Studying Point-Select-Drag Interaction Techniques for Older People with Cognitive Impairment

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Abstract. Graphical user interfaces and interactions that involve pointing to items and dragging them are becoming more common in rehabilitation and assistive technologies. We are currently investigating interaction techniques to understand point-select-drag interactions for older people with cognitive impairment. In particular, this study reports how older perform such tasks. Significant differences in behavior between all of the interaction techniques are observed and the reasons for these differences are discussed according the cognitive impairment.

Keywords: Cognitive impairment, older people, interaction technique, task duration, Alzheimer disease.

1 Introduction

Introducing Information Communication Technology (ICT) for aging population raises promises and challenges. The challenges are the accessibility of ICT even if there are physical, emotional and cognitive barriers that may inhibit use of the technologies. For example, computer's using may raise physical and cognitive demands depending on the interaction devices and/or the input/output interaction [11].

Improved pointing techniques selection has been the subject of many studies in the mainstream human-computer interaction (HCI) community, where the techniques may also be applied in the interfaces to assistive systems. One of the key challenges in developing assistive and rehabilitation systems for older people is finding some easy and effective means of interaction. However, there is some research into the design of novel interaction and in the behavior understanding.

[3] and [4] reported studies on age-related differences in movement control. [5] and [6] discussed the use and the investigating of novel point-select techniques for older people. [1] examined the influence of age related changes in the component skills required to use a mouse, specifically processing speed, visuo-spatial abilities and motor coordination. They defined slip errors as events when the cursor left the target without completing the task (either clicking or double clicking on the target). These errors proved to be a major source of age-related differences in movement time and distance travelled. The hypothesis was motor co-ordination.

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[2] also shown movement time as an result age-related linked to cognition; in fact older people tend to take longer time to process incoming information and typically require more time to respond. Then [77] reported twenty-one difficulties with mouse use like losing the cursor, running out of the application window, or the mouse click getting stuck.

A major point from this literature is that older subjects take longer to realize selections, and require a greater proportion of time and a higher number of corrective movements to reach the targets with the same level of accuracy as younger subjects. So, compared with younger users, older subjects can have greater difficulty to perform the aiming, clicking, and movements required to point-select-drag interactions.

Based on the researches reported above, this paper investigates how older people with cognitive impairment respond to Point-Select-Drag interaction techniques. This ongoing study presents our experiment and aims to provide an understanding of how the performance of older people with cognitive impairment is affected by three interaction techniques to move an item to another item. Actually this knowledge could be useful toward the design of adequate computer interaction that could be used in the development of cognitive rehabilitation systems.

This paper describes the methods that will be used in upcoming experiments on three interaction techniques to point and drag virtual items on a screen. Then, we report the significant differences in task duration observed according the cognitive impairment.

2 Experimental Design

This experiment studies three interaction techniques to select and to move an item to another one with a mouse. The aims of this experiment are to:

- Analyse performance differences between older subjects without cognitive impairment and with cognitive impairment;
- Identify and analyse factors that can explain any preference or better efficiency observed between these interaction classes.

Fig. 1. Exercise view

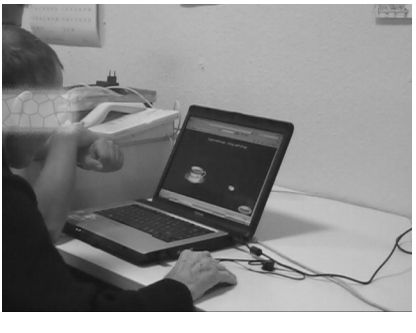

Fig. 2. A subject doing the exercise

The experiments were conducted on a Satellite Pro A200Toshiba laptop with a 15 inch widescreen, 1024*768 TFT display. An optical computer mouse was used as an input device. The right button was deactivated. The mouse was selected to be representative of an input device that would be typical for personal use. A hand cursor was preferred as a good metaphor.

2.1 Task

Study participants (Figure 2) have been asked to perform some serial pointing and moving tasks (Figure 1). They have been asked to select the item (the piece of sugar) and to put it in the coffee. Three interaction techniques have been defined:

- The *clicking* interaction (CL): The subject selects the sugar by clicking it, moves the cursor to the coffee cup top, and clicks the area of coffee ; then the piece of sugar is falling down;
- The *dragging* interaction (DR): This technique corresponds to the usual *drag and drop*. The subject selects the sugar by clicking it, maintains the pressure on the mouse button until the cursor is over the cup of the coffee, then the sugar is falling down;
- The *clicking and magnetization* interaction (CAM): The subject selects the sugar by clicking it, then the sugar is automatically attached to the cursor; secondly the subject is asked to move the cursor without pressure over the cup of the coffee, then the sugar is falling down.

A sound feedback is playing to inform that the sugar is taken by hands during the clicking action. A splash sound is playing when the piece of the sugar is over the coffee.

2.2 Method

Participant sessions involved a set of training and test computer sessions using a program recording cursor movement, and a semi-structured questionnaire. The training phase consisted in: firstly, describing the run of the mouse (moving and clicking principles), secondly doing the exercise with each interaction technique. We have considered that the technique was mastered when the subject was capable of using it without any comment or help from the experimenter. The questionnaire was designed to complement the movement behaviour and to address issues such as computer expertise, preferred interaction technique, difficulties of computer use, etc.

2.3 Participants

The older participants were recruited at Toulouse geriatric hospital. A Mini Mental Scoring (MMS) examination was made by an expert doctor in Alzheimer disease. Subjects were regrouped in three cognitive impairment groups: Mild cognitive impairment (MCI), Alzheimer's disease (AD), control (C) without cognitive problem. The subjects never used a computer before the experiment.

Table 1. Participants characteristic

N°	MMS	Gender	Age	Pathology simplified	Preferred model	Best efficient mode
1	26	F	65	MCI	1	3
2	25	F	76	MCI	1	1
3	14	M	82	Alzheimer's disease	3	3
4	15	F	71	Alzheimer's disease	3	3
5	27	F	74	MCI	1	2
6	12	M	73	Alzheimer's disease	3	3
7	26	F	67	MCI	1	3
8	20	M	89	Alzheimer's disease	4	3
9	-	M	81	Control	4	3
10	-	M	74	Control	2	1
11	-	M	83	Control	3	2
12	10	W	81	Frontal temporal dementia	0	-
13	15	W	75	Alzheimer's disease	0	-
14	7	M	69	Alzheimer's disease	0	-
15	8	W	88	Alzheimer's disease	0	-

3 Results and Discussions

From the empirical observations, we identify several difficulties with mouse, such as:

- Keeping the mouse steady when moving;
- Losing the cursor out of the exercise map;
- Bad control in moving in the adequate direction;
- Running out of the room on the mouse cursor
- And the mouse cursor getting stuck.

This study proves that, for low MMS (<10), the subject does not remember the instructions (Table 1). The results for CAM technique and the CL one are equivalent concerning points (four occurrences).

The CAM interaction is well appreciated because the technique represents well the natural actions (taking and moving). It is a good metaphor. The DR was rejected by subjects because it requests too much workload: this fact can be explained because two simultaneous processes (moving and pressure) are involved in the task.

When the subject was falling in one of the part of exercise (clicking or moving with or without pressure), he/she developed two main behaviours: one is asking help (for instance, can you show me, can you explain me, what do must do now?), another is doing with hand as he/she would have done in a real world.

Although the number of participants was too small to allow statistical analysis it is worth noting the difficulty in doing the task.

One major significant (Figure 3) result is that the duration factor is significantly different for the three interaction techniques: the DR duration is much longer than this CAM one (for MCI, -40s towards 17,8s- and for DA -43 s towards 12,9s- user groups. CAM duration (Figure 6), around 20 seconds per action, is stable for all patients. This result is independent of the age.

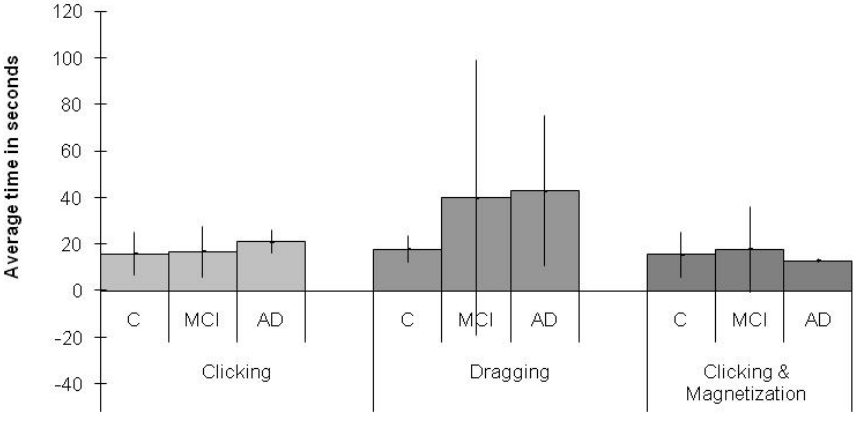

Fig. 3. Average Time for the 3 interactions techniques according to the cognitive impairment

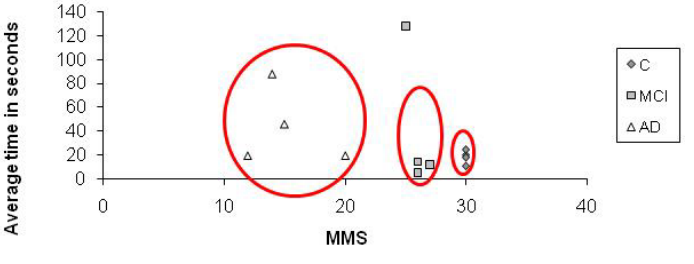

Fig. 4. Average time in seconds for the *clicking* interaction

Fig. 5. Average time in seconds for the *dragging* interaction

Another important result is that the duration increase is correlated to the decrease of the Mini Mental Score (MMS) for DR ((Figure 5).We observe also large behaviour variability for a MMS comprised between 15 and 20.

CL ((Figure 4) duration is also dependant of the MMS (the more MMS is low, the more duration is long).

From the empirical observations, we identify several difficulties with mouse, such as losing the cursor and bad control in moving with DR.

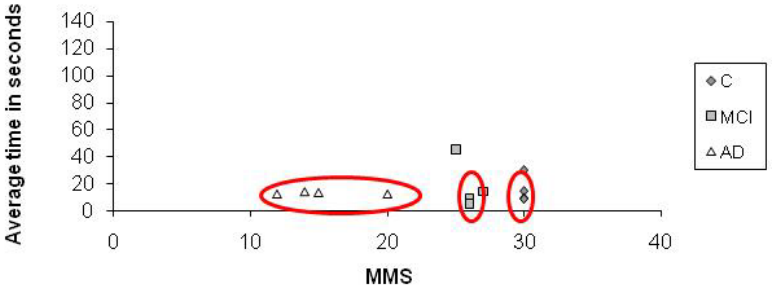

Fig. 6. Average time in seconds for the clicking and *magnetization* interaction

4 Conclusion and Future Works

The population of older people is a rapidly-growing group of users of assistive and rehabilitation technologies. As such, the development of interfaces that are usable by older people is of high importance. While a number of novel pointing techniques have been assessed in the HCI literature, the activity of older users remains to be investigated. We have described an ongoing research which aims to provide a fundamental understanding of how older subjects with and without cognitive disabilities react to interaction techniques by pointing. This point is vital in particular to design interactive rehabilitation system based on suitable interaction techniques for older adults with cognitive impairment.

This paper has focused on presenting the experiment experiments on point-select-drag interactions. One of the most important point is that the pointing interaction technique has an important impact on the cognitive activity of the subject. We plan to analyse the number of clicks missed and those of target re-entry to select the object. The aim is to differentiate between the point-and-click behaviour of able-bodied users and users with quite severe motion impairments, as already done by Mackenzie et al. [99].

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