Usability of a Low-Cost Head Tracking Computer Access Method Following Stroke

Jasmine Mah, MD (candidate) [1,2], Jeffrey W. Jutai, PhD[1,2], Hillel Finestone, MD,FRCPC[2,3,4], Hilary McKee, OT(C) [3], Melanie Carter, OT(C)[3]

[1] Interdisciplinary School of Health Sciences, University of Ottawa, Ottawa, Canada
[2] Bruyère Research Institute, Ottawa, Canada
[3] Bruyère Continuing Care, Ottawa, Canada
[4] Division of Physical Medicine and Rehabilitation, Faculty of Medicine, University of Ottawa, Ottawa, Canada

BACKGROUND

Why Stroke?

- 795,000 people in the USA experience stroke each year[1].
- Stroke costs the USA $38.6 billion in health care, medication and lost productivity[2].
- One third of all stroke survivors suffer from severe upper motor impairments[3].

Computers and Recovery Following Stroke?

- Computers are ubiquitous in today's society and are essential for social connectivity as well as vocational, educational and leisure pursuits[4].
- Access to computers have been shown to promote a sense of connection to the outside world, improve quality of life, improve rehabilitation outcomes and facilitate access to information, especially for disabled populations[4].
- Assistive technology devices for computer access can therefore facilitate social reintegration and promote independence for people who have had a stroke.

OBJECTIVE

- To examine the usability of a new, low-cost assistive technology device called the Nouse™ and describes the satisfaction of persons living with stroke with this method for computer access.

Nouse™ TECHNOLOGY

- Assistive technology device that allows hands-free computer access .
- Software requires a standard webcam and computer for operation.
- Uses advanced algorithms to map the tip of the nose to the movement of the mouse cursor.

Nouse™ Technology and Software

METHOD

- Ten participants (mean age 58 years) who were receiving in- or outpatient stroke rehabilitation at Bruyère Continuing Care completed a series of computer tasks using the Nouse™ and then completed a device usability questionnaire.
- One hour testing sessions included:
  - (i) **Nouse™ orientation** including an introduction video.
  - (ii) **Participant task performance** using Nouse™. Tasks ranged in complexity from basic tasks (i.e. simple clicks) to more advanced common activities (i.e. scrolling, browsing the internet and typing).
  - (iii) **Observational assessment, administration of the usability questionnaire and gathering of participant demographic information**. These forms were analyzed descriptively to determine the Nouse™'s ease of use, perceived performance and user satisfaction. Wwe considered a rating of 4 or higher (on a 7 point scale) on the usability questionnaire to indicate a potential problem area that may limit the usefulness and acceptability of the technology for stroke patients.

Task performance with post-stroke patients using Nouse™ Technology

RESULTS

- Task Performance: Observation of the participants revealed that no one experienced pain, discomfort, distractibility, or discouragement and the majority appeared to have no significant problems completing the tasks using Nouse™. Completion times of all tasks ranged from 5 to 375 seconds. More advanced tasks such as typing and dragging took noticeably longer than simple clicking.
- Participant computer use and experiences: FIM scores appeared to be correlated negatively with task completion time. Participants whose dominant hand was affected by the stroke and more experienced users gave particularly favorable responses.
- Usability: Most of the participants were satisfied with the ease of use of the Nouse™ (70%) and liked using it (60%). Participants indicated they could resume most of their usual computer activities (such as e-mail, reading the news and obtaining health information) apart from word-processing using the device.

Participant ratings of Nouse™ usability*

Questionnaire item	Lowest rating	Highest rating	Mean rating	SD
Overall, I am satisfied with how easy it is to use the Nouse	1	6	2.7	1.89
If I had to use the Nouse, I can effectively complete my computer tasks using the Nouse	**1**	**7**	**4.2**	**2.04**
I feel comfortable using the Nouse	1	5	2.2	1.55
It was easy to learn to use the Nouse	1	3	1.8	0.92
I believe I became productive quickly using the Nouse	1	7	3.5	2.46
When something goes wrong with the Nouse, the computer gives me a message that tells me how to fix the problem	0	5	1.4	2.27
Whenever I make a mistake using the Nouse, I recover easily and quickly	0	4	2.0	1.70
The information (such as on-screen messages and other documentation) provided with the Nouse is easy to understand	1	4	1.5	0.97
The information that I see on my computer screen when I am using the Nouse is well organized	1	4	1.7	0.959
The Nouse training video was helpful	1	3	1.6	0.84
The Nouse has all the functions and capabilities I expect it to have	1	7	3.3	2.31
Overall, I like using the Nouse	1	6	2.6	1.71

*Rated on a scale of 1–7, where 1 = Agree strongly, 4 = Neither agree nor disagree, 7 = Disagree strongly and 0 = Not applicable.

DISCUSSION

- Incidence of stroke continues to rise. Stroke survivors experience reduced social engagement and decline in social contacts and networks[5], which significantly affects their hospital discharge destination[6] and quality of life[7].
- This study provides preliminary but unique data indicating that a computer access technology can benefit patients with stroke. Given the dearth of published evidence on the usability of such technologies in stroke, it is difficult to compare our findings with those from other studies.
- Although chi-square test results were not statistically significant because of the small sample, there appeared to be some strong associations between clinical and background variables and satisfaction with the Nouse™.
- Specifically, the findings suggest that hands-free head tracking computer access devices like the Nouse™ are a good option for people: (i) who have mild to moderate stroke, (ii) whose dominant hand is affected by stroke, and (iii) who are highly motivated to resume personal computing.

CONCLUSION

- While this paper demonstrates that stroke patients are generally satisfied with Nouse™, there is little comparative clinical evidence of the therapeutic and social value of such devices in stoke, which suggests the need for further research.
- Nouse™ technology can be applicable to all disabled population groups and especially to many stroke populations. Our study provides some data to help the rehabilitation professional identify who may benefit most from this relatively inexpensive, commercially available computer access device

REFERENCES & ACKNOWLEDGEMENTS

[1] Roger, V. L., Go, A. S., Lloyd-Jones, D. M., Benjamin, E. J., Berry, J. D., Borden, W. B., ... Turner, M. B. (2012). Heart disease and stroke statistics. 2012 update: a report from the American Heart Association. *Circulation, 125*(1), e2-e220.

[2] Heidenreich, P. A., Trogdon, J. G., Khavjou, O. A., Butler, J., Dracup, K., Ezekowitz, M. D., ... Woo, J. (2011). Forecasting the future of cardiovascular diseases in the United States: a policy statement from the American Heart Association. *Circulation, 123*, 933-944.

[3] Hendricks, H. T., Van Limbeek, J., Geurts, A. C. H., & Zwarts, M. J. (2002). Motor recovery after stroke. A systematic review of the literature. *Archives of Physical Medicine and Rehabilitation, 83*, 1629-1637.

[4] Drummond, A. (1991). Leisure activity after stroke. *International Disability Studies, 12*, 157–160.

[5] Desrosiers, J., Rochette, A., Noreau, L., Bravo, G., Hébert, R., & Boutin, C. (2003). Comparison of two functional independence scales with a participation measure in post-stroke rehabilitation. *Archives of Gerontology and Geriatrics, 37*, 157-172.

[6] Mauthe, R.W., Haaf, D.C., Hayn, P., & Krall, J.M. (1996). Predicting discharge destination of stroke patients using a mathematical model based on six items from the Functional Independence Measure. *Archives of Physical Medicine and Rehabilitation, 77*(1): 10-30.

[7] Nichols-Larsen, D.S., Clark, P.C., Zeringue, A., Greenspan, A., & Blanton, S. (2005). Factors influencing stroke survivors' quality of life during sub-acute recovery. *Stroke, 36*, 1480-1484.

This research was supported in part by the Bruyère Academic Medical Organization Incentive Fund and the Canadian Stroke Network (Summer Studentship Program). The researchers gratefully acknowledge the participation of patients and clinicians of the Stroke Rehabilitation program at Bruyère Continuing Care in Ottawa. A special thank you to Dr. Jeffrey Jutai for his wonderful guidance and mentorship throughout this project.