Technologies for People with Low Vision - Part 1

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This article is the first in a two-part series about technologies for people with low vision and blindness. For the purposes of clarity, the author uses the Wikipedia definition of technology as *"the collection of tools, including machinery, modifications, arrangements and procedures used by humans"* (Wikipedia contributors, 2015). Part One of this series focuses on the impact of low vision on the specific task of reading, which is the most commonly cited complaint in people seeking low vision rehabilitation.

Low vision

Low vision is defined as a visual impairment that cannot be corrected with glasses, medications, or surgery. The International Classification of Diseases, 10th edition, (ICD-10) has specific diagnostic codes for low vision and blindness. In essence, low vision and blindness are sensory impairments which relate to cranial nerve two, the optic nerve. Oculomotor impairments that cause diplopia or other eye teaming problems (arising from impairments in cranial nerves 3, 4, or 6) are not considered sensory impairments and therefore are not classified as low vision, despite their potentially negative impact on daily function. For the purposes of this article, only the current ICD-10 low vision diagnoses are considered (World Health Organization, 2014).

In the United States, low vision has been an emerging area within occupational therapy (OT) since the late 1990s. From a global epidemiological perspective, low vision affects the elderly more than any other segment of the population (Bourne et al., 2013). This is due to the four age-related eye diseases: macular degeneration, diabetic retinopathy, cataracts, and glaucoma. Strokes also can result in low vision due to visual field defects. The first three eye diseases—macular degeneration, diabetic retinopathy, and cataracts—typically result in blurred vision and loss of the ability to detect contrast. The last two conditions usually result in narrowing or constriction of the visual fields. In most instances, people with these conditions also are less tolerant to glare and require more task lighting.

Devices for reading

Reading difficulty is the most common complaint in people seeking low vision rehabilitation, and is frequently a primary

goal in OT intervention (Smallfield, Clem, & Myers, 2013). Magnification combined with targeted illumination is the most common modification for people with blurred vision and poor contrast. Traditional lens magnifiers come in many different powers, measured in diopters. The power of the lens magnifier should be prescribed by an eye doctor who specializes in low vision. Ideally, there should also be a built-in power source and bright illumination.

While traditional lens magnifiers may seem like a commonplace technology, anyone who has worked in the field of low vision rehabilitation has heard complaints from patients about magnifiers which "don't work". Using magnification devices correctly and matching them to the desired task can indeed be tricky. Firstly, traditional lens magnifiers can come in a range of powers. As the power of the magnifier increases, the size of the lens decreases, making it more difficult to view a large area. Most patients desire a magnifier with the highest power and the largest lens, or the power of the magnifying lenses placed into their spectacles. According to the laws of optics and physics, this is not possible. Additionally, with increased magnification, the distance between the magnifier and the object decreases, meaning that the lens needs to be held closer to the object. If a high-powered lens is pulled away from the object, the image in the lens will be inverted.

Magnifiers can either be held in one's hand or placed flat on a page, but usually not both. The OT needs to know the differences between hand-held and stand magnifiers and should assist the client with the skills to use them, including focusing the device at the correct distance, aligning the device with the better-seeing eye, and making sure that the client can find all of the desired information across the page. At higher powers, lenses should be held close to the better-seeing eye as the materials are placed close to the lens at the correct focal distance. The device should be easy for the patient to manipulate for use, e.g., powering the device on and off, and replacing or charging its batteries. The client needs to understand the impact of illumination when using the magnifier, and therefore the importance of keeping the device powered with fresh batteries or a fresh charge.

In the past, magnifying lenses stronger than 4 diopters could only be purchased from an eye care specialist. Nowadays, illuminated hand-held and stand magnifiers can be purchased via online merchants such as LS&S (www.lssproducts.com) and MaxiAids (www.maxiaids.com), amongst others. Illuminated magnifiers with powers up to 55 diopters can range in price from $15.00 to $95.00.

Figure 1. The OT needs to teach the client to align the magnifier with the better eye while focusing the menu at the correct focal distance

Another option that has gained popularity over the past years is the portable electronic magnifier. Electronic magnifiers have become cheaper and readily available from online vendors. In addition to variable levels of magnification within a single device, most portable electronic magnifiers have the added benefits of larger screens (when compared with the size of traditional lens magnifiers). They also have settings for enhanced contrast as well as reversed contrast which inverts the image; for example, a newspaper may appear as white print on black paper. The particular features of image color manipulation and reversal of contrast are beneficial for people who experience the disabling effects of glare, and who cannot use traditional illuminated lens magnifiers due to the brightness of the light source or reflectivity of the magnifying lens.

Most portable electronic magnifiers have foldable legs which allow the device to rest on the page at the correct focal distance, while making it easier for the patient to navigate through larger volumes of printed materials. The online retailer Amazon offers a wide selection of portable electronic magnifiers at a range of prices, from $70.00 to $900.00.

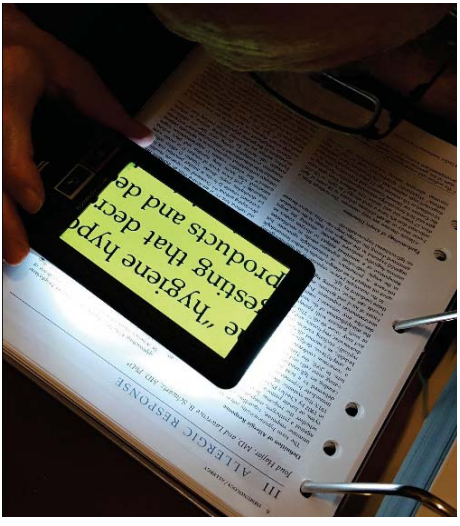

Figure 2. An electronic magnifier has a larger viewing area and the image can be manipulated to enhance contrast

For those who are comfortable with computers, reading can be accomplished by modifying the visual display or by using audio strategies. However, OTs need to understand the role of spectacles for reading. Although low vision is not a normal part of aging, presbyopia is related to age and is experienced by most people

over age forty. Presbyopia is decreased flexibility of the crystalline lens in the eye, making it more difficult to focus up close, as required for reading. Most people in their forties and beyond require reading glasses, and many combine their prescription for distance with their need for reading glasses in a pair of bifocals or trifocals, collectively called multifocals, because each lens has two or more focal zones. The middle zone of trifocals or multifocals is typically made to bring targets at the distance of an arm's length into sharp view, for example a computer screen or a museum exhibit.

Many people who wear multifocals, regardless of whether or not they have low vision, have difficulty viewing through the correct focal area of the lens for the task they are trying to accomplish. This is particularly difficult for people with low vision, who may perform better with single-vision glasses designed to focus at one particular distance. For example, if a person completing a task on a computer needs to use one hand to line up the spectacles to read the screen, keyboarding with two hands becomes more difficult.

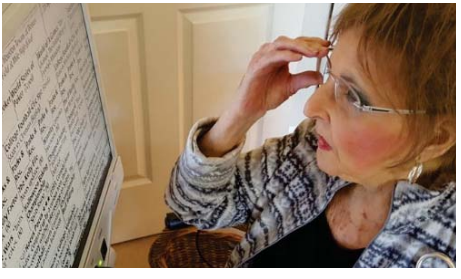

Figure 3. A woman trying to align her multifocals for viewing a computer screen

Aside from wearing spectacles for the correct focal distance, OTs can help with modifications to a computer's operating system to alter the display of information on the monitor. Text and icons can be enlarged and the colors of the display can be changed or inverted. The mouse pointer and cursors can also be customized. Each version of every operating system has the possibility of altering the display characteristics at no additional charge to the user.

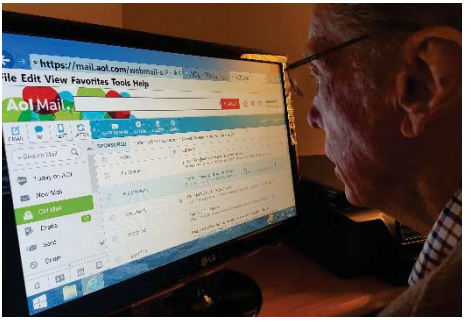

Figure 4. Modified computer display

Glare screens can be installed on monitors to decrease glare. Stickers with enlarged letters and numbers can be placed on keyboards for better contrast. These low-cost, high-contrast stickers can be purchased for approximately $7.00 to $12.00 from online retailers such as Amazon, using the words "keyboard stickers" in the search bar.

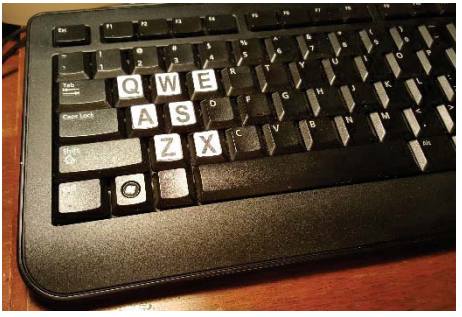

Figure 5. Stickers with enlarged letters for computer keys

Computer software programs can help to magnify the screen beyond that which is possible through the computer's operating system. ZoomText by Ai Squared is one such example that combines screen magnification with screen reading capabilities. Prices range between $400.00 for magnification only to $1,500.00 for magnification and screen reading (www.aisquared.com). Another program which aids in visual reading of on-screen text is MagnaFlyer by SoftOlogy IdeaWorks. This program, which is derived from a commercial application, RapidReader, enables the user to read digital texts by displaying words, one at a time, on a darkened screen. MagnaFlyer also comes with a series of exercises and tutorials designed specifically for people with low vision to learn the skill of Eccentric Viewing while employing the Steady Eye Strategy (www.MagnaFlyer.com). The program costs approximately $250.00. OTs are encouraged to download a free version of the commercial application, RapidReader, to understand the utility of this strategy.

Smartphones and tablets offer many built-in accessibility options that can be useful for people with low vision. Like computers, there are customizable settings that allow for enlarged icons and fonts, color schemes with enhanced contrast, customizable screen brightness, and voice commands, like Siri. While these enhancements are beneficial, they are often only selectively useful due to the inaccessibility of the menus as in the example of the original e-reader by Amazon, the Kindle (Burton & Clements, 2008).

In smartphones and tablets, the zoom feature of a camera can act as an electronic magnifier. Once the user opens the camera app and points the camera towards the text, finger gestures can be used to zoom in and focus on the desired reading target. There are also many smartphone and tablet magnification apps that use the device's camera. Since most cameras are located on the top side of the smartphone or tablet, the OT needs to teach the user to point the camera, not the center of the screen, toward the visual target. This displacement can often be confusing and the OT should be mindful to address this skill when training a client to use a smartphone or tablet as a magnifying device.

OrCam is an Israeli invention that combines features of a computer with spectacles. OrCam looks like a pair of glasses with an additional hand-held (or pocket) component. A tiny camera built in to the frame of the glasses recognizes and reads texts and products and speaks to

the user via a bone-conduction earpiece, which is also hidden in the frames. The OrCam learns to identify and respond to the user's finger gestures. For example, when the user points a finger at a newspaper, the OrCam discreetly reads the printed text to the user. It can also learn to recognize previously identified faces, money, food labels, credit cards, medicine labels, etc. The price of the OrCam ranges from $2,500.00 to $3,500.00 (www.OrCam.com).

Summary

It's hard to imagine a world in which we do not have to read for many activities of daily living including those necessary for basic survival, like reading a medication label, instructions for heating food, or a bank statement. The loss of the ability to read due to vision impairment can lead feelings of inadequacy, illiteracy, and dependence. Understanding the impact of vision loss on the activities of your clients is essential when trying to find acceptable solutions. Your client will likely benefit from a variety of techniques for different types of reading, including listening to audio books. A free *Talking Books* program is available as a national service in many countries around the world, e.g., the United States, England, Canada, Australia, and Israel.

In Part Two of this series, the author will describe technologies for people with low vision to enable participation in other activities of daily living including those associated with mobility safety.

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