WORKSHOP PROPOSAL

Title: Assesment of The Effectiveness of Neuroscience-Based Exercises for Elderly Individuals with Head-Forward Posture Disorder

Workshop duration: half day

Workshop form: online

Organizers: Veysel Alcan[1] and Fatma Kübra Çekok[2]

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Workshop description and objectives: Postural disorders causes deviations from the ideal or normative alignment of the spinal column and other anatomical regions. These deviations can manifest at any stage of life, but their prevalence tends to increase with age due to a confluence of factors, including changes in the musculoskeletal system, decreased muscular strength, and lifestyle patterns. Head-Forward Posture Disorder (HFP), a condition typified by the anterior displacement of the cranium in relation to the shoulders, is often linked to the aging process and frequently constitutes a component of a more intricate postural predicament. HFP can also occur in children and adolescents as well. Contributing elements to the emergence of HFP in aging individuals comprise the weakening of the neck and upper back musculature, degenerative transformations of spinal discs, and the cumulative consequences of years of inadequate postural habits. HFP can precipitate an array of adverse outcomes, including heightened stress on the cervical spine, which may lead to pain, discomfort, and an increased susceptibility to cervical spine disorders. Moreover, altered biomechanics consequent to HFP can undermine balance and increase the risk of falls among older adults. Additionally, compromised respiratory function may arise as HFP may restrict lung capacity and give rise to shallow breathing. The assessment of postural disorders in elderly individuals is of great importance. This assessment may include a physical examination typically performed by a healthcare professional and may include evaluation of alignment, muscle strength, flexibility, and range of motion. The management of HFP and other postural disorders frequently necessitates a multiple approach, involving interventions such as physical therapy to augment muscular strength and flexibility, and postural exercises to rectify alignment. It is noteworthy that the literature explored predominantly evaluated traditional exercises in addressing HFP, with limited attention devoted to investigating the efficacy of neuroscience-based exercises. It is well known that activation of the visual, vestibular and proprioceptive systems through neuroscience-based exercises plays an important role in regulating postural control. As a result, establishing a harmonious relationship between sensory and motor systems is vital for motor control. In this workshop, we intend to perform neuroscience-based exercises training for enhancing upper extremity function and balance performance by employing a laser point affixed to either the cranium or the upper extremity. Alternatively, we posit that the execution of neuroscience-based exercises while utilizing a laser point will engender an immersive and motivational milieu for elderly individuals suffer from HFP. The assessment of the effectiveness of neuroscience-based exercises will be done using a EoG measurement.

By investigating the effectiveness of neuroscience-based exercises on functional performance and balance function in elderly individuals with HFP, our research endeavors to contribute unique insights to the existing body of knowledge. We hypothesis that neuroscience-based exercises will improve cervical proprioception by engaging the pathways associated with the head-eye connection and the motor-oculomotor and vestibulo-ocular reflexes. Furthermore, we postulate that the identification of musculoskeletal issues in elderly individuals suffering from HFP will provie useful data for the implementation of preventive interventions and holistic programs.

Research Questions H1: Are neuroscience-based exercises efficacious in enhancing physical performance and balance function in elderly individuals with head forward posture? H2: Are neuroscience-based exercises ineffective in augmenting physical performance and balance function in elderly individuals with head forward posture?

Intended audience and plans to solicit participation:

We intent to perform an experiemtal study for audiences. The aim of this experimental presentation is to Show a correlation between eye movements an neuroscience-based exercises by employing a laser point affixed to either the cranium or the upper extremity. Figure 1 shows the schematic diagram of the experimantal setup in propsal workshop.

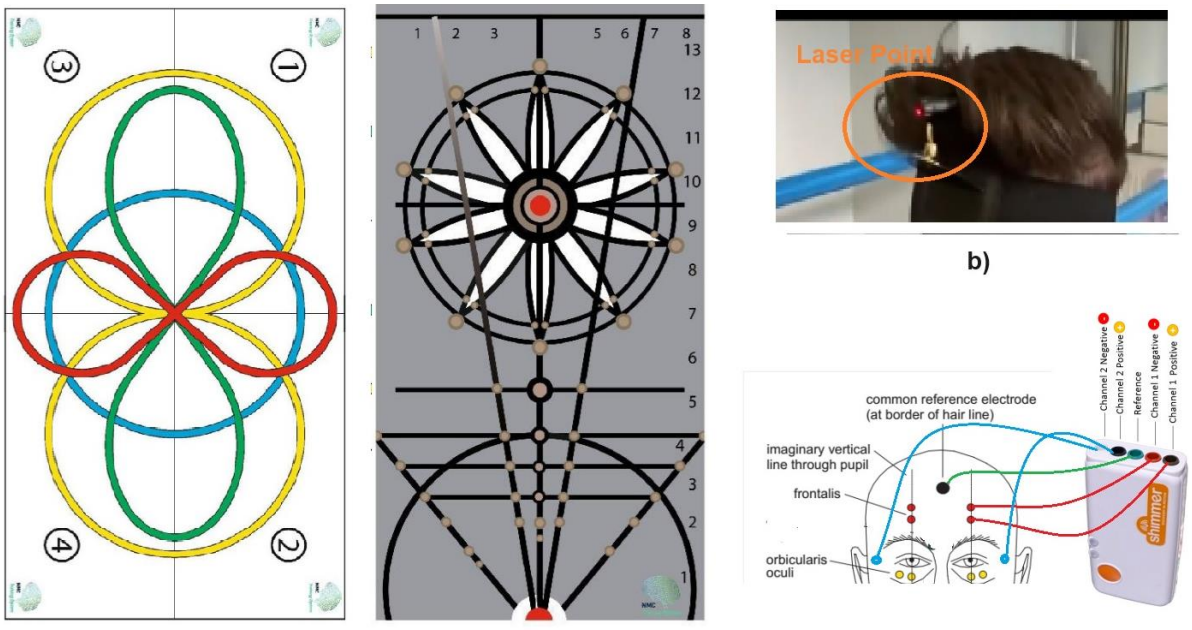

Figure 1. The schematic diagram of experimantal setup a) neuroplasticity and vestibulocular training wall images b) laser pointer on head, c) EoG test using surfaee EMG electrodes

The electroocoulogram (EOG) is an quantative elecrophysiologic test that measure the potential difference between the cornea and ocular fundus. It has advantages over other techniques for tracking ocular movements. Therefore, EOG measurement will be used as a tool to assess HFP and its impact on cervical function. according to our knowledge, There is no study to ivestigate

a correlation between EOG measurement and HFP. To measure the vertical and horizontal eye movements, the Shimmer Wireless EOG & Accelerometer box will be used . (Figure 1c) Both EOG signals and their noise levels will be controlled through the Consensys® which is the GUI of the Shimmer EOG unit.

List of topics:

- a physical examination of Head-Forward Posture Disorder (HFD)

- neuroscience-based exercises

- the electroocoulogram (EoG) as a quantative elecrophysiologic test

List of invited speakers: NA

Title:
Robotics for Seniors (RoboSens)

Workshop duration:
Half day

Workshop format:
Hybrid workshop

Organisers:

Dr. Gokce Nur Yilmaz, Computer Engineering Department, TED University, Turkiye, email: gokce.yilmaz@tedu.edu.tr

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Dr.Fatma Kübra Çekok,Physical Therapy and Rehabilitation Department,Tarsus University, Tarsus, Turkiye, email: kubracekok@tarsus.edu.tr

Workshop description and objectives:

Digital breakthroughs in the healthcare industry have been brought about by the use of wearable, robotics-assisted, handheld, and smart technologies. Especially the field of robotics has provided a wealth of instruments that are highly valuable for doing research in the domain of movement science. Given the demographic shift towards an older population and the increasing number of seniors, there is growing interest in the potential use of robotic systems for various applications. These applications include fall risk assessment and prevention, enhancing physical activity, and facilitating rehabilitation, among others. When considering motor control and (re) learning, which are responsible for the shift from poorly skilled to highly skilled movements and making them automatic, robots provide a wealth of kinematic and kinetic data that may be utilized for analysis and modeling purposes.

The primary objective of this workshop is to concentrate on various facets pertaining to the use of robotics with a special focus on the use of social robotics, relevant tools, and effective factors in order to comprehend and enhance the motor control and (re)learning capabilities of seniors. In order to ensure this objective, the workshop will cover the effects of social interaction, visuospatial processing , and neuroscience-based exercises in motor control and (re) learning in seniors.

<u>Effects of social interaction based motor (re) learning and control for fall prevention and stroke recovery of seniors:</u>

Bone fractures are primarily caused by falls within the seniors demographic. Furthermore, the apprehension of experiencing a fall, which arises as a result of these incidents, might potentially contribute to limited engagement in physical activities, ultimately leading to a sedentary lifestyle. Previous studies have established a correlation between falls in the senior population and higher death rates (Lohman et al., 2019). Despite the considerable amount of research conducted on fall prevention over the course of several decades, there has been no notable alteration in the occurrence of falls. It has been observed that around one-third of adults aged 65 and above report experiencing at least one fall per year (Bergen et al., 2016). The utilization of robotic systems with the objective of improving motor learning has great potential in enhancing balance performance.

Stroke is a significant and widespread global health issue that carries substantial severity. Stroke is a significant contributor to mortality on a global scale, ranking as the second most prevalent cause of death, as

well as a prominent factor in causing disability, ranking third in this regard. Based on estimations, it is projected that about one out of every six individuals may have a stroke during their lifespan. In such cases, it is estimated that a significant proportion, namely 88% of stroke survivors, will likely face impairments in the functioning of their limbs. The utilization of robotic rehabilitation (RR) presents a viable and promising alternative to the traditional methods of post-stroke rehabilitation. Nevertheless, the approach and processes remain inadequately defined at now. In order to enhance the effectiveness of robotic rehabilitation, it is possible to employ social and haptic engagement channels. The objective of robotic mirror treatment is to augment corticospinal activity in order to increase motor (re)learning within the context of a sensorimotor experience. This part of the workshop is intended for how to enhance the process of motor (re) relearning and control through social interaction with robotics.

Effects of visuospatial processing in motor (re) learning and control of seniors:

Effective navigation for everyday activities ranging from driving a car to brushing hair necessitates precise visuospatial processing. Therefore, successful visuospatial processing is necessary for safe and efficient navigation and functioning in the real world. Even minor visuospatial impairments can have a significant impact on normal functions, and regrettably, senior people suffer from a wide range of these impairments. Impairments include issues with motion processing, eye movements, and distinguishing crucial information (i.e, signal) from irrelevant information in non-pathological (i.e., healthy) seniors.The greater incidence of falls during navigation or decreased driving abilities are caused by these age-related visual impairments. It is therefore vital to alleviate the effects of age-related visual impairments for improving the well-being of seniors.

Recent studies present that (re) motor learning, which is about how an individual acquires, develops, and retains motor memory patterns so that programs can be utilized, reused, and updated throughout functional activities decreases, with advancing age. Therefore, the observed age effects on motor (re) learning may be explained by variations in cognition. Moreover, according to recent research, visuospatial performance in seniors is correlated with how well a motor task is (re) learned or in other words the level of motor (re) learning process. Nevertheless, research on how aging affects sensitivity to depth, which is a a crucial visuospatial process leading to motor (re) learning and control remains relatively unexplored. In this part of the workshop, the effects of aging on fundamental visual processes, such as the effects of aging on the visual system as a whole and on depth processing and pursuit systems in particular, related to motor (re) learning and control will be discussed.

Effects of neuroscience-based exercises in enhancing physical performance and balance functioning based motor control and (re) learning in seniors with Head Forward Posture (HFP):

Postural disorders cause deviations from the ideal or normative alignment of the spinal column and other anatomical regions. These deviations can manifest at any stage of life, but their prevalence tends to increase with age due to a confluence of factors, including changes in the musculoskeletal system, decreased muscular strength, and lifestyle patterns. HFP, a condition typified by the anterior displacement of the cranium in relation to the shoulders, is often linked to the aging process and frequently constitutes a component of a more intricate postural predicament. Contributing elements to the emergence of HFP in aging individuals comprise the weakening of the neck and upper back musculature, degenerative transformations of spinal discs, and the cumulative consequences of years of inadequate postural habits. HFP can precipitate an array of adverse outcomes, including heightened stress on the cervical spine, which may lead to pain, discomfort, and an increased susceptibility to cervical spine disorders. Moreover, altered biomechanics consequent to HFP can undermine balance and increase the risk of falls among older adults. Additionally, compromised respiratory function may arise as HFP may restrict lung capacity and give rise to shallow breathing. The assessment of postural disorders in senior individuals is of great importance. This assessment may include a physical examination typically performed by a healthcare professional and may include evaluation of alignment, muscle strength, flexibility, and range of motion. The management of HFP and other postural disorders frequently necessitates multiple approaches involving interventions such as physical therapy to augment muscular strength and flexibility, and postural exercises to rectify alignment. It is noteworthy that the literature explored predominantly evaluated traditional

exercises in addressing HFP with limited attention devoted to investigating the efficacy of neuroscience-based exercises. It is well known that activation of the visual, vestibular and proprioceptive systems through neuroscience-based exercises plays an important role in regulating postural control. By investigating the effectiveness of neuroscience-based exercises on functional performance and balance function in senior individuals with HFP, this part of the workshop endeavors to contribute unique insights to the existing body of knowledge and its relation to robotics and especially with a focus on social robotics.

Intended audience and plan to solicit participation:

The intended workshop audience are academics, researchers, industrialists, and stakeholders working or interested in Robotics and Social Interaction, Health and Well-Being of Seniors, Human Visual System, Image Processing, Robotics, Motor Learning, Motor Control, Artificial Intelligence, Neuroscience related fields.

The workshop will be structured in an interactive way with presentations of the workshop organizers and invited speakers, an exercise training, and roundtable discussions.

In the exercise training part of this workshop, neuroscience-based exercise training will be performed for enhancing upper extremity function and balance performance by employing a laser point affixed to either the cranium or the upper extremity. The neuroscience-based exercises will be executed by utilizing a laser point which will engender an immersive and motivational milieu for senior individuals suffering from HFP. The assessment of the effectiveness of neuroscience-based exercises will be done using an Electrooculogram (EoG) measurement, which is an quantitative electrophysiologic test that measures the potential difference between the cornea and ocular fundus. We hypothesize that neuroscience-based exercises will improve cervical proprioception by engaging the pathways associated with the head-eye connection and the motor-oculomotor and vestibulo-ocular reflexes. Furthermore, we postulate that the identification of musculoskeletal issues in senior individuals suffering from HFP will provide useful data for the implementation of preventive interventions and holistic programs.

In the roundtable discussions part of this workshop, key words and tasks related to the workshop will be assigned to different groups of the participants. The participants will be asked to conceptualize the assigned tasks considering the key words in a roundtable discussion format.

List of topics:

- Evaluation of fall risk and improvement of balance with robotic tools
- Social interaction with robots
- Image processing
- Rehabilitation
- Proprioception
- Computational motor control and (re) learning
- AI tools for seniors
- A physical examination of Head-Forward Posture Disorder (HFD)
- Neuroscience-based exercises
- The Electroocoulogram (EoG) as a quantative elecrophysiologic test

List of invited speakers:

-Dr. Ali Berkol, Avionics Program Manager, Aselsan-Bites, Ankara, Turkiye. The title of the talk will be “Artificial Intelligence-Enhanced Robotics and Image Processing Solutions for Seniors”.

-Ali Nail Inal, Senior Team Lead, Defence System Technologies, Mechanical and Mechatronics Design Department, Aselsan, Ankara, Turkiye. The title of the talk will be Walking Hand in Hand: Lower Limb Exoskeletons for Elaveting Elderly Mobility”.

-Hande Guventurk, Director of Innovation and Strategic Partnerships, Güven Future Health Technologies, Ankara, Turkiye. The title of the talk will be “Development of a Cognitive Game Kit with Integrated Sensory Immersion to Help Improve the Cognitive Functions of Alzheimer's Patients”.

Acknowledgements:

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