

AN INVESTIGATION OF THE USE AND POTENTIAL USE OF ACCESSIBILITY OPTIONS BUILT INTO COMPUTER OPERATING SYSTEMS

PURPOSE

This study was designed to investigate how accessibility features built into computer operating systems are used by people with disabilities. It was also designed to identify operations that are problematic and should be addressed in the future, making computer use even easier for all people, including people with disabilities. The following premises were among those that lead to the completion of this project.

- Many people with disabilities are not aware of features built into Microsoft Windows that can help their productivity.
- People without the label of disability do not, but could, take advantage of many accessibility features built into Windows 98 to further improve their productivity and the ease with which they use computers.
- Additional functional limitations may not be addressed by current features.

This project was completed in 2000 and funded by Microsoft Corp.

PARTICIPANTS

Thirty-six participants (total) were recruited in New York City and in Boston. Discussion groups included people with vision impairments, coordination impairments, and cognitive processing limitations whether from disability or the aging process. Diagnostic categories included low vision, blindness, CP, spinal cord injury, multiple sclerosis, traumatic brain injury, stroke, and mental illness. People who did and did not use Microsoft Windows' Accessibility features were recruited. People without the label of disability were also asked to identify their needs and to discuss features that might be useful to them.

FINDINGS

The computer-related experiences varied among participants. Some participants were new computer users, just learning about computers. Others were very experienced users. Some used their computers for work, others for leisure, and many for both work and leisure. Some used their computers quite regularly, some seldom. Some owned computers, others used computers only at work or in public areas and did not have computers of their own at home. Some used the latest software and hardware, others used equipment and software that were older. The following list summarizes the types of activities that participants performed using computers:

- Writing and editing
- Communication (written, email, online telecommunications)
- Web TV
- Web-based research
- Management of finances and household information
- Reading

- Presenting information
- Playing games and other leisure pursuits
- Art and design
- Computer programming and testing

The participants of this project provided a wealth of information concerning computer use. Findings indicate that, above all, people are individuals and what works for one person may not work for another. People used a variety of strategies to meet their needs. Some relied on accessibility features, while others rigged strategies for themselves.

There were, however, certain things brought up by participants indicating that all of their needs were not being met. This developed into a sort of wish list, identifying features that some people said would be helpful to them. The wish list presented here reflects some of the more common comments discussed.

WISH LIST

- Have keyboard commands standardized between all operating systems and various applications. Right now, some key commands work only in certain programs, but there is no consistency.
- Develop key commands for all pointing device (mouse) functions.
- Make keyboards that can adjust the amount of force required to activate keys.
- Make key size, spacing, and arrangement easily adjustable.
- Provide markings on the numeric keypad for using mouse keys.
- Make other pointer schemes with different sizes and different colors available.
- Develop a reliable method to use 'eye gaze'.
- Develop an integrated 'touch screen'. One suggestion was to develop a tactile interface with spoken output.
- Develop an operating system that can provide voice output of the boot-up process along with any errors until the screen reader is loaded.
- Build Microsoft Active Accessibility into all software so that users can install, recover, and maintain their systems independently (using a screen reader).
- Develop screen reader interaction that provides auditory feedback for selections, e.g. check boxes, as well as error messages and dialog windows.
- Develop auditory feedback regarding location of cursor on screen.
- Make spell check, dictionary and help features accessible when a screen reader is used.
- Allow selection of icon size and magnification on initial boot up.
- Develop a system allowing multiple users (on one machine) to customize their own desktop and start menus. Provide 'simple' desktop and start menu for new users.
- Make voice recognition more reliable.

- Build non-glare monitors.
- Improve auto-correct so that the ability to customize the feature is evident and easy to use.

DISCUSSION GROUP FINDINGS

The wealth of information gathered from the participants in this project proved interesting and useful to us, as well as to the Microsoft Corporation, and we feel the information could be very useful to others. The following synopsis includes information organized by computer part or function: keyboard, pointing device, visual feedback, auditory feedback, cognitive, and social implications. Within each of these categories, discussion was generated regarding accessibility features, enhancements, related information, and things that the participants wished were currently in existence.

Please remember that the participants used a variety of computers, operating systems, and applications of various versions. Some of their comments may not be relevant to all computers, operating systems, or versions of applications.

ACCESSIBILITY FEATURE: STICKY KEYS

- + Useful for people who cannot reach far enough to hit key combinations (e. g. Ctrl+Alt + Delete)
- Doesn't always work with top row of keys (e. g. number key with \$).
- Some people, who would benefit from using sticky keys, didn't know about the feature.
- Some people (such as those with temporary conditions, like traumatic hand injuries) *did not consider themselves disabled* and did not look at the 'wheelchair icon' for help.

ACCESSIBILITY FEATURE: FILTER KEYS

- It was not always apparent what some of these settings can do.
- Using the BounceKeys feature did not always help if a person "bounced" on a neighboring key (which was a possible occurrence).

ACCESSIBILITY FEATURE: TOGGLE KEYS

- + May be useful to people with low vision.
- + Typically built into screen reader software, so these users did not go to the accessibility features setting for this.
- While most people were familiar with this, it was rarely used.

ENHANCEMENT: SPELL CHECK

- + People were generally familiar with spell check and used it.
- People using screen readers did not always know which incorrect word has been selected.
- Some thought their spell check function made errors (and did not know how to correct the dictionary).
- People were generally not familiar with how they could edit their own dictionary.

ENHANCEMENT: GRAMMAR CHECK

- Not often used.
- Many grammar check suggestions tend to be inappropriate.

ENHANCEMENT: SHORT CUT KEYS

- + People who use them think that they are easier than the mouse.
- + People who use them generally think they are quicker than using the mouse, and thereby increase speed (words per minute).
- + People with difficulty using the mouse, (such as from hand coordination deficits), felt that they perform better using short cut keys.
- Commands are difficult to remember.
- Commands vary among different applications and operating systems.
- Some people commented that it was annoying when the software assumed you were using a mouse and not the keyboard, (e. g. 'click here' instruction found with hyperlinks).

ENHANCEMENT: ABBREVIATION EXPANSION

- Many people were familiar with what this function is, but not how it is used.
- Not system-wide (e. g. used in MS Word via auto-correct setting, but not in OS).

ENHANCEMENT: MACROS

- Many people were familiar with macros, but didn't use them.
- Difficult to remember how to use (e. g. performing record & playback commands).
- Not system-wide (seen only in select applications, and not in OS).
- Not necessarily associated as a way to decrease input effort (e.g., a family member used macros at work, but did not make the connection that it would also be helpful for her relative who has difficulty keyboarding).

WISH LIST

- Standardized keyboard commands could be helpful to improve the learning curve.
- Cheat sheet of keyboard commands, similar to the 'old' template that accompanied WordPerfect and was placed above the top row of keys (in the hay days of DOS).
- Ability to turn keyboard repeat rate OFF completely, not just slow it down
- System wide abbreviation-expansion and macro features; rather than different in each application
- Ability to select keyboard layouts from software with corresponding display on keyboard. Instead of moving keys around on the keyboard, perhaps backlit LEDs could be used to highlight different key arrangements.
- Provide visual and auditory feedback with keypress.
- Clear instructions for changing settings (e.g., auto-correct, typesize, toolbars) - some defaults and preferences not obvious to users.
- Ability to adjust key sensitivity.
- Key on keyboard for spell check.
- Many participants look forward to using voice input. Some who tried it complained that it is not flawless.

ACCESSIBILITY FEATURE: MOUSE KEYS

- Using a mouse is still preferred over using Mouse Keys, whenever possible, because it is generally easier and faster to use.
- People with recent injuries may feel that using Mouse Keys (not being able to use a conventional mouse) is an admission that their skills have changed
- It is difficult to remember which keys on a numeric keypad do what, since they are labeled with numbers and do not have arrows or other markings on them. It is difficult to figure out how to use Mouse Keys even when using the demo and tutorial.
- Using a numeric keypad can be awkward due to its placement on the far right side of a conventional keyboard. Using both the keyboard and numeric keypad requires a long reach. If only the numeric keypad is used, it is difficult to place in a centered position. The difficulty in moving the position of the number pad has an even stronger impact when the person has limited movement, uses typing aids, or uses a mouthstick.

ENHANCEMENTS

- There was generally not much discussion about enhancements for pointing device use. Most people were familiar with the settings to optimize pointing device use, but found the defaults satisfactory.
- Not everyone was aware that some systems include acceleration speed as part of the speed adjustment.
- Many folks, especially those with low vision, wanted to change the size and/or color of pointer, but could not find the right place to do this.

OTHER INFORMATION LEARNED

- Not everyone knew that the right click button had a specific function.
- People with limited hand function tended to be those who wanted programmable buttons (e.g., for double-click or drag operations) and also preferred trackballs - the more limited the individual, the more crucial it was to be able to use the program
- There was some unfamiliarity with dragging text to cut and paste.
- People with limited hand function often found dragging operations difficult
- There was generally a positive response to using touch screens - either on a computer or ATM.

WISH LIST

- Markings on the numeric keypad related to pointer movement.
- More prominent numeric keypad keys for mouthstick/typing stick users - or more centrally located.
- Corresponding shortcut keys for all mouse functions.
- A joystick (similar to those used for games) to function as a mouse preferred by those with limited hand use.
- Easy to access larger and different colored pointers.
- Voice recognition for mouse functions requiring finer resolution of movement (e.g., window resize or push buttons).
- Corresponding keyboard commands for all mouse functions.
- Reliable way to use built-in eye gaze system.
- Built-in touch screen.

ACCESS FEATURE: MAGNIFICATION (Part of Mac Access Features, and Windows Enhancements)

- + Magnification settings were also used by wheelchair users who, because of chair size, or laptray, can't get really close to monitor.
- Many people without low vision were not familiar with magnification and how to change settings. Nor were they aware that magnification might be useful to them to make computer use easier.
- Many people did not know that it was possible to magnify individual elements rather than the whole screen.
- Among computer users with low vision, there was a strong desire to be able to locate cursor and active elements, e.g. controls and edges of windows.
- Some people commented that they did not know how to change the settings for icon or font size.
- Some people knew they could change document size, but they were not sure how this affected print-out and, therefore, did not use it to make it easier to read documents on the monitor.
- Some people wanted to change text size in dialogs without magnifying the entire screen.
- Ability to auditorily locate cursor and active elements, e.g. controls, edges of windows.

ACCESSIBILITY FEATURE: HIGH CONTRAST

- Few people knew where to find the high contrast setting.
- Few knew how the high contrast setting changed the 'look' on the monitor.

ENHANCEMENTS

- + People often use color schemes that are visually pleasing to them.
- While people may change color schemes so they are visually pleasing, they rarely change schemes for their vision needs.
- Most people thought that the color schemes could be changed, but that the changes were purely aesthetic and did not realize that they could be used to enhance viewability.
- One participant who had laser eye surgery with resultant dry eyes wanted to decrease glare, but was not sure if the brightness/contrast setting would help.
- Some people did not know they could change default settings in applications to make viewing them easier.
- The brightness of the monitor was irritating to some people. The people who mentioned this did not know how to make adjustments either on the monitor itself or through the control of the schemes.

- People who use bifocals often have difficulty using computers because in order to see the information on the monitor (reading) they need to look through the bottom portion of their lenses. That often requires them to bend their heads back, which can cause neck and back pain. One solution may be to increase the font size in the applications.
- Users with bifocals and trifocals had a hard time seeing the monitor straight on and had to compensate head or monitor position to use the bottom of the lens ... if they take off glasses to see computer then can't see documents.

WISH LIST

- Provide visual and auditory feedback with each keypress.
- Provide clear instructions for changing settings, some defaults and preferences.
- Make it possible to select a desired icon size (etc.) at very first computer start-up.
- Ability to pick different sizes and colors of pointer.
- Ability to zoom in at area of pointer.
- Ability to change the size of text in dialog boxes (alerts, error messages, etc.).

AUDITORY FEEDBACK

- + Auditory feedback is useful as a cue to certain events for people with cognitive impairments.
- + Generally desirable for people who are blind or have low vision.
- Many people who use screen readers do not want the operating system to take over the role that the 3rd party screen readers currently have.
- The number of events that have auditory feedback is limited.
- Some did not know what the sound warnings were (e.g., you know that there is an alert, but not what the dialog message is).
- In order to install software, the user must typically quit all open applications. This means that the screen reader is not available and is thus unable to provide access to installation screens.
- Microsoft Active Accessibility (MSAA) is a useful feature, but is not utilized consistently across platforms, nor is it used consistently by third party software such as an MP3 player plug in or chat programs.
- Bitmaps are not accessible to screen reader users.
- Active Desktop is problematic for screen readers when compared with the Classic Desktop.
- Screen reader users indicated problems with templates, Help, multimedia (e.g., encyclopedias), highlighting text, how browsers handle forms, knowing the boundaries of a spreadsheet, the Assistant being activated without the user knowing (and therefore losing focus), Task Manager losing focus, and the Find & Replace feature.

- People using screen reader have problems with navigating through the feature that allows adjustment of the volume of the system and tend to change speaker volume instead.

WISH LIST

- The Number One Request: To be able to operate system independently. Many request that speech be a part of the operating system so that it is available during the boot-up process, providing alerts to error messages such as the information provided in dialog boxes, and file management components.
- When tab or pointer puts the focus on a certain element on the display, such as when the location cursor is on an object, the user should know what the object is as well as its state. Knowing only that he or she is 'on' a graphic is insufficient, the type and state of the graphic should also be made known.
- Comment for separation of rendering (content, structure) from the presentation layout.
- MSAAs need to be applied more consistently across the operating system and applications (perhaps built into the programmer's tool kit if it isn't currently so).
- There is a desire for combined tactile and speech interface.
- Some users with low vision requested the ability to get a description of window content when it is initially displayed.
- There is a request to increase the range of system event sounds so that they extend to things such as sounds of the Internet browser connecting to the next page.

IMPACT OF COGNITIVE AND SOCIAL FUNCTIONING ON COMPUTER

During the course of the discussion group meetings we learned about the impact that computer use has on people with cognitive and psychiatric conditions.

- People with delusions may think that the computer is talking to them. Automatic responses and usually helpful features, such as the "Helper" that appears in Microsoft software, may be disconcerting.
- People with cognitive and psychiatric conditions may have impaired attention span either due to their condition or secondary to medication. This may limit the person's ability to complete computer-based tasks.
- Some medications for psychiatric conditions affect vision. Some participants complained of blurred vision that limited their ability to use the computer.
- Arm and hand stiffness, tremor, and incoordination may be a side effect of medication and may limit a person's ability to type and use a pointing device.
- Using a computer can be interesting and motivating and may be a useful tool to help people with a limited attention span.

GENERAL ISSUES

During the course of the meetings, people made statements that did not fit easily into the categories we investigated. This information was still useful to us and may be interesting to you.

- Defaults are sometimes not the users' preferences and can be confusing to change.
- Software requirements, as they appear on packaging, are too small to read!
- If the requirements are written on a sticker on the wrapping, they are gone once the package is opened.
- Packaging and CD boxes are very difficult for people with impaired hand function to manage.
- It seems that every application has the serial number located in a different place- sometimes the CD-ROM, sometimes on the box, sometimes in the manual. This makes it difficult to find it when loading software. A standard location would make it easier for people to find. One participant also commented that he didn't realize until he was part way through loading software that he needed a sighted assistant to find the serial number, causing the participant to have to cease the loading process

ACCESSIBILITY FEATURES

Computers are wonders of modern technology and there are many features of the computer that can be set to make it easier to use. Many people do not even know they can change the way things look or work on their computer. Ease of use may mean automating some functions, or making the information easier to see. It may also mean the difference between being able or not being able to use the computer - such as for someone with low vision, hand pain due to arthritis, or paralysis.

The settings described here can make the computer easier, pleasant or even possible to use. This web page describes many of the features that are available to customize your computer. It also tells you where you might find the settings. This is not meant to be an exhaustive listing, but rather a beginning resource. Following the list of features, there are resources for more information on the web.

DESCRIPTIONS OF OPTIONS

The following information describes options that are available to customize your computer's behavior and appearance according to your individual needs.

TYPING

If you only use one hand to type, the following software might be useful to you:

Abbreviated Expansions- allows you to type in an abbreviation and have the system automatically expand it to a longer word or phrase.

Auto-correct - editing feature that allows you to add words that you often type wrong along with the correct spelling that they will automatically be replaced with. You can use this feature to type

in abbreviations that can be then turned into expanded words or phrases. Microsoft Word®: Tools menu.

BounceKeys - prevents having the same character typed if you quickly press a key twice, such as when you are releasing your finger from the key. The system only recognizes a key press if it is a different key than the one just pressed, or if the key is held down for a set amount of time. Windows: My Computer/Control Panel/Accessibility Options/Filter Keys setting .

ClickTyper - provides picture of keyboard on computer screen to allow you to type by selecting "keys" with the mouse. Macintosh shareware.

Dvorak Keyboard (Left or Right) - keyboard layout based on frequency of use for touch typists. This layout places the most frequently used keys under your most dominant fingers (e.g., pointer and middle fingers), and requires you to learn a new layout. Macintosh & Windows: Keyboard control panel.

EasyTyper - allows you to only type in partial words or phrases. You then press at hotkey (selected key combination) and have the computer automatically finish the word or phrase. This requires that you initially enter these words or phrases into the software (therefore good if you use them frequently), but may be used with any of a number of text editing programs (e.g., MS Word®) Macintosh shareware.

Half-QWERTY Keyboard - keyboard layout for touch typists, using half the existing keyboard. Available for right or left hand. Free demos available on-line.

HyperTyper - provides picture of keyboard on computer screen to allow you to type by selecting "keys" with the mouse. Macintosh shareware.

Key Repeat (Rate & Delay) - prevents repeated characters if you cannot release your finger from the key fast enough. Macintosh: Keyboard control panel & Windows: My Computer/Control Panel/Accessibility Options/FilterKeys setting.

Keystrokes - provides picture of keyboard on computer screen to allow you to type by selecting "keys" with the mouse. Macintosh freeware (but must register).

Macro - editing feature that allows you to record typing and/or mouse actions and then play them back with either an assigned keyboard command or menu selection. Microsoft Word®: Tools menu.

Macros- allows you to record a series of keyboard and/or mouse selections and then automatically play them back with either keyboard commands (e.g., <Alt> + <Z>) or a menu option.

One-Finger Typing- if you only use one finger to type, the following software might be useful to you.

On-screen Keyboard / On-screen Keyboard - provides picture of keyboard on computer screen to allow you to type by selecting "keys" with the mouse. Windows 2000, Macintosh freeware

SlowKeys - ignores accidentally pressed keys such as when you might drag a finger on an unintentional key, or accidentally bounce on a neighboring key. The system only recognizes a key press after you hold down the key for a certain amount of time (you set what this delay time

is). Macintosh: EasyAccess control panel & Windows: My Computer/Control Panel/Accessibility Options/FilterKeys setting.

StickyKeys - allows you to press keys sequentially rather than at the same time, such as <Shift + <A, or <Ctrl + <Alt +<Del. Macintosh: EasyAccess control panel & Windows: My Computer/Control Panel/Accessibility Options.

ToggleKeys - auditory feedback for selection or de-selection of CapsLock, NumLock, or ScrollLock keys. Windows: My Computer/Control Panel/Accessibility Options.

TypeIt4Me - provides abbreviation-expansion capability in any place you might enter text, such as a document or renaming a file folder. Macintosh shareware.

MOUSE FUNCTIONS

Accelerator Keys - keyboard access to menu options and pushbuttons. Keyboard selections are listed as menu options or as text within a button with one letter or one of several letters underlined. Pressing the <Alt> key with this underlined letter will select the menu option or pushbutton. Windows

AppTab - allows you to use the keyboard to select icons to switch between current applications. Macintosh shareware

Automated Selection - commands that can be automatically performed by the computer to save you an extra step when making a selection (e.g., clicking the mouse on a button).

AutoMenus Pro - allows you to open menus without having to click the mouse, just by moving pointer onto menu heading. Menus will stay open until you move pointer outside menu area. Macintosh shareware

ButtonKey - allows you to select buttons and checkboxes with the keyboard by typing the beginning character(s) of the button's name. You can also set the <Escape> key to make the Cancel button selection. Macintosh shareware

CanIt - allows you to empty Trash with a keyboard command. Macintosh <Shift> + <Tab> keys - keyboard key combination that allows you to switch between open applications. Window

ClickLock - allows you to simulate mouse lock button (e.g., for "dragging"). Macintosh

Double-click Speed - sets the speed of how fast you need to click the mouse button to perform a "double-click" (or no. 5 button using MouseKeys). Macintosh & Windows: Mouse control panel

DoubleScroll - reduces visual and mouse movement by providing up and down arrows at both ends of the scroll bars, thereby allowing you to scroll in two directions from one location. Macintosh shareware (Version 2.1.2 is for MacintoshOS Systems prior to 8.0. Version 2.2 works with MacintoshOS System 8.0)

EasyKeys - allows you assign function keys or key combinations to launch applications, desk accessories, or FKEYs. Macintosh shareware

eXpress - allows you to access items in the Application menu (on the top right corner of the screen) via the keyboard. Macintosh shareware Mouse Pointer Speed & Acceleration

Function Keys - keyboard access to many computer functions. System allows you to assign tasks (such as brightness/contrast setting) to function keys. Macintosh (8.6 other OS unknown) Keyboard control panel, Function Keys button

Keys! - allows you to use key commands for dialog box features (buttons, radio buttons, and check boxes). Macintosh freeware

MouseKeys - recognizes the numeric keypad (i.e., number pad typically located on the right side of the keyboard) for moving the pointer right, left, up, down, and diagonally. The no. 5 key is used for click and double-click. (Some keyboards, such as those on laptops, without a numeric keypad may use the function key with letter keys to reproduce the numeric keypad). This is often aided by Mouse control panel settings for speed and initial delay ("acceleration"). Macintosh: EasyAccess control panel & Windows: My Computer/Control Panel/Accessibility Options

MouseKeys for Powerbook - similar to MouseKeys, but for laptop without numeric keypad. Macintosh freeware Abbreviation-Expansion: allows you to type in an abbreviation and have the system automatically expand it to a longer word or phrase.

Okey Dokey Pro - reduces mouse use by automatically selecting the default button (i.e., button defined to be selected automatically) in a dialog box after specified time. Macintosh freeware

Pointer Acceleration - adjusts the delay from when you move your mouse to when the pointer (arrow) moves. This setting accommodates different user reaction times and visual tracking abilities. Macintosh: EasyAccess control panel/MouseKeys & Windows: My Computer/Control Panel/Accessibility Options/MouseKeys

Pointer Speed - adjustment of how fast the pointer (arrow) moves on the screen relative to movement of the mouse. This feature is often used with MouseKeys. This setting accommodates different user reaction times and visual tracking abilities. Macintosh & Windows: Mouse control panel

Pointing Device - provides speed setting for alternate mouse. Macintosh s

Program Switcher - allows you to switch between open applications by pressing the <Option> key + <Tab> key at the same time. Macintosh shareware

Short-cut Keys - keyboard access to menu options (etc.). Many mouse-driven selections can also be selected via the keyboard. When you see menu options that also list a letter and modifier key (e.g., Ctrl + S, or .S), you are being told what keys can make that selection. Macintosh & Windows: Refer to Help feature of application or OS, or resources listed at the end of this site

Sloop - reduces mouse clicks by allowing you to select different windows by merely positioning pointer on an open window and having it automatically brought to the front. Macintosh shareware

SnapTo - reduces mouse movement by automatically moving the pointer to the default button (i.e., button defined to be selected automatically) whenever a new dialog window appears on your screen. Macintosh shareware

Speedy Mouse - allows you to move mouse about twice as fast as its normal setting. MacintoshFreeware Mouse Click

StickyClick - allows you to simulate mouse lock button (e.g., for "dragging"). Macintosh shareware

UltraLaunch - allows you to assign keyboard keys to launch any application or open any document or desk accessory via scheduling times. Macintosh freeware

WrapScreen - allows pointer to "exit" on the right side of the screen and reenter on the left as you continue moving mouse in the same direction. This can help reduce additional motion for trackball (etc.) users. Macintosh shareware

VOICE INPUT

HearCalc - speech recognition calculator. Macintosh shareware

SpeechTypier - allows you to speak rather than type in common words and phrases. This requires that you initially enter these words or phrases into the software (therefore good if you use them frequently). Macintosh shareware

SurfTalk - allows you to speak commands to Netscape® Navigator (requires PlainTalk and microphone). Macintosh shareware

VISION

Audio Interface - allows you to hear the contents of menus and dialog boxes read aloud by moving the pointer onto a menu or dialog box. Macintosh freeware

Braille Font - see: <http://www.tsbvi.edu/education/fonts.html> Macintosh & Windows freeware

CaretPatch - makes cursor slightly thicker. Macintosh freeware

Change Arrow 1.2 - allows you to choose from one of six options to replace the existing pointer. Macintosh

CloseView - magnifies display on screen from 2 to 16 times the original size. Also allows you to independently reverse from dark images on a light background to light images on a dark background (contrast). Macintosh: Control panel

Color Arrow - allows you to change the pointer to one of 3 sizes of red arrows. Macintosh shareware

Color Master - allows you to change your pointer to any of a variety of colors. Macintosh shareware

CursorAnimator - lets you substitute all of the five system cursors (arrow, watch, text, cross-hair, and plus) by a static or animated cursor of your choice. If your Mac supports color, you can even get color cursors. Macintosh freeware

Desktop Colors - provides different color schemes for desktop elements (background, menu bars, etc.). Macintosh: Appearance control panel/Themes, or Desktop Patterns control panel & Windows: My Computer/Control Panel/Display/Appearance tab/Schemes

Dot to Dot - Braille editor for use by trained braille transcribers. Macintosh freeware

FatCursors - provides larger-than-normal pointer and cursor. Macintosh shareware

Find Cursor - changes the pointer into a heavy box when you hold down the control key and click the mouse. Macintosh (also see section below)

Front&Center - allows you to locate the pointer by having it flash and/or move to a predetermined location on the screen. This is done by pressing a hotkey (selected key combination). Macintosh shareware

HearIt - allows you to highlight text and have it read aloud. Macintosh freeware

Highlighter Color - allows you to change the color of highlighting for selection of text or menu options. Macintosh: Control panel/Appearance & Windows: My Computer/Control panel/Display/Items field/"Selected Items" and Color field

Icon Caption Size - enlarges the text associated with icons. Windows: Display Appearance tab/Item field

Icon Size - enlarges the size of icons. Macintosh (OS 8.6): Control panel/Views & Windows: My Computer/Control Panel/Display/Appearance tab/Item field

KeyClicks - allows you to hear sounds when you press keyboard keys, such as a typewriter sound with letter keys and a "whoops" sound with the delete key (can be enabled or disabled at will). Macintosh shareware

Magnifier - magnifies display on screen up to 9 times the original size. Feature allows you to change the position, size, and location of the magnification window as well as choose from one of several tracking options. This also provides for inverting screen colors, using a high-contrast scheme and choosing from different pointer sizes and colors. Windows: Startbutton/Programs/Accessories/Accessibility

Menu Text Size - enlarges the size of menu items. Windows: Display Appearance tab/Item field

MFZoom - allows you to increase the text size of menu and window titles up to 14pt. Macintosh freeware

Mouse Tracks or Pointer Trail - provides a trail to indicate direction pointer is moving, as well as where it is on the display. Macintosh: Mouse control panel & Windows: My Computer/Control Panel/Mouse/Motion tab

Narrator - text-to-speech utility for reading what is displayed on the screen, such as the contents of the active window, menu options, or text that has been typed. Hear new windows, menus or shortcut menus, typed characters, or watch the mouse pointer follow the active item on the screen. Windows 2000: Start button / Accessories / Accessibility

Pointer Color -provides options for changing color of pointer (black, white or inverse). Windows: My Computer/Control Panel/Mouse

Pointer Size - provides selections for larger pointers. Windows: Mouse control panel: Properties

Say It - allows you to have keystrokes spoken as you type. Macintosh

Screen Contrast - Reverses contrast so that you see light letters on dark background, therefore making images appear larger and more distinctive. Macintosh: CloseView control panel & Windows: Display/Schemes, or Control Panel/Accessibility Options/Display tab

SndControl - allows you to replace the standard beep with unique sounds for different key and over 30 system events. Macintosh shareware

SoundMaster - allows you to associate sounds with certain system events occurring, such as key clicks or emptying the trash. Macintosh shareware

Speak2me - allows you to have icons in the Finder read aloud. Macintosh

SpeakAlert - speaks text in alert dialog boxes. Macintosh freeware

System Event Sounds - attaches distinctive sounds to different system events such as an error message or a windows closing. Windows: My Computer/Control Panel/Sounds

TalkingAlerts - speaks text in alert dialog boxes. Macintosh: (8.6) Speech control panel

TappyType - allows you to hear typewriter noises as you press keyboard keys. Macintosh freeware

Tex-Edit Plus - text editing program that allows you to have text read aloud either by word or sentence. Also allows you to record and insert sounds, and change the color of the text. Macintosh shareware

ToggleKeys - auditory feedback to selection or deselection of CapsLock, NumLock, or ScrollLock keys. Windows: My Computer/Control Panel/Accessibility Options

ZoomLens - magnifies the portion of the screen under the mouse pointer. Macintoshfreeware

HEARING

Gallaudet Font - TrueType and Type 1 font that contains graphic representations of the ASL alphabet. Macintosh freeware

ShowSounds - instructs programs to display captions for the speech and sounds they make. Windows: My Computer/Control Panel/Accessibility Options

SoundSentry - provides visual cues for system sounds. Windows: My Computer/Control Panel/Accessibility Options

System Volume - ability to increase the volume of sounds produced by the computer can either be done by the volume control on the speakers, or as part of the OS software. Macintosh: Sound control panel & Windows: Start button/Accessories/Volume Control

RESOURCES

The computer you are using already comes with many built-in features to customize its behavior and appearance. You can access most of these features from the Control Panels folder. You can find out more about these and other features (or download them if need be) at the websites listed below.

Macintosh:

- <http://www.apple.com/education/k12/disability/macaccess.html>(select link)
- <http://www.apple.com/education/k12/disability/map.html>
- Phone: (800) 767-2775 - FAX: (800) 510-2834
- Easy Access and CloseView control panels-<http://www.apple.com/education/k12/disability>
- Keyboard and Mouse settings - Keyboard or Mouse control panel under apple in top left of screen
- Display - General Controls, Monitors or Appearance control panel (depending on your OS version) via Control Panel under apple in top left of screen
- Keyboard Shortcuts - Help menu (rightmost menu on menu bar at top of screen)
- Multiple user settings (OS 9 review) - <http://www.apple.com/uk/macOS/feature2.html>

Windows:

- Windows: <http://www.microsoft.com/enable/products/aids.htm>
- Step by Step Guides:<http://www.microsoft.com/enable/training/steps.htm>
Documentation: <http://www.microsoft.com/enable/products/docs>
- Microsoft: (Phone: (800) 426-9400 - TTY: (425) 635-4948) Accessibility Options control panel - <http://www.microsoft.com/enable> & <http://www.microsoft.com/enable/products/archives.htm>
- Accessibility Wizard - OS software to walk users through setting up accessibility features
- Keyboard and Mouse settings - Keyboard or Mouse control panel via Control Panel in Settings option under the Start menu in lower left of screen.
- Display control panels
- Keyboard Assistance - <http://www.microsoft.com/enable/products/keyboard.htm>
- Multiple user settings - <http://www.apple.com/uk/macOS/feature2.html>

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There is also commercial software, as well as shareware and freeware that have been developed to extend the customization potential for your computer. Shareware and freeware similar to commercial software may be more limited, but less costly. Freeware is software that has been developed and is available to you at no cost. Shareware is similar, but asks that you pay a nominal fee to compensate for the time and efforts of the individual who developed it. Freeware and shareware have been included in the listing above as some features of one operating system may be found as freeware or shareware for another. Freeware and shareware should not be substituted for commercial software that may be more sophisticated and suited to someone's needs.

PROJECT STAFF

Project staff includes Anita Perr and Electra Petra in New York City, and Cristina Burwell in Boston, MA.

Anita Perr, MA, OT, ATP, FAOTA is a Clinical Assistant Professor in the Occupational Therapy Department at New York University. As an Assistive Technology Practitioner with 16 years experience, Ms. Perr is responsible for teaching entry-level and post-professional master's degree students about assistive technology used by people with disabilities, including assistive technology relating to computer use. Her previous work experience includes assistive technology product testing for the Rehabilitation Engineering Center of the National Rehabilitation Hospital in Washington, DC.

Electra Petra, MA, OTR/L, ATP was a doctoral student in the New York University Department of Occupational Therapy. Originally educated in Greece, Ms. Petra had four years experience in the United States at the Matheny School and Hospital in Peapack, New Jersey and at the United Cerebral Palsy Center of New York providing assistive technology and computer access to people with severe disabilities. She is also certified as an Assistive Technology Practitioner.

Cristina Burwell, MA, CIE, ATP, is an Industrial Designer based in Boston, MA. She has experience in designing and developing products for people with disabilities. Ms. Burwell also worked as a Human Factors Specialist for GTE where she was responsible for ergonomic assessments and software usability testing. She taught a course on assistive technology at the Occupational Therapy Department of Boston University, focusing on computer-related issues. She holds certification as an Industrial Ergonomist and Assistive Technology Practitioner.

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