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Research Article

Study of efficiency of bimanual coordination among drivers

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Abstract

Introduction: To perform day to day activities we need symmetric or asymmetric and coordinated actions by both the hands .These day to day activities can be anything from brushing your teeth, tying our shoe laces, driving, computer usage etc. Driving is an everyday example for this bimanual task which once learnt will be performed effortlessly in natural environment

Materials and Methods: The study was conducted on 30 male vehicle drivers and 30 age matched male controls who are involved in administrative work and are not driving after taking informed consent. Institutional ethical clearance was obtained. Study was conducted at Sri Devraj Urs Medical College, Kolar. The efficiency of bimanual coordination of upper limbs of both drivers and controls was assessed by using two hand coordination test apparatus with electrical chronoscope (Anand agencies, Pune). The time (T) taken for completion of the task and the error (E) committed was recorded by the chronoscope and efficiency index (E.I) was calculated as E .I= (T-E)/T *100.

Results: Results showed that there is no significant difference between efficiency index of drivers and controls with P value 0.343.

Conclusion: The study concludes that there is no difference in efficiency of bimanual task performance between drivers and those involved in administrative work.

Keywords: Drivers, Efficiency, Bimanual coordination

1. Introduction

To perform day to day activities we need symmetric or asymmetric and coordinated actions by both the hands. These day to day activities can be anything from brushing your teeth, tying our shoe laces, driving, computer usage etc. Driving is an everyday example for this bimanual task which once learnt will be performed effortlessly in natural environment. This execution is possible because we use feed forward inputs from vision, proprioception and preplan our actions and feedback information for necessary corrections for smooth execution of movements. Bimanual tasks have been used as important skill to train in rehabilitation centers.[1] In patients recovering from stroke these bimanual tasks help in functional recovery thus maximizing the potential for positive neuroplastic change.[2] Driving as a motor skill when learnt progresses from high attention seeking stage to advanced automatic stage. Acquisition of motor skill like driving induces neuroplastic changes in the brain.[3] The present study was undertaken to study the efficiency of bimanual hand coordination among the drivers.

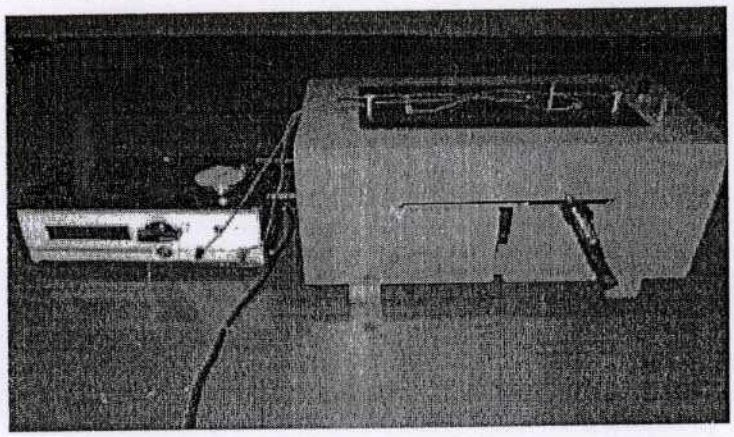
2. Materials and Methods

The study was conducted on 30 male vehicle drivers, who practice driving as a profession and 30 age matched

male controls who are involved in administrative work and do not drive vehicles on day to day basis for commuting. Institutional ethical clearance was obtained . Study was conducted at Sri Devraj Urs medical college, Kolar Subjects with known history of motor, behavioural, orthopaedic, reported history of learning difficulties or neurologic deficits and participants with primary uncorrected visual deficit or medical condition that might interfere with their ability to carry out motor task were excluded from the study. Those who provided consent for the study were subjected to clinical examination of sensory and motor system. Bimanual coordination of upper limbs of both drivers and controls was assessed by using two hand coordination test apparatus with electric chronoscope (Anand agencies,Pune)(Figure 1). The subjects were to trace the figure on the apparatus with the help of the pointer from start to end using two handles with both the hands simultaneously. If the pointer touches the walls of figure on the apparatus it was noted as error (e) committed and was digitally recorded by chronoscope in seconds. They were given trial twice before the actual task was to be performed. Time required for completion of the test (T) and error (e) committed during completion of task was noted in seconds.

Efficiency index, E.I. = (T-e)* 100/T was calculated accordingly.

Figure 1: Bimanual hand coordination test apparatus with electric chronoscope



2.1 Statistical methods used

The results thus obtained were tabulated and statistically analyzed using chi-square and student t test.

3. Results

The mean age of drivers was 34.48±9.73 and control group was34.87±10.15 and they were age matched with P value of 0.881 (Table 1). The Efficiency index of driver group was 95.85±4.32 and that of controls was 94.56±5.86. There was no significant difference between the efficiency index of driver and control group with p value of 0.343(Table 2).

Table 1: Age distribution of patients studied

Age in years	Driver	Controls	Total
18-20	0(0%)	1(3.3%)	1(1.7%)
21-30	15(50%)	10(33.3%)	25(41.7%)
31-40	9(30%)	13(43.3%)	22(36.7%)
41-50	3(10%)	3(10%)	6(10%)
51-60	3(10%)	2(6.7%)	5(8.3%)
>60	0(0%)	1(3.3%)	1(1.7%)
Total	30(100%)	30(100%)	60(100%)
Mean ± SD	34.48±9.73	34.87±10.15	34.68±9.87

Samples are age matched with P=0.881

Table 2 : Efficiency index of drivers and controls

Efficiency index	Driver	Controls
80-85	0(0%)	4(13.3%)
85-90	5(16.7%)	3(10%)
90-95	7(23.3%)	5(16.7%)
96-100	18(60%)	18(60%)
Total	30(100%)	30(100%)
Mean ± SD	95.85±4.32	94.56±5.86

* No significant difference between efficiency index of drivers and controls with P=0.343

4. Discussion

Bimanual coordination is very important to carry out day to day activities like brushing teeth to tying a shoe lace. For smooth execution of bimanual hand movement there has to be smooth functioning of peripheral as well as central nervous system.[4] When movements are performed together by upper limb a strong tendency emerges to synchronize the pattern of motor output.[5] Cerebellum, Basal ganglia and posterior column tract provide input to and act together with the motor cortex in producing coordinated movement responses.[6]

Driving is everyday example of a motor skill which involves highly coordinated movements of the hands. In our study when drivers were exposed to a new bimanual task they were not able to perform better than controls. Any motor skill when learnt progresses from an initial stage that is highly attention-demanding to later stage whereby the skill runs off automatically. Various neurophysiologic as well as imaging studies have shown that this is accompanied by neuroplastic changes in the brain.[7,8]

Neuroimaging studies have reported that whenever a new motor act is learnt, depending on the stage of learning and the type of task there is involvement of differential cortico-striatal and cortico-cerebellar routes.[7,8,9] Prefrontal and parietal cortex are predominantly engaged during early learning, where as when a task is well learned motor cortices including primary and supplementary motor areas become more involved.[8, 9,10]

A functional magnetic resonance imaging study which traced learning-related activation changes during the acquisition of a new complex bimanual skill showed that bimanual skill learning was associated with a shift in activation among cortico-subcortical regions providing further evidence for the existence of differential cortico-subcortical circuits preferentially involved during the early and advanced stages of learning.[3]

5. Conclusion

The study concludes that there is no difference in efficiency of bimanual task performance between drivers and those involved in administrative work indicating that whenever a new motor skill is learnt it involves activation of various areas of the brain and it is not influenced by already learnt motor skill. Further work is needed to evaluate the effect of age, years of experience in driving on efficiency of bimanual coordination.

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