Determining the usability of computer input devices by Parkinson's disease sufferers

To the editor: Parkinson's disease (PD) causes a range of possibly disabling symptoms. The combination of these symptoms impairs a PD sufferer's mobility and makes it difficult to use household appliances and devices, such as telephones, television sets and microwave ovens.[1] PD sufferers often lose their communication skills, are isolated and become bored. Because the PD sufferer is not mentally disabled, this isolation often leads to frustration and depression.[2]

Over the past few years, computers have proven to be an excellent tool to mentally stimulate the computer user and assist with communication. The Internet has evolved and enabled like-minded people to form virtual communities, helping people who were previously isolated and unable to interact socially to communicate using their computers.[3]

Computers can help PD sufferers in various ways. The two most significant ways are assisting with communication, especially taking part in Internet communities, and providing mental stimulation.

In order for PD sufferers to gain the benefit of using a computer, they need to be able to *use* the computer. The ability to use a computer is a skill that can be measured accurately by means of usability tests.

Usability tests are performed using different methods, which are determined by the purpose of the test.[3] The method used in this study covers three aspects, namely gathering personal information via questionnaires, measuring the user's performance with specially designed computer software, and observing the user's actions.

The **standard keyboard and mouse**, which are devices that everybody is familiar with, were used for testing after setting their sensitivities with the Windows® Accessibility options, allowing the user more control over both.[4]

The **special keyboard** is a modified standard keyboard that is covered by a key guide. The key guide shields the keyboard, allowing the user to rest his/her hands on the keyboard without pressing any keys. The guide has finger holes corresponding to the keys on the keyboard, allowing the user to press the keys.

The **joystick** used for testing was a Microsoft® Sidewinder® Force Feedback 2 joystick. It allows for the setting of various resistant forces, pressing against or guiding the user's hand in a chosen direction. For the joystick test, three different force profiles were set up to be tested, namely:

- No force. The joystick was able to be moved freely without any forces working on it.
- Guiding force. When the user deviated from the correct path, the joystick forced the user back onto the correct path.
- Constant force. The joystick always exerted a force against the user, requiring effort to move in any direction.

The **motion glove** used was a 5GT virtual reality glove that can measure the angle of the wrist and the position of the fingers on the hand. The glove was set up to perform in a similar way to the mouse. Moving the wrist facilitated the movement of the pointer and opening and closing the hand facilitated the pressing and releasing of the button.

The usability test: As discussed above, the usability test method followed for this study included three aspects, namely the questionnaire, the measuring software and the observations.

A short **questionnaire** was drawn up to gather the user's details. Among the details gathered was the participant's age, race, gender, the duration of PD since diagnosis, the presence of tremors, the severity of the tremors if present, the effect of PD on the sufferer's balance and speech, and the participant's current and previous computer experience.

Computer software was specifically designed for the test. The software allowed accurate measurements of the participant's actions to be captured on the computer. Two programs were developed for this purpose. The first program measured key presses (for the keyboards) and the other program measured the accuracy of the movement of a pointer on the computer screen (for the mouse, joystick and glove).

A **panel of researchers observed** the participants during the test to identify behavioural aspects and to identify key problems. The researchers conducted the training of the participants before and during the tests to ensure that the results reflected only the effect of PD symptoms and not the lack of computer literacy.

The significant results of the questionnaire are contained in Table I.

The following results were obtained from the testing of the standard and

Table I: Participants in the study

Participant	Age	Gender	Duration of disease since diagnosis	Tremors present and severity	Previous computer experience	Willing to use a computer in future
A	67	Male	6 years	Yes, not severe	No	Yes
B	67	Male	7 years	No	Yes	Yes
C	71	Male	9 years	Yes, severe	No	Yes
D	81	Female	12 years	Yes, not severe	No	No
E	24	Female	-	-	Yes	-
F	23	Male	-	-	Yes	-
G	25	Male	-	-	Yes	-

special keyboards:

- All the participants used both keyboards successfully;
- Placing the keyboards more to the middle of the table allowed the elbows and wrists to rest on the table, providing stability and easier use;
- The special keyboard significantly increased the accuracy of PD participants with tremors;
- The standard keyboard allowed faster typing speeds than the special keyboard for all participants, even when tremors were experienced; and
- Due to the distance of the placement of the keyboards, the lettering on the keys was difficult to read.

The tests done with the force feedback joystick showed the following results:

- The best position for optimal stability of the joystick was achieved by having the joystick on the table right in front of the PD participants, with the elbow of the hand using the joystick pressed against the body and the other hand providing support by holding the wrist;
- The PD participants were unable to use the "No Force" profile successfully, as they could not stabilise their movements;
- The "guiding force" profile, even though it seemed to be a good idea, resulted in the poorest results, even for the non-PD participants; and
- The "constant force" profile resulted in the best performance for the PD participants, as the constant force reduced the effect of their tremors. It was very slow and tiring to complete the task, because continuous effort was required to use the joystick.

The standard mouse and motion glove showed the following results:

- The most comfortable position for the PD participant to use the glove was to lift the hand slightly above the table and slowly move his/her wrist, whilst holding the forearm with the other hand to stabilise it;
- The route followed by the PD participants when using the glove was almost perfect, because they were able to control the pointer precisely. The progress was very slow;
- The non-PD participants attempted to complete the maze much faster, which resulted in losing control of the pointer; and
- Using the standard mouse resulted in a much more erroneous route by the PD participants. The route was completed much faster, however.

From the results it is clear that PD sufferers can successfully use computers. In cases where tremors are severe, special devices may be required, but most sufferers can use the standard keyboard and mouse after setting the sensitivities of these devices appropriately.

PD sufferers should take into account that, as their mobility deteriorates, they will take longer to respond to a task and to complete it. The types of programs used by the PD sufferers must therefore not require quick responses. Further tests will be performed on a larger group to verify the results.

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