank criteria. Patients who were diagnosed with any neurological disease other than PD, or with any psychiatric disorder, including depression, as defined by the criteria of the Diagnostic and Statistical Manual (DSM-IV) of the American Psychiatric Association, were excluded from participation. The presence of any psychiatric disorder, notably major depressive disorder, was established in an unstructured psychiatric interview assessing DSM-IV criteria. Other exclusion criteria were the use of psychoactive medication, such as antidepressants and antipsychotics; the use of l-dopa (direct dopaminergic effect); the abuse of alcohol or drugs; and dementia, which was operationally defined by a short psychiatric interview checking for the DSM-IV criteria and a score on the Mini-Mental State Examination (MMSE) of less than 23. Both patients and controls had an average MMSE score well above 23 (27.7 ± 1.5 vs. 28.6 ± 1.4, respectively), indicating no clinically relevant cognitive impairments. A prior personal or family history of depression was also reason for exclusion. Patients had a low mean HAMD score of 0.85 (± 0.9), indicating no clinically relevant signs of depression. Patients were tested on medication. For further clinical features of these patients and their individual medications see Table 1.
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