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Case Study

Users of assistive technology also require assistance with ergonomics

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Abstract. This case study describes an ergonomics workstation assessment conducted for an administrative worker with vision impairment due to keratoconus. The worker, PT, was provided with multiple assistive technology devices to help her with her work, but this resulted in an overcrowded workspace. The purpose of the workstation assessment was to assist the worker with her workstation arrangement to make it more comfortable and efficient. During the assessment, a range of physical, cognitive and organisational ergonomics issues were identified and addressed. Multidisciplinary teams are often used in the rehabilitation of workers with complex medical problems. An ergonomist can play a valuable role on this team.

Keywords: Vision impairment, multidisciplinary, rehabilitation, workstation assessment

1. Introduction

Employment is important for establishing professional and social relationships and can contribute to self-worth and self identity [1]. It has been reported that only 34.5% of Australians [4] and 41.5% of Americans [6] with vision disorders are employed. An individual with vision impairment may have a high motivation to integrate within the working community and there may be significant benefits to retaining such a worker e.g. improved workplace morale, productivity gains [9]. A commonly cited barrier to integration of vision impaired workers in the workforce is awareness of and access to services and technology [3,6,15].

A 45 year old female administrative worker (PT) was referred to the author, an optometrist and ergonomist, for a visual ergonomics assessment to assist her with her workstation arrangement. PT has keratoconus, a progressive eye disease which causes thinning of the cornea and subsequent distorted vision. Depending on the course of the disease, keratoconus may affect one or both eyes and vision impairment can range from very mild to severe [8]. Its incidence has been estimated as 1 per 2000 of the general population [8]. PT has a more severe form of keratoconus and has had two corneal grafts on her left eye in an attempt to retain vision in that eye. Her visual acuity is poor (right eye: 6/60 distance, N64 at 25cm; left eye: hand movements) and she subsequently reports visual fatigue. PT also has other physical health difficulties including psoriatic arthritis (a form of inflammatory arthritis), kidney disease and migraine.

Despite her vision and health difficulties, PT is keen to remain in the workforce and her employer is supportive of her aims. To this end, PT was provided with a range of assistive devices to help her with her work duties, including computer software and magnification aids (see Table 1) and has received training and instruc-

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Table 1
Some of the devices provided to PT to assist her with her work

Assistive device	Purpose
Desktop video magnifier	Documents and objects placed on the document tray are magnified up to 57x and displayed on a 19 inch monitor.
Zoom text	A computer screen magnifier which allows the computer display to be split into two – half the display is viewed at normal size; half the display is magnified up to 36x
JAWS screen reader	A computer program which converts text within Microsoft Office programs to speech.
Document scanner	Hard copy documents are scanned and stored on the computer. They can then be converted to speech by the screen reader.
Optical character recognition software	Converts text within pdf documents to Microsoft Office programs. This then allows the JAWS screen reader to convert the text to speech
Document reader/voice note-taker	A portable device which can be used away from the workstation. It allows "notes" to be made by voice and electronic documents can be downloaded onto the device and converted to speech.
Dual channel headset	The two channels allow voice from the telephone to be directed to one ear while speech from the JAWS reader is directed to the other ear.
Hand held video magnifier	A portable magnifier for use when away from the workstation
Software for mobile phone	Computer programs which convert the mobile phone display to speech and which download calendar information from the computer to the phone.

tion in their use. However, upon delivery of the assistive technology PT had less desk space due to the size of the equipment and described her work area as "cluttered". PT also reported difficulty discerning between the tangle of cables which connect the assistive devices to the USB ports on her computer.

Assisting a vision impaired individual can be challenging and may require a multidisciplinary approach [7]. Professionals involved in the rehabilitation of PT included an occupational physician, an adaptive technology consultant and a workplace rehabilitation case manager. This case report describes the importance of also involving an ergonomist in the rehabilitation process so that PT could work efficiently and comfortably.

2. Case history

2.1. Overview

PT has university qualifications in the physical health sciences but now works in an administrative role due to her vision difficulties. Her work tasks include dealing with customers over the telephone and face to face, reading electronic and hard copy documents, word processing and attending meetings and presentations. She is left-handed for writing tasks, yet uses her right hand for operating the computer mouse.

An assessment of the workstation was conducted by the author in the presence of PT. The lighting was found to be satisfactory. Modifications to the workstation arrangement were trialled during the assessment and PT provided feedback on the suitability and feasibility of proposed interventions. The author contacted PT by telephone twice in the post-assessment period (after one week and one month) to discuss if any further modifications or action were required to assist comfort and efficiency. PT reported that she was happy with the interventions and did not require further ergonomics assistance.

2.2. Assessment

A photograph of the pre-assessment workstation is shown in Fig. 1 and demonstrates that the workstation was "cluttered". Other difficulties identified during the assessment included:

- The desktop video magnifier was located on the left hand side of the workstation, yet PT only has usable vision in her right eye. This meant that PT needed to make a large turn in her chair to see the display with her right eye.
- The desktop video magnifier was located on the left hand side of the workstation where PT would normally write on hard copy documents. Subsequently, PT needed to twist her body to write with her left hand on the right hand side of the desk.
- There was insufficient space around the desktop video magnifier which prevented the document tray from moving as designed. Subsequently, PT needed to physically hold and move documents under the magnifier instead of sliding them on the tray.
- The document scanner was stored in a vertical orientation behind the monitor as there was insufficient desk area for it to be placed flat on the desk.

Fig. 1. Workstation before implementing change.

This meant that PT either needed to accurately insert documents in the vertically positioned scanner or move the scanner elsewhere on the desk to operate it in its horizontal position

– Instruction manuals for various software applications were stored on appropriately labelled CD-roms which meant that PT needed to read the label on the CD-rom label and then insert the CD in its drive. The CD-rom drive was in an awkward location directly behind the monitor stand.
– Although PT had been provided with magnification programs for the computer display, she still preferred to work at a short working distance. She had positioned the computer monitor as close to the front of the desk as the keyboard would allow (28cm from the front of the desk), but still found it necessary to lean over the desk to read the display.
– The telephone at this workstation had large number displays but rested flat on the workstation. PT had difficulty seeing the telephone keypad, instead relying on tactile cues when using the control pad.
– There were three cables for assistive devices connected to the USB port of the computer. As the devices were not always connected to the cables, PT relied on "feel" to connect the devices to their respective cables. She requested that they be labelled and had a labelling machine available during the assessment for this purpose.

2.3. Modifications

The principle modification to the workstation arrangement was to move the desktop video magnifier to the right hand side of the workstation (see Fig. 2). PT was given the opportunity to trial the video magnifier's new location during the assessment and she suggested some minor modifications to its orientation on the desktop to improve comfort and ease of use. The rationale for relocating the video magnifier was:

– To enable sufficient room for the document tray to be used as designed
– To allow PT to view the display easily with her right eye without twisting her body or head or excessively rotating her chair. Locating frequently used visual displays in a central position has been shown to be beneficial for physical comfort [12].
– PT could now use the left hand side of the desk for writing tasks (see Fig. 3). There was sufficient room for using the mouse with her right hand
– The scanner could be placed flat on the desk which made it easier to use

In its new location on the desktop, the video magnifier faced away from the customer contact area. This addressed the secondary issue of privacy which arose with the introduction of the device and reduced the risk of magnified documents being viewed by non-authorised people.

Other recommendations for workstation modification included:

Fig. 2. Workstation after implementing change. The desktop video magnifier was relocated to the right hand side of the workstation where it was more easily used by PT.

Fig. 3. Workstation after implementing change. Once the desktop video magnifier was relocated to the right hand side of the workstation, there was now more room on the left hand side of the workstation for the scanner and for PT to write with her left hand.

– Providing a stand for the telephone so that was angled for easier viewing
– Mounting the monitor on an articulated arm so that PT could manoeuvre it to a shorter working distance as required. This also enabled easier access of the CD-rom drive
– Installing the software instruction manuals on the computer desktop so that PT did not have to locate and correctly identify the CD-roms on her workstation and then insert them correctly into the drive
– Colour coding assistive devices and their respective cables. This was considered a better option to text labelling as the text would need to be 16mm high for PT to read unaided or she would have needed to use a hand held magnifier. Colour cod-

ing has also been shown to assist low vision object recognition [14].

Although a wireless computer mouse would have further reduced the number of cables at the workstation, PT feared that she might not be able to easily locate the mouse on her workstation, or worse, drop it on the floor and then have difficulty retrieving it due to her visual and physical limitations. The corded computer mouse was retained.

3. Discussion

This case study describes the role of an ergonomist in the workplace rehabilitation of a vision impaired worker who was provided with multiple items of assistive technology by her employer for use within the workplace. The ergonomist was one of several professionals involved in the care of this worker. A multidisciplinary approach is usually considered more efficient for delivering care in complex cases [10] as multiple practitioners can provide different perspectives and expertise to the problem solving process [7,11].

Ergonomics is a scientific discipline. Its underlying philosophy is to find a balance between the capabilities of individuals and the environments in which they work and so achieve comfort, safety and efficiency. The International Ergonomics Association (IEA) identifies three domains of specialisation within ergonomics: physical, cognitive and organisational [5]. This case study demonstrates that while the location of assistive devices on a workstation is important for physical comfort, there are also cognitive implications (for example, ease of identifying objects on the workstation) and organisational implications (for example, privacy of data displayed on the video magnifier and job satisfaction).

The worker described in this case study was an intelligent lady with tertiary education in the physical health sciences, yet had difficulty identifying solutions to the ergonomic issues she faced at her workstation. Her post-assessment comment was:

> *"I was overwhelmed with the new equipment but didn't really know how to make it work for me. You don't even think to change it – you just use it. Having an external person made the world of difference."*

One approach for addressing workstation arrangement issues with assistive technology might be prescriptive whereby the workstation is set up according to pre-defined criteria or checklists. An ergonomics approach is broader than this; an integral component of ergonomics is to involve the worker in an ergonomics assessment as it engenders ownership of problem solving [2,13] and it enables them to offer their own perspective on the effectiveness and appropriateness of interventions. Although the recommendations in this assessment were based on sound ergonomics principles, a consultative approach was used in this assessment to more fully identify and understand the current and potential issues faced by the worker.

4. Summary

Assistive technology can enable visually impaired individuals to remain in the workforce. There are significant costs with purchasing assistive devices and training individuals to use them, yet there is the risk that these devices will be rejected or not used to their full functionality if the installation does not allow for the visual and physical capabilities of the worker. An ergonomics assessment can facilitate this process and ensure greater acceptance and usability of the technology which can in turn improve productivity and job satisfaction.

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