Open Access Library Journal

Effects of Mental Activity on Hand Skill Rate Performance Ability among Second Grader Medical Students

Nimet Unay Gundogan, Erhan Kiziltan, Leyla Aydin*, Ersin Ogus

Department of Physiology, Faculty of Medicine, Baskent University, Ankara, Turkey
Email: nimetg@yahoo.com, erhankiziltan@gmail.com, *leyla3b@yahoo.com, eogus@baskent.edu.tr

Received 5 January 2016; accepted 20 January 2016; published 25 January 2016

Abstract

Introduction: Determination of hand skill rate is thought to be important for the functional evaluation of nervous system. Therefore, hand skill performance monitoring could be a reliable measure for the effect of audio-visual medical teaching on central nervous system. The aim of this study was to evaluate the effect of mental activity on the hand skill rate performance ability following one hour audio-visual medical teaching. Methods: Participants were 34 healthy screened right handed volunteers (19 female, 15 male, age between 18 - 22 years). Hand skill rate performance time was assessed by Annett's peg moving task. Each participant repeated the task five times in a different time, before and after the lecture. Data were analyzed by statistical software package SPSS. Statistical significance level of $p < 0.05$ was considered to be significant. Results: Hand skill rate performance time value was not associated with the gender difference. Based on this result, statistical evaluation was performed without gender discrimination (n = 34). When the hand skill rate performance times of each hand were compared with the values obtained before and after lecture, it was found that hand skill rate performance times for both right and left hands were decreased in all subjects after the lecture. Conclusions: This study may suggest that attending an audio-visual medical teaching lecture and performing Annett's peg moving test may both cause activation in the common areas of nervous system. This activation may lead a state of alertness on the students, which in turn affects hand skill rate performance time in a positive manner. Therefore, we may suggest placing laboratory sessions in the curriculum at least one hour following a theoretical lecture since this may lead to increasing the success and the practicability of the sessions.

Keywords

Annett's Peg Moving Task, Mental Activity, Manual Dexterity, Hand Skill Rate Performance Time, Audio-Visual Medical Teaching

Subject Areas: **Anatomy & Physiology**

*Corresponding author.

How to cite this paper: Gundogan, N.U., Kiziltan, E., Aydin, L. and Ogus, E. (2016) Effects of Mental Activity on Hand Skill Rate Performance Ability among Second Grader Medical Students. *Open Access Library Journal*, **3**: e2275.
http://dx.doi.org/10.4236/oalib.1102275

1. Introduction

Area for hand and fingers in the premotor cortex which is immediately anterior to the primary motor cortex is a region that is important for "hand skill" [1]. That is, when tumor or other lesions cause destruction in this area and hand movement becomes uncoordinated and nonpurposeful, a combination called motor apraxia [2].

Motor signals are transmitted directly from the cortex to the spinal cord through the corticospinal tract and indirectly through multiple accessory pathways that involved the basal ganglia, cerebellum and various nuclei of the brain stem. In general, direct pathways are concerned more with discrete and detailed movement, especially of distal segments of limbs, particularly hands and fingers [3]. The movement of distal segment of extremities, particularly fine complex movements of the hand and fingers, is believed to be directly related with cortex. These movements are fine motor activities [2]. That's why the determination of the hand skill performances thought be important criterion in the evaluation of the function of central nervous system (CNS).

The measurement of hand skill rate performance time (HSRPT) could be a reliable measure for the effect of audio-visual medical teaching (AVMT) on CNS. We have not found any previously published data that examined the relation between mental activity and hand skill rate performance time ability (HSRPA) in medical students after AVMT. This point also attracted our attention to investigate on this subject.

2. Methods

This study was approved by Baskent University Institutional Review Board and Ethics Committee (Project no: KA13/58) and supported by Baskent University Research Fund. The aim and method of the study were explained in detail and informed consent was obtained for each subject. Participants were 34 healthy screened right handed volunteers 19 female (56%) and 15 male (44%) range between 18 - 22 years were included in the study. Individuals who voluntary participated in this survey were not financially supported by any institute.

Recruitment: We explained to the students that if they have personal interest on the effects of following audio-visual medical teaching on their CNS by detecting their HSRPT, they should contact us for participating voluntarily for the survey. The volunteers were selected by questionnaire from 160 medical faculty students. The volunteers are expected to meet some certain requirements. The subjects with a history of systemic disease such as hypertension, diabetes mellitus, thyroid dysfunction, use of alcohol, coffee and cigarette addicts, sleepless and tired, heavy and constantly engaged in sports, drug users were excluded from the study [4]-[6]. We applied Annett's peg moving task in healthy young students for the assessment HSRPT [6] [7]. The students were advised not to exercise such as ascending stairs, running etc. before the test. For this reason the tests were performed in the laboratory which was right opposite the classroom.

In each of application two assessments were performed for the same participant before and after AVMT at 10.00 and 11.00 a.m., respectively. The HSRPA measurements were performed to all subjects in the same condition by the Annett's peg moving task apparatus [8]. The "Peg Moving Task" is a widely used method for the evaluation of motor functions of upper extremities, since Annett proposed for the first time in 1985 [9]. Since then the method has been accepted as an important tool for following up the hand skill development and its correlation with cognitive development in children [10]. In this study we used the original version of the test. In this test the tool consists of small board with two parallel slats, each containing 10 holes [9]. The participant was asked to transfer the pegs from one slat to other, in an order using one hand as fast as possible. The task duration was recorded by a stopwatch. The task was repeated five times with each hand, starting with dominant hand. The mean peg-moving time of successive trials of each hand was evaluated as HSR.

3. Statistics

Data were analyzed by statistical software package SPSS (version 17, Chicago, IL, USA). In this study, descriptive statistics for discrete and continuous variables (mean, standard deviation, standard error of mean, median, minimum, maximum, and number and percentage points) was given. In the case where one of the factors in factorial arrangement repeated "Repeated Measures Analysis of Variance" was applied. In cases where the assumption of sphericity provided "Greenhouse-Geisser" corrected degrees of freedom were evaluated using statistical methods. However, when multiple comparisons were held constant in the first type error probability of 0.05 is not sufficient for the program's menus "Usage" functions using a multiple comparison tests "Bonferroni-Dunn test" was used. Statistical significance level of $p < 0.05$ was considered to be significant.

4. Results and Discussion

The demographic characteristics such as age, weight, height and body mass index (BMI) of the participants showed homogeneous distribution between groups. Mean ages, weights and heights were 20 ± 0.67 years, 61 ± 11.16 kg and 165 ± 7.39 cm, respectively in women whereas 20 ± 1.44 years, 79 ± 13.7 kg and 177 ± 6.13 cm in men. BMIs were calculated as 22 ± 3.14 in women and 25 ± 3.27 in men. Demographic characteristics of all participants are summarized and given separately for total and both sexes in **Table 1**.

HSRPA were compared in men and women and it was found that there was no statistically significant difference in between them (**Figure 1**). Therefore, it was accepted that gender difference was not an important factor in hand performance and then all the data were re-evaluated independent of sexes.

Before AVMT in all participants the mean right hand HSRPA was found 9.72 ± 0.83 s, while the left hand value was found 10.38 ± 0.20 s. This difference between right and left hands is statistically significant ($p < 0.05$). Similarly, after AVMT between right and left hands in HSRPA were also found 9.01 ± 0.69 s and 9.82 ± 1.21 s, respectively. This difference was also statistically significant ($p < 0.05$). Before and after AVMT HSPRA were 9.72 ± 0.83 s and 9.01 ± 0.69 s in right hand and 10.38 ± 0.20 s to 9.82 ± 1.21 s in left hand which were gain rapidity statistically significant ($p < 0.05$, **Table 2**).

Table 1. Demographic characteristics of the participants (n = 34).

Subject Properties	Female (n = 19)	Male (n = 15)	Total (n = 34)
Age (year)	20 ± 0.67	20 ± 1.44	20 ± 1.08
Weight (kg)	61 ± 11.16	79 ± 13.7	69 ± 15.19
Height (cm)	165 ± 7.39	177 ± 6.13	171 ± 9.22
Body mass index (BMI)	22 ± 3.14	25 ± 3.27	24 ± 3.42

Table 2. Annett HSR results for right and left hand.

	Right hand	Left hand	p
HSRPA before AVMT (s)	9.72 ± 0.83	10.38 ± 0.20	<0.05
HSRPA after AVMT (s)	9.01 ± 0.69	9.82 ± 1.21	<0.05
p	<0.05	<0.05	

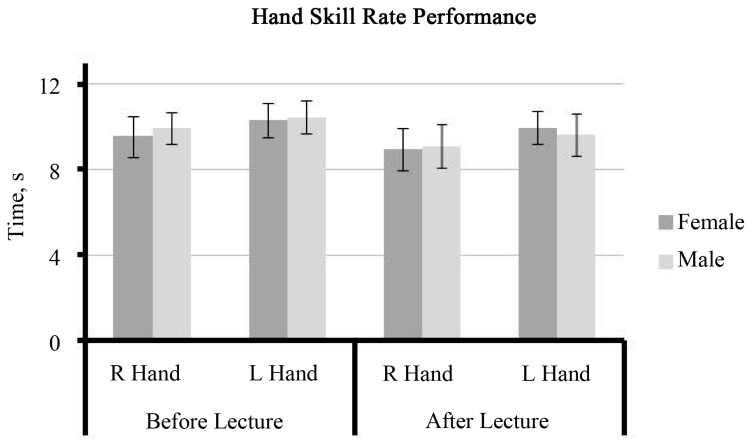

Figure 1. Annett's peg moving task results before and after audio-visual medical teaching lecture. Bar graphic compares the results of both hands and sexes. Statistical analysis showed that there was not a significant difference between genders (n = 19 in women and n = 15 in men, $p > 0.05$) (R/L stands for right/left).

5. Discussion

We have, in this study, not found any significant HSRPA difference between men and women participants. This finding is consistent with our earlier study [11] and the standard results that Annett has found previously [12]. Besides this, left hand HSRPA results were measured to be slower than right hand results in right handedness participants. This may be explained as the impacts of functionally frequent use of dominant hand. The studies experiencing the relation between laterality and motor ability suggest also that motor performance in dominant hand is better than non-dominant hand [11]-[13]. In this perspective, it may be suggested that somebody's HSRPA is better discussed if evaluated and compared based on dominant hand's results.

The aim of this study was to investigate the impacts of mental activity such as attending a lecture on hand skills. The results showed that HSRPA performed after AVMT increases significantly. Our previous study suggests that short term motor activity has a positive effect on HSRPA. Similarly, the current study may support the conclusion that mental activity may have positive effects on hand skill performance since HSRPA becomes quicker in participants after attending a 50 min AVMT lecture.

Being an active student and trying to follow a lecture by heart are a complex performance. This, in general, implicitly consists of many activities such as listening the lecturer, following visual materials of figures and writings on the screen/board, trying to correlate presented information with the information stored in short/long term memory, transforming the given written/verbal information into thought, taking note and storing new information into memory. All these activities to function properly the following special areas in the brain must be active; primary and secondary auditory cortex, primary and secondary visual cortex, hippocampus, Broca's area, Wernicke's area, head rotation area, voluntary eye movement field etc. [2]. Increased mental activities in turn lead the related synapses in CNS increasing synaptic transmission.

There are serial successive actions performed during Annett's peg moving task. These may be summarized as grasping the peg by hand, assessing the distance at which the peg is out of hole, taking the peg out of hole, looking at the hole on the other side to localize it that the peg is to be put in, to move to peg towards the hole on the other side and put it into the hole. During these actions there may be new interactions that must be programmed in accordance with, are visual, auditory and other sensory feedback information.

All these motor functions are accomplished by not only the proper functioning of motor system but also the nervous system. Some of the areas in nervous system serving this movement are area for hand skills, motor cortex, primary and secondary auditory cortex, primary and secondary visual cortex, hippocampus, Broca's area, Wernicke's area, head rotation area, voluntary eye movement field, basal ganglia, thalamus and lateral area of cerebellum. The fine motor activities of hand and fingers may only be achieved by the synchronous functioning of all these structures [2].

In the previous paragraphs we have emphasized on that the same neural areas become activated during an AVMT lecture and Annett's peg moving task. The idea, rooted in neural network theory, holds that aging results from the random breaking of "links," resulting in diminished reaction times [14]. On the contrary, the increased reaction times or performances may result from the creation of new "links" between neurons. In this case, we may, theoretically, explain the increase in HSRPA performance by the new links established during the lecture [15]. Beside this the gradual increase in HSRPA performance during successive test repeats before the lecture may point out the importance of the impacts of short time memory on peg moving task. On the other hand, the over activated common neural areas during the lecture does not let short time memory causing any further increase in hand performance in the successive test repeats after lecture. If this is so, the foresight that the audio-visual education stimulate CNS intensively, may be accepted as a logical approach.

We believe that almost all of the neural circuits which are in relation with the event are activated during high level intensive mental activity. This has reminded us the well-known and well described response of striated muscles to a maximal and supra maximal stimulus [2]. Striated muscle stimulated by a maximal stimulus does not response further to a supramaximal stimulus. The process of bringing more motor units into play is called recruitment or multiple motor units (MMU) summation [16]. This is seen not just in artificial stimulation, but is part of the way the nervous system behaves naturally to produce physiological response in neuromuscular system. The same physiological mechanisms in the process of intensive audio-visual theoretical medicine courses may reflect recruitment the fact that it can develop in CNS and we could be able to explain our findings. Subsequent research will throw light on this subject.

6. Conclusion

This study may suggest that attending an audio-visual lecture and performing Annett peg moving test may both cause activation in the common areas of nervous system. And this activation may lead a state of alertness on the students, which in turn affects HSRPA in a positive manner. Therefore, we may suggest placing laboratory and/or application sessions in the curriculum at least one hour following a theoretical lecture since this may lead to increasing the success and the practicability of the sessions.

Acknowledgements

We would like to thank research volunteered to participate to our study from medical faculty in DI and D-II students and we would also wish to express our appreciations to our research study group for obtaining data on a regular basis whose names were Ozer Dogancan, Koru Mine, Durak Nazenin, Gürcan Buse, Olşen Cenk Anıl.

References

[1] Amunts, K., Schlaug, G., Jancke, L., Steinmetz, H., Schleicher, A., Dabringhaus, A. and Zilles, K. (1997) Motor Cortex and Hand Motor Skills: Structural Compliance in the Human Brain. *Human Brain Mapping*, **5**, 206-215. http://dx.doi.org/10.1002/(SICI)1097-0193(1997)5:3<206::AID-HBM5>3.0.CO;2-7

[2] Guyton, A.C. and Hall, J.E. (2011) Textbook of Medical Physiology. Motor Cortex and Corticospinal Tract. 12th Edition, Elsevier, Philadelphia, Pennsylvania, 685-697.

[3] Yousry, T.A., Schmid, U.D., Jassoy, A.G., Schmidt, D., Eisner, W.E., Reulen, H.J., Reiser, M.F. and Lissner, J. (1995) Topography of the Cortical Motor Hand Area: Prospective Study with Functional MR Imaging and Direct Motor Mapping at Surgery.

[4] Sapper, C.B., Scammell, T.E. and Lu, J. (2005) Hypothalamic Regulation of Sleep and Circadian Rhythms. *Nature*, **437**, 1257-1263. http://dx.doi.org/10.1038/nature04284

[5] Garcia-Rill, E., Homma, Y. and Skinnr, R.D. (2004) Arousal Mechanisms Related to Posture and Locomotion: 1. Descending Modulation. *Progress in Brain Research*, **143**, 281-290. http://dx.doi.org/10.1016/S0079-6123(03)43027-6

[6] Hogervorst, E., Riedel, W., Jeukendrup, A. and Jolles, J. (1996) Cognitive Performance after Strenuous Physical Exercise. *Percept Motor Skills*, **83**, 479-488. http://dx.doi.org/10.2466/pms.1996.83.2.479

[7] Kamijo, K., Nishihira, Y., Hatta, A., Kaneda, T., Wasaka, T., Kida, T. and Kuroiwa, T. (2004) Differential Influences of Exercise Intensity on Information Processing in the Central Nervous System. *European Journal of Applied Physiology*, **92**, 305-311. http://dx.doi.org/10.1007/s00421-004-1097-2

[8] Annett, M. (2002) Handedness and Brain Asymmetry: The Right Shift Theory. Psychology Pres is a Part of Taylor & Francis Group, New York, 332-336.

[9] Annett, M. (1985) Left, Right, Hand and Brain: The Right Shift Theory. Lawrence Erlbaum, London.

[10] Dellatolas, G., De Agostini, M., Curt, F., Kremin, H., Letierce, A., Maccario, J. and Lellouch, J. (2003) Manual Skill, Hand Skill Asymmetry, and Cognitive Performances in Young Children. *Laterality*, **8**, 317-338. http://dx.doi.org/10.1080/13576500342000121

[11] Gundogan, N.U., Yazici, A.C., Ozmen, I., Koctekin, B. and Simsek, A. (2009) Effect of Short-Term Motor Activity on Hand Skill Rate. *Dirim Tıp Gazetesi*, **84**, 115-124.

[12] Annett, J., Annett, M., Hudson, P.T. and Turner, A. (1979) The Control of Movement in the Preferred and Non-Preferred Hands. *Quarterly Journal of Experimental Psychology*, **31**, 641-652. http://dx.doi.org/10.1080/14640747908400755

[13] Yetkin, Y. and Erman, K. (2012) Laterality of Voluntary Motor Tasks: Are Basketing, Targeting, and Peg-Moving Performance Asymmetric? *Journal of Neuroscience and Behavioral Health*, **4**, 59-75. http://dx.doi.org/10.5897/JNBH11.009

[14] Sharps, M.J. (1998) Age Related Change in Visual Information Processing: Toward a Unified Theory of Aging and Visual Memory. *Current Psychology*, **16**, 284-307.

[15] Kiziltan, E., Yazici, A.C., Aktas, G., *et al.* (2013) The Impacts of Mental Rotation Abilities on Preclinical Medical Education: Baskent University Experince. *Tıp Eğitimi Dünyası*, **37**, 1-14.

[16] Guyton, A.C. and Hall, J.E. (2011) Textbook of Medical Physiology. Membrane Physiology, Nerve, and Muscle. 12th Edition, Elsevier, Philadelphia, Pennsylvania, 45-103.

List of Abbreviations

AVMT: Audio-visual medical teaching
BMI: Body Mass Index
CNS: Central nervous system
HSR: Hand skill rate
HSPRA: Hand skill rate performance ability
HSRPT: Hand skill rate performance time