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DUAL TASK PERFORMANCE IN PARKINSON'S DISEASE

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ABSTRACT

Introduction: A capacity to perform two tasks at the same time is a prerequisite for an individual to have a normal life. Under normal circumstances, performing motor and cognitive tasks concomitantly is common. Objective: The aim of this study was investigate the motor-cognitive dual task performance in Parkinson's disease patients. Method: Two groups were studied. One group was composed by 10 healthy individuals and the other by 10 patients with a diagnosis of Parkinson's disease. In both groups, the ages were between 47 and 75 years and the individuals were paired in relation to gender and age. They were asked to put on a button-up shirt as fast as possible as a single task and also while saying girls' names in random order (dual task). Each task was repeated three times. The movement time and errors committed were analyzed. Results: The patients took more time to complete both tasks (p= 0.006) in relation to the healthy group. Both groups committed more errors in the dual task (p= 0.03). There was a reduction in the movement time with the repetition of the task (p= 0.039) for both groups. Conclusion: These results suggest that individuals with Parkinson's disease present a loss in motor performance in relation to healthy individuals. However, the cost of performing the task is independent of motor-cognitive interference and the possibility of performance's improvement with practice is real.

Key words: Dual task, Parkinson's disease, motor performance.

INTRODUCTION

In several activities of daily living more than one task are executed at the same time. The ability to execute dual tasks is highly advantageous and is a pre-requisite to normal life. A stroll, for example, allows for communicating with someone else, transporting of objects from one place to another and monitoring of the environment to avoid accidents[1,2]. In normal circumstances, the concomitant execution or motor and cognitive tasks is common, and in such situations, motor activities are performed "automatically", that is, no effort of conscious attention are required[3]. Such autonomous stage of performance of a motor ability[4] is achieved trough a process of motor learning in which practice and its variability bring about the formation of action programs[5].

Action programs are controlled by open circuit, with little interference of feedback[5]. Therefore, demands on attention mechanisms necessary to efficient performance are very low, facilitating attention to focus on other items relevant to task performance. From this point on, it is possible for an individual to execute a second task simultaneously with the first, without any interference in performance. The analysis of the performance cost of a task executed simultaneously with a secondary task is called dual task[6].

Performance in dual tasks is also known as simultaneous performance, and involves the execution of a primary task, which is the main focus of attention, and a secondary task, performed simultaneously[2]. The execution of two tasks at the same time demands a high level of information processing and thus performance of one or both tasks is deteriorated[7,8]. Decreased performance in the primary task is regarded as a consequence of the dual task and indicates lack of automatism[9]. The negative influence on the primary and or secondary task occurs because both tasks compete with similar processing demands[7].

The influence of cognition or motor control alterations (or both) in the performance of dual tasks can be an important indicator of the functional status of a patient during illness or during rehabilitation. In the literature, such alteration is usually regarded as motor-cognitive interference[10]. After a cerebral lesion, motor-cognitive interference can occur, causing activities which were previously automatic to require a controlled process, with increased attention demands. This in turn deteriorates performance in dual tasks[8].

Parkinson's Disease is a progressive degenerative disorder of the central nervous system characterized by impairments of the basal nuclei, with progressive loss of neurons from the substantia nigra pars compacta. The consequent alterations in motor control become remarkable resulting in rest tremor, rigidity, bradykinesia, postural alterations, balance and gait disturbances, among other symptoms[11,12]. Due to the variability in disease progression, Hoehn and Yar[13] developed a five-stage classification system to characterize patients in relation to their degree of dependence. It is a practical classification that allows assessments to be made by different examiners, regardless of the functional level of patients.

Patients with Parkinson's Disease can generate normal motor patterns when they focus their attention on performance, that is, when they think on the execution of movements. This way they activate the intact pre-motor cortex area and avoid relying on the impaired circuitry of the basal nuclei to and assist in the production of movements. In dual task situations, the use of these cortical resources to execute motor tasks can restrict performance in both tasks. The objective of this study is to analyze the performance of patients with Parkinson's Disease in the execution of a motor-cognitive dual task.

METHODS

Subjects

Twenty individuals comprising two groups took part in this study. The experimental group was composed by patients with a medical diagnosis of Parkinson's Disease with ages varying between 47 and 75 years (62.3 ± 9.74 years). There were nine men and one woman. Patients were requested to maintain their usual medication during data collection. Patients were characterized according to the Hoehn and Yahr scale[13], with scores varying between 1 and 5, according to patient symptoms and degree of dependence. Patients were also assessed with the Mini Mental State Examination (MMEE)[14], that has a maximum score of 30 points, with scores lower than 24 suggesting dementia. The control group was comprised of healthy volunteers without any history of associated diseases, complaints that interfered in their activities of daily living or alterations in the MMEE. Their ages varied between 50 and 75 years (60.7 ± 9.75 years). The control group was also composed of nine men and one woman.

Procedures

The study was approved by the Methodist University of São Paulo Ethics Committee (Document nº158/04). One researcher that had not previously met any of the study participants performed the assessments. Each participant was individually directed to a partially soundproof and artificially lit experimental room. Patients were positioned in a stool with the feet properly supported. Instructions about procedures of the study were given to patients and they formally agreed to take part in the study.

The test was performed in two sessions that happened in consecutive days. Participants performed three repetitions of the task in each session. In on session, after a signal of the researcher, individuals dressed up a button shirt as fast as they could, and the time taken to complete the task was registered by a chronometer (Sport Time®). In the other session, while executing the same task as before, the participants were requested to say female first names. The order of the sessions was randomized between participants.

Statistical Analysis

Variables used in this study were submitted to analysis of variance (ANOVA) for repeated measures and to the Newman-Keuls test at post-test, when appropriate. Group (experimental and control), task (simple and dual) and repetitions (1,2 and 3) were considered main effects. A level of significance of 0.05 was used. Descriptive analyses were performed for the Hoehn and Yahr scale, MEEM and age off participants of both groups.

RESULTS

Clinical characteristics of the ten patients with medical diagnoses of Parkinson's Disease that took part in the experimental group are described in Table 1.

Table 1. Description of the Parkinson's disease patients of the experimental group in relation to the age, gender, instruction level (Inc.= incomplete), Hoehn & Yahr scale, MMSE score and medication.

Subject	Age	Gender	Instruction level	Hoehn Yahr	MMSE	Medication
1	74	M	2nd grade	1	26	*Parkidopa*
2	63	M	Inc. graduation	1	29	*Cinetol*
3	51	M	1st grade	1	29	*Sinemet*
4	52	M	Superior	1	28	*Mantidan*
5	65	M	2nd grade	3	20	*Mantidan/Levodopa*
6	75	M	1st grade	1	26	*Levodopa*
7	61	F	1st grade	1	20	*Cinetol*
8	71	M	Inc. 1st grade	1	27	*Selegilina*
9	64	M	Inc. 1st grade	1	27	*Cinetol*
10	47	M	Superior	1	25	*Geodon / Cinetol*

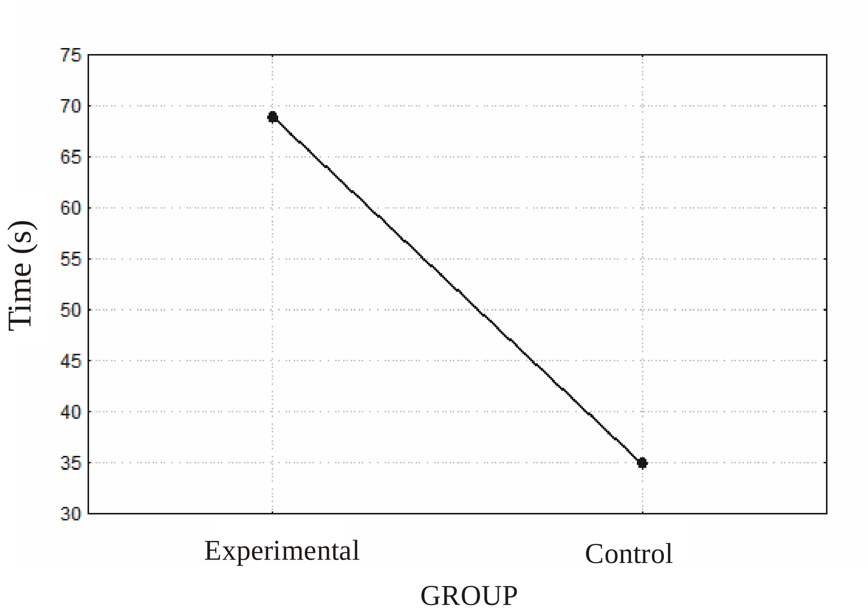

Figure 1. Time (s) to complete de tasks by the experimental and the control groups.

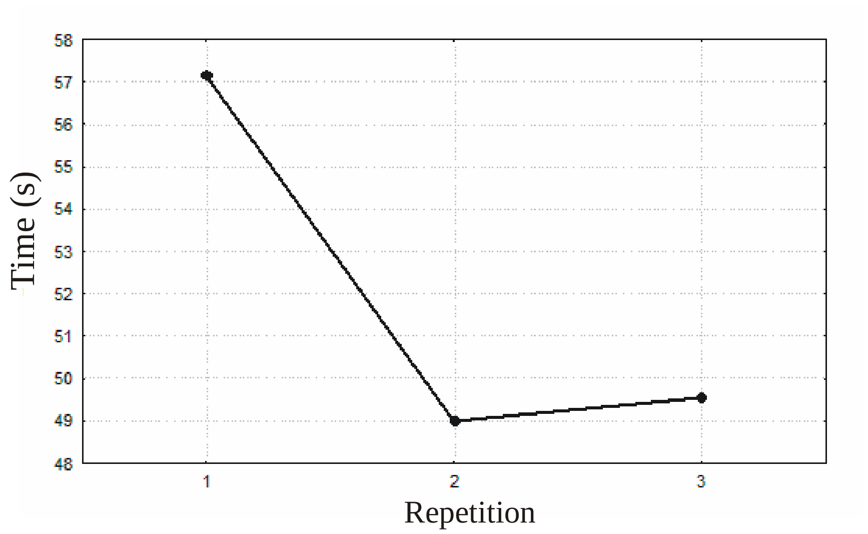

Figure 2. Time (s) to complete the three repetitions of the task by the experimental and control groups.

In the experimental group, 20% of the patients demonstrated scores lower than 24 at the MMEE. These patients (participants 5 and 7) had their performance analyzed separately. In relation to the Hoehn Yahr scale, 90% of the participants were included in stage 1 of progression of Parkinson's Disease. Only one patient was characterized as being in stage 3, he was also one of the patients with an alteration in the MMEE. Regarding educational level, 40% of the participants of this study had not finished elementary school, 10% had completed elementary school, 10% had completed high school, 10% had not finished college and 20% had completed college. No participant of the control group presented any alteration in the MMEE. In the control group 30% of participants had not finished elementary school, 10% had completed elementary school, 20% had completed high school, 10% had not finished college and 30% had completed college.

The analysis of variance comparing time taken by participants to complete tasks demonstrated a significant difference (p= 0.006) between the two groups, with the experimental group (68.9 ± 35.55 s) taking more time to complete the two tasks in relation to the control group (34.87 ± 10.76 s), as shown in Figure 1.

A significant difference (p= 0.039) was also observed in relation to the three repetitions of the task for the two groups. Individuals took more time to complete tasks in the first repetition (54.95 ± 37.15 s) when compared to the second (47.25 ± 25.81 s) and third (47.79 ± 25.48 s) repetitions (Figure 2).

Individual analysis of performance of participants 5 (309.6 ± 162.6 s) and 7 (367.3 ± 80.16 s) of the experimental group revealed that both took an excessive time to complete the task compared to the group mean (68.90 ± 35.12 s). In

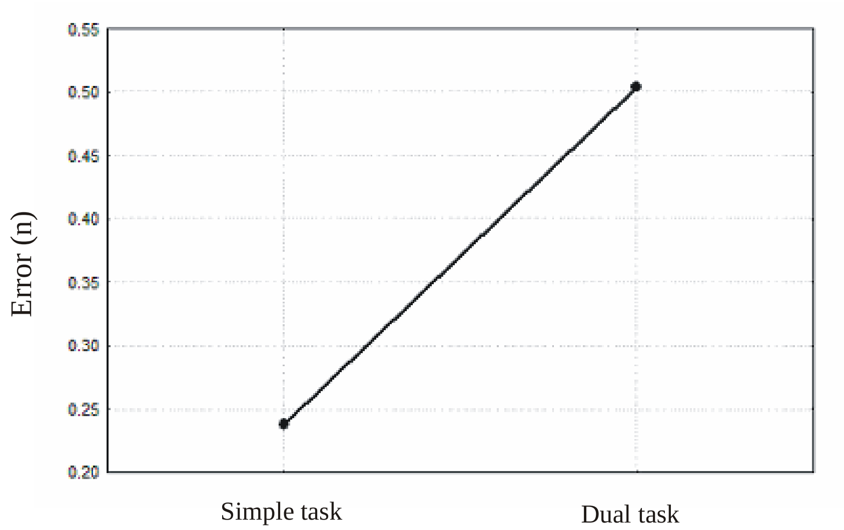

Figure 3. Errors (n) carried out by the participants to execute the simple and the dual tasks.

relation to the three repetitions of each task, participants 5 and 7 took more time com complete the first repetitions of both tasks compared to the remaining repetitions, similarly to the rest of the group.

The analysis of variance comparing the errors carried out by participants demonstrated no significant difference (p= 0.2) between the two groups either in the simple or in the dual task. Nevertheless, the analysis between tasks demonstrated that participants made a significantly higher number of errors (p= 0.03) while performing the dual task (0.5 ± 0.61 errors) when compared to the execution of the simple task, (0.2 ± 0.42 errors), as is shown in Figure 3.

There was a significant interaction between groups, tasks and repetitions (p= 0.02). The experimental group demonstrated more errors than the control group, both in the simple and in the dual task, for all repetitions except for the first repetition of the dual task, in which less errors were committed (0.4 ± 0.52 errors) in comparison to the control group (0.8 ± 0.78 errors).

In relation to the performance of patients 5 (2.7 ± 1.10 errors) and 7 (1.5 ± 0.5 errors) of the experimental group, a greater number of errors were observed in comparison to the mean of the remaining patients (0.46 ± 0.50 errors). Both performed more mistakes in the second repetition of both tasks, unlike the rest of the group.

DISCUSSION

Performance of the dual task involves the execution of a primary task as the main focus of attention and a secondary task executed simultaneously[2]. In this study, patients with Parkinson's Disease and healthy subjects were assessed while performing a primary task (dressing up a seven-button shirt) in isolation and in association with a secondary cognitive task (saying female first names).

Only two individuals of the experimental group demonstrated scores lower than 24 points in the MMEE. Those individuals were excluded from group analysis because of the possibility that the cognitive impairment could contribute to functional disabilities[15] not associated to the performance of the dual task being analyzed in this study. Patients with Parkinson's Disease and associated dementia demonstrate decreased motor performance when compared to patients without dementia[16], similarly to what was observed in this study. It is important to note that the ages of both individuals (61 and 65 years old) were similar to the group mean. Age, therefore, was not a contributing factor to the lower score in the MMEE[17], emphasizing the relation between age and performance in this test.

Results of this study demonstrate that the experimental group took more time to complete the simple and dual tasks compared to the control group. Movement time depends on the distance, precision degree, strength and number of movements involved in the task. Nevertheless, if movement is interrupted by action of antagonist muscles, movement time is increased[18]. Patients with Parkinson's Disease demonstrate, among other signs, muscle rigidity involving all muscle groups with predominance in anti-gravity muscles. Rigidity is characterized by occurrence of co-contraction of agonist and antagonist muscles. Additionally, the importance of the basal nuclei in controlling the speed of voluntary movement is well recognized. Such role of the basal nuclei is related to the slowness of motion observed in patients with Parkinson Disease compared to healthy individuals. In this study, participants executed the task in the presence of the examiner. It was possible to observe that patients presented a remarkable increase in tremor during the test and this may have contributed to increased movement times. The participant with most pronounced tremor was among the ones with worst performance in all analyzed variables.

Either healthy individuals or patients with Parkinson Disease took more time to complete the task associated with cognitive demands. This decrease in performance with increased movement times was also observed in patients with neurological deficits such as Alzheimer, Parkinson's Disease and Cerebral Vascular Accident performing dual tasks involving manual dexterity and verbal tasks[2,19,20,21].

Regarding the three repetitions of the two tasks for both groups, it was observed that individuals took more time to complete the tasks in the first repetition in the two days, when compared to the second and third repetitions. This improvement in performance as a function of training clearly reflects learning[5]. Learning occurred regardless of the individual executing the simple or dual task. Therefore, although the dual task required more time to completion, it was also amenable to learning, with improvements in performance.

In general, individuals with Parkinson's Disease carried out more errors than individuals of the control group for both tasks. This result also demonstrates the impact of disease on motor performance, regardless of the kind of task.

Results of this study demonstrate the existence of a performance cost in the execution of the dual task. Nevertheless, it is important to note that this cost exists not only for patients with Parkinson's Disease, but also for healthy individuals. It is questionable, therefore, if the performance of a dual task should be considered a form to assess the "automatic" performance of the primary task or if the dual task should be regarded as a new and more complex task compared to the primary task. Individuals of both groups improved their performance in the dual task across repetitions. This fact demonstrates the occurrence of learning of a new task, now comprised by motor and cognitive components.

Attention should also be considered. The correct movement is not the result of a succession of specific efferences to muscle only, but the result of a flexible negotiation between available contribution and demanded production, through many strategies directed to the same organ[9]. The selection of a specific strategy depends on the complexity and on knowledge of the task, ability of the individual, integrity of the system, demands of the environment and cognitive variables such as motivation, attention and emotion. The primary task had high complexity as it demanded fine movements of the upper limbs. Despite being a common daily life task, it demands a great deal of attention from participants. This characteristic may have contributed to the performance cost observed in both groups.

The use of dual tasks in rehabilitation is frequent and should be considered as a determinant to patient performance. The conjoint utilization of motor tasks, verbal commands to explain and correct and open environments with multiple sources of information interfere with task practice[7,8]. Such interference can be used as an additional therapeutic resource. As dual tasks are an integral part of the daily life of any person, specific training should be emphasized in the rehabilitation process[21]. Additionally, it is important to remark that depending on the degree of complexity of the primary task, the association of a second task can be, in many cases, considered to originate a new task, and this should be considered.

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