

Wearable Focused Vibrotactile Stimulation Device CUE¹ Improves Movement Performance for People with Parkinson’s Disease : Early Stage User Testing Report

Examiner : Charco Neurotech
 Email : info@charconeurotech.com
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INTRODUCTION

CUE¹ is a wearable non-invasive focused stimulation device that sits on the sternum. It has been developed and precisely tuned with the participants to bring most effective results and comfort for the user. The positioning of the prototype has been determined through early prototype stage testing. This user testing study has been carried out to determine the potential use of CUE¹ to improve movement performance for people with Parkinson’s Disease.

PARTICIPANTS

Test size : 13 volunteers with Parkinson’s Disease

Demographics : 6 Females 7 Males , aged between 50-80

Disease state: various stages of Parkinson’s including one participant who had DBS surgery

Recruitment : Voluntary participation

Controlled : Tasks carried out with CUE¹ inactivated

Intervention : Tasks carried out with CUE¹ activated

Table 0. Participant information - gender and symptoms

P Positive N Negative

Participant No.	1	2	3	4	5	6	7	8	9	10	11	12	13
Gender	F	M	M	M	M	M	F	F	M	F	F	F	M
Bradykinesia	P	P	P	P	P	P	P	P	P	P	P	P	DBS
Tremor	N	P	P	N	P	N	N	N	Y	P	P	P	DBS

** Please note that this scoring has been done through patient feedback and visual examination only. It has not been assessed by clinical professionals.

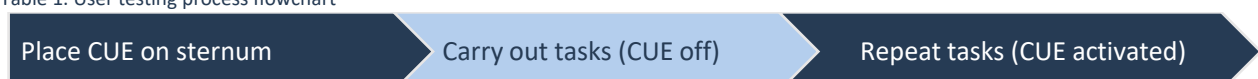
*Participant 12 does not take medication due to side effects

*Participant 13 had Deep Brain Stimulation surgery with mild residual symptoms

USER TEST PROCESS

All testing was carried out while participants were on their best medicated status “On state”, excluding participant number 12 who does not take medication due to side effects.

Table 1. User testing process flowchart



The CUE¹ prototypes were placed on the participant’s sternum using medical adhesives. Participants carried out various tasks with CUE¹ prototype off and repeated the tasks with the prototype activated. Occasionally the order of testing was reversed with the tasks initially being carried out with the device activated on the second round of testing with the inactive device.

SELECTED TASKS

12 tasks were carried out by 13 participants with Parkinson’s disease. Tasks were selected to represent the stiffness and slowness of movement affected by Parkinson’s Disease.

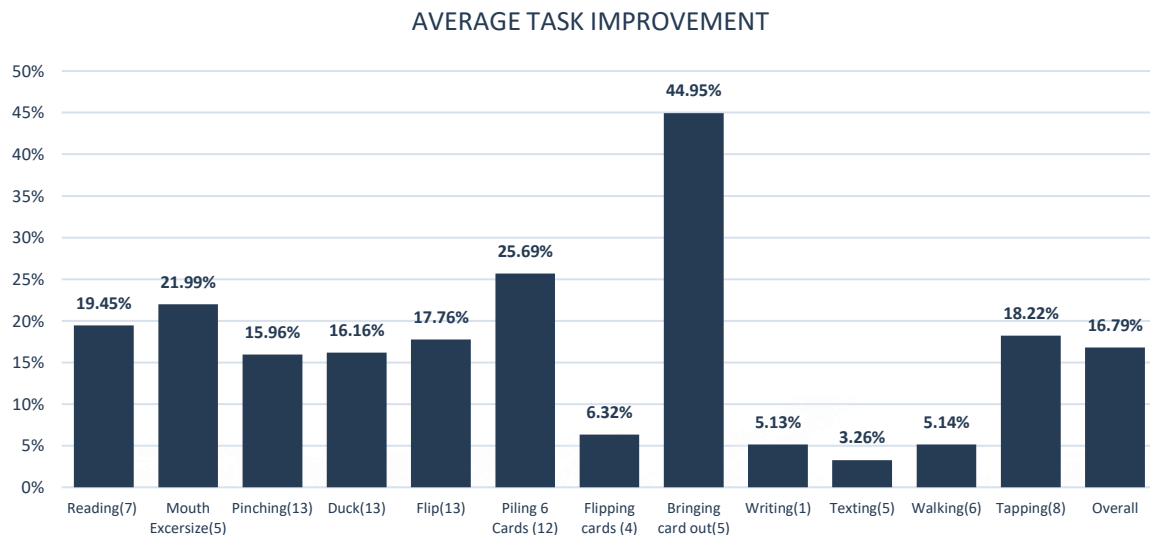
Table 2. Tasks used for examination

	Tasks	Measurement
Facial movement	- Reading - Mouth Exercises (Open and shut)	Time comparison between control / intervention
Hand movement exercises	- Pinching - Duck - Turning over	
Using / moving objects	- Piling up cards - Flipping cards - Bringing a card out of a wallet	
Using Tools	- Writing - Texting	
Gait	-Walking (distance varied from 2 meters to 3 meters)	
Tapping	- Tapping	Comparing the number of taps

All the participants were asked to carry out the hand movement exercises – pinching, duck, and turning over. Other tasks were optional and guided by participant status and request.

RESULT ANALYSIS

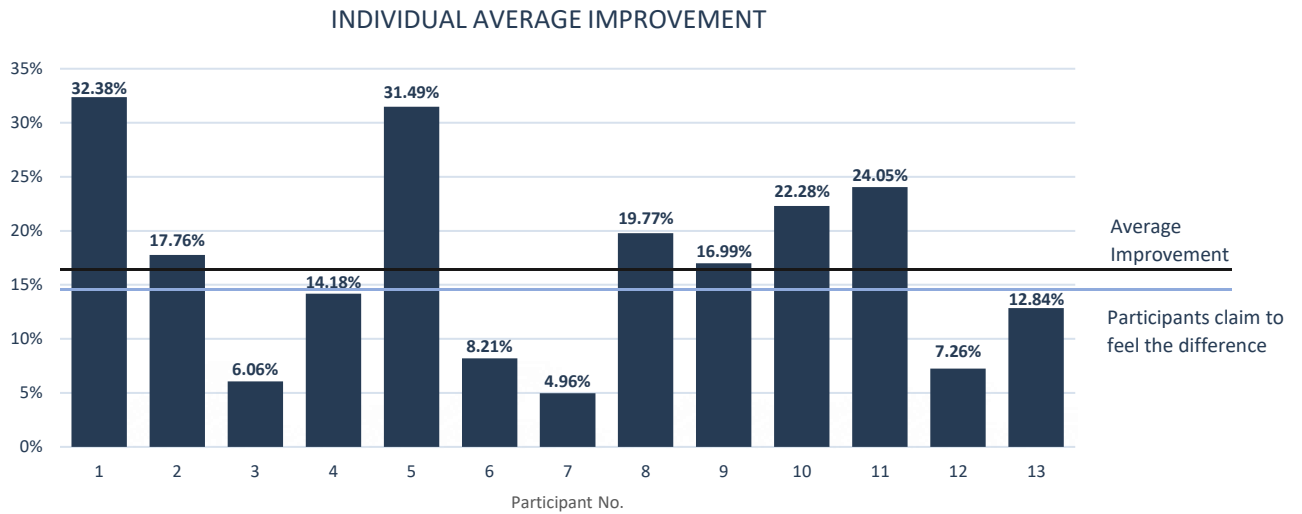
Table 3. The average improvement with the intervention across motor tasks



Participants using the intervention demonstrated an average of 16.63% improvement in time to complete hand movement tasks.

The largest improvement was demonstrated on bringing a card out from the wallet which was on average 44.95% faster by 5 participants. Piling 6 cards to one place has shown an average of 25.69% reduction in time by 12 participants.

Table 4. Individuals average difference in time to carry out tasks with the intervention



All of the participants have shown improvement. The improvement ranged from 4.96% up to 32.38%. 62.5% of the participants who have shown over 14% improvement have given positive self-assessment. Reporting tasks carried out with the intervention felt more easy, relaxed, controlled and co-ordinated.

CONCLUSION

CUE¹, a focused vibrotactile stimulation device prototype has been developed through a series of testing stages using different forms, materials, weights, strengths and waveforms.

Pilot testing has been carried out on 13 volunteers with Parkinson’s Disease. When using the device **all of the participants displayed faster movements** in hand and walking tasks. The time to complete tasks had been **reduced by an average of 16.79% across all the given movement tasks**. Participants also claimed they felt their movement was smoother, better coordinated, and under more control.