MODULE 3-P2: A usability study on mobile EMG-guided neurofeedback training for individuals with stroke – MyoPanda

Hao-Ping Lin[1], Xue Zhang[2], Yang Xu[3], Daniel Woolley[2], Lina Zhao[3], Weidi Liang[3], Issac Lu Qian Qi[1], Hsiao-ju Cheng[1], Lixin Zhang[3], Nicole Wenderoth[1,2]

[1] Singapore-ETH Centre, Future Health Technologies Programme, CREATE Campus, Singapore; [2] Neural Control of Movement Laboratory, Department of Health Sciences and Technology, ETH Zurich, Switzerland; [3] Department of Rehabilitation, Shengjing Hospital of China Medical University, China

1 Introduction

- Up to 80% of stroke survivors suffer from upper limb impairments that lead to difficulties in performing activities of daily living (ADL) and a reduced quality of life [1].
- The usability of medical technology is an important factor influencing treatment quality and user experience, yet there is still a lack of research on this topic [2].
- **Aim**: To evaluate the usability of a mobile platform based on electromyography (EMG)-guided neurofeedback, called **MyoPanda**, for wrist extension training in individuals with stroke.

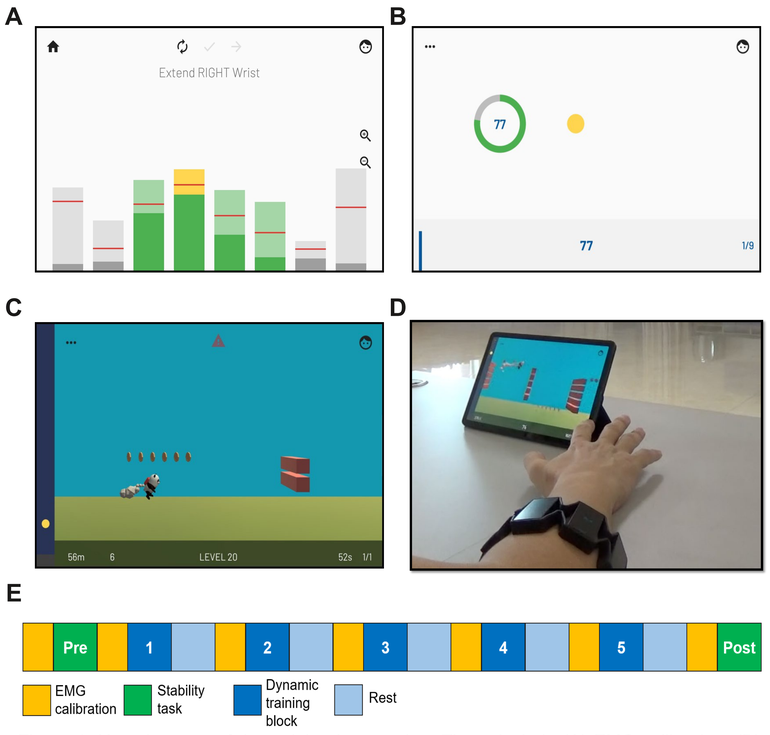

Figure 1: Key elements of the training intervention. These include (A) EMG calibration, (B) Stability task, (C) Dynamic training. (D) The current setup with the tablet. (E) The training protocol: pre- and post-training stability tasks and five dynamic training blocks. EMG calibration (<1min) was required before each dynamic training block (2.5 mins) and stability task (1 min).

2 Methods

- Participants: Eight individuals with stroke and measurable EMG activity in the muscle extensor carpi radialis of the affected arm.

ID	Age	Sex	Days post-stroke	Affected body side	FMA-UE
S1	52	M	145	R	8
S2	65	M	39	L	13
S3	32	M	136	L	20
S4	52	M	46	R	28
S5	68	M	37	R	33
S6	52	M	42	L	35
S7	52	M	31	R	37
S8	48	M	72	R	53

- Intervention: Ten sessions (Figure 1E) of EMG-guided neurofeedback training for wrist extension using MyoPanda for two weeks with the support of a therapist in a hospital.
- Outcome measures: System Usability Scale (SUS) and a questionnaire on the possibility of training at home with the system.

3 Results

- SUS scores: median 82.5 (Excellent)

ID (FMA-UE)	S1 (8)	S2 (13)	S3 (20)	S4 (28)	S5 (33)	S6 (35)	S7 (37)	S8 (53)	Median
I think that I would like to use this system frequently.	4	5	4	5	4	5	5	4	4.5
I found the system unnecessarily complex.	2	1	1	2	2	2	2	1	2
I thought the system was easy to use.	4	5	5	5	2	5	5	4	5
I think that I would need the support of a technical person to be able to use this system.	5	5	4	4	4	5	5	1	4.5
I found the various functions in this system were well integrated.	4	5	3	3	4	5	5	4	4
I thought there was too much inconsistency in this system.	2	1	2	2	1	1	1	1	1
I would imagine that most people would learn to use this system very quickly.	4	5	4	5	4	5	4	4	4
I found the system very cumbersome to use.	1	1	1	1	1	1	1	1	1
I felt very confident using the system	4	5	4	5	5	4	5	4	4.5
I needed to learn a lot of things before I could get going with this system.	2	1	1	1	2	2	1	1	1
SUS score	70	90	77.5	82.5	72.5	82.5	85	87.5	82.5

Table 1: SUS scores. The interpretation of SUS score [4]: 51.7 - 71.0 (OK), 71.1 - 80.7 (Good), 80.8 - 84.0 (Excellent), 84.1 - 100 (Best imaginable)

- Possibility of training at home:
  - Patients indicated that they were willing to continue the training at home.
  - However, many patients still felt that they would need someone to help with placement of the armband on the forearm and operation of the tablet.

ID (FMA-UE)	S1 (8)	S2 (13)	S3 (20)	S4 (28)	S5 (33)	S6 (35)	S7 (37)	S8 (53)	Median
I think the training improved my functional recovery.	5	4	4	5	4	5	5	5	5
I would like to continue the training	5	4	4	5	5	5	5	5	5
I could perform the training independently.	4	1	2	4	2	3	3	5	3
I need others to help with putting on the Myo	5	5	4	5	5	5	5	1	5
I need others to help with operating the tablet.	5	5	1	2	5	5	5	1	5
I would like to take the training device home (if it is free of charge).	5	3	4	5	5	5	5	5	5

Table 2: Possibility of training at home with the technology. 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree), 5: (strongly agree).

4 Conclusion

- MyoPanda is a potentially promising tool for training wrist extension, even in very weak patients.
- It is feasible to use the current setup in clinical settings for stroke rehabilitation with assistance from therapists/caregivers.
- While patients were generally positive about their experience with MyoPanda, many indicated they were reluctant to use the armband and software application independently. Reasons for this need to be further explored before testing is extended to the home setting.

References:

[1] J. K. Burton et al., "Predicting discharge to institutional long-term care after stroke: A systematic review and metaanalysis," Journal of the American Geriatrics Society, vol. 66,no. 1, pp. 161-169, 2018.

[2] O. V. Bitkina, H. K. Kim, and J. Park, "Usability and user experience of medical devices: An overview of the current state, analysis methodologies, and future challenges," International Journal of Industrial Ergonomics, vol. 76, p. 102932, 2020.

[3] A. Bangor, P. Kortum, and J. Miller, "Determining What Individual SUS Scores Mean: Adding an Adjective Rating Scale," J. Usability Stud., vol. 4, pp. 114-123, 2009.

(FHT) FUTURE HEALTH TECHNOLOGIES

(SEC) SINGAPORE-ETH CENTRE CREATE ETH zürich Neural Control of Movement 中国医科大学附属盛京医院 SHENGJING HOSPITAL OF CHINA MEDICAL UNIVERSITY