Human Factors Workplace Considerations

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Research Institute for Advanced Computer Science

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ABSTRACT

Computer workstations assume many different forms and play different functions today. In order for them to assume the effective interface role which they should play they must be properly designed to take into account the ubiguitous "human factor". In addition, the entire workplace in which they are used should be properly configured so as to enhance the operational features of the individual workstation where possible. This paper presents a number of general Human Factors Workplace Considerations prepared for the RIACS staff. This ongoing series of notes covers such topics as achieving comfort and good screen visibility, hardware issues (e.g., mouse maintenance), screen symbology features (e.g., labels, cursors, prompts), and various miscellaneous subjects. These notes are presented here in order to (1) illustrate how one's workstation can be used to support telescience activities of many other people working within an organization., and (2) to provide a single complete set of considerations for future reference.

INDEX OF NOTES

INTRODUCTION

A good deal has been written about the design and operational characteristics of computer workstations since they are the primary hardware through which one performs useful computer-related work. A workstation is defined as the complex of equipment (keyboard, mathematical processing unit, memory, display, etc.) which permits the worker to access and interact with a computer(s), data bases, and other workers. Most published articles which deal with human factors aspects of workstations only cover anthropometric and ergonomic subjects. Relatively little is available on their cognitive, perceptual, and other attributes.

Probably because of the complexity involved, far less has been written about the workplace which surrounds the worker. The workplace includes the entire sensory array of information that is needed to accomplish work as well as other workers. The workplace contains not only the workstation (when there is one) but also numerous other things which can be shown to impact productivity in one way or another. Some of these other attributes include specific illumination and acoustical characteristics, air flow and temperature, etc. Each of them plays a role in helping maintain ones productivity over the entire work period. The workplace should be considered from the standpoint of physiology and comfort, adequacy of sensory support, and cognitive/informational support, among others things. A properly designed workplace is as complex a subject as it is important to ones productivity. One of the objectives of writing the present series of notes was to address these kinds of human factor considerations.

A second and equally important reason for preparing these notes was to show that a networked workstation within a research institute can be used to disseminate personally useful information to personnel. Thus, the series of Human Factors Workplace Considerations (HFWC) presented here were put on the RIACS electronic mail system at irregular intervals about one week apart over a period of four months. An attempt was also made to keep track of the staff responses that were made to them. In general, they were well received. Indeed, several HFWC were prepared in direct response to questions or suggestions which earlier issues had elicited. While some of these notes were more instructional in nature, most were intended to be practical so that the reader could take some action to improve his or her workplace.

FORMAT

I decided to adopt a common format for each HFWC to make it easier for the user to find certain key information (once he or she was familiar with it). This common format is as follows (with numbered comments):

Subject: Human Factors Workplace Consideration: **TITLE**   (1)

<u>**No. X**</u>   (2)

"Brief Summary Sentence Here"   (3)

First text paragraph here

Second text paragraph here.

Etc.

                                     My Name   (5)

================= END OF MESSAGE ==================   (6)

Notes:

(1) Subject: "Human Factors Workplace Consideration". I determined that the staff had so much mail to read each day that a means was needed to flag the unique identity of a HFWC for them. Of course the overall memo format also helped to do this.

(2) Each article was numbered consecutively for use in cross-referencing later articles.

(3) A horizontal double line was used to mark the upper margin of the article.

(4) An abbreviated summary statement (often a terse overview) was given in parentheses.

(5) I always added my name at the lower right of the article to lend a more informal flavor and a means of suggesting that the reader would have a single point of contact if he or she needed more information on a given subject.

(6) The bottom of the article was bounded by a horizontal double line with the words "END OF MESSAGE" centered in order to clearly end it.

HUMAN FACTORS WORKPLACE CONSIDERATIONS

Subject: Human Factors Workplace Consideration: Physiological status

No. 1

"Keep your feet flat on the floor"

Research has shown that one should sit in a chair which permits your feet to fully reach the floor.   Gravitational pressure on the soles of both feet plays an important role in maintaining blood pressure at the brain level.   In fact, people who are suspended on a tilt table, i.e., sitting or being supported at a vertical angle without any foot support, will eventually blackout. A related issue is that of upper and lower leg blood flow. It is important to have chair support that does not cut off arterial blood flow behind the knees. You will know (by the pain in produces) if it is happening.

Dick Haines

===================== END OF MESSAGE ==========================

Subject: Human Factors Workplace Consideration: Video Display Screen Glare

No. 2

"Don't put up with screen glare"

There are many ways of reducing the visual problems associated with glare off your display screen. All such glare acts to (1) reduce the contrast of the displayed information and cause your eyes to work harder than they need to, and (2) distract your eye-scan pattern during normal computer work. What are some solutions?

(a)   Orient your display screen so that overhead lights, windows, desk lamps, etc. do not reflect into your eyes off the screen's surface.

(b)   Use a polarizing (or other) filter attached permanently over your screen. They cost from about $15 to $150. Get a circularly polarized version if possible.

(c)   Install so-called "parabolic" light diffuser units in your overhead fluorescent light fixtures if you have them.   A 2' x 4' "egg-crate" unit costs about $25.   It operates by controlling the downward angle of emitted light within an almost vertical cone. Come into my office (room 104) for a demonstration. They are excellent for preventing the light from ceiling fixtures from being seen by reflection off your screen.

Dick Haines

===================== END OF MESSAGE ==========================

Subject: Human Factors Workplace Consideration: Lower Back Support

<u>No. 3</u>

"Maintain some lower back support at all time"

Many of us sit in chairs that are too deep. We "slouch" in our lumbar region for hours on end. This is not a good idea! If you cannot vary your chair's geometry then at least put some padding, pillow, etc. directly behind the small of your back for support. You'll be pleasantly surprised at the results.

<div align="right">Dick Haines</div>

===================== END OF MESSAGE =========================

Subject: Human Factors Workplace Consideration: Left Edge Screen Margin

<u>No. 4</u>

"Leave a space on the left"

Sometimes large data tables or ASCII text is allowed to be (or is deliberately placed) directly adjacent to the left margin of the display screen. This is not good practice from a human visual perception point of view. Why? As we visually scan lines horizontally a prominent cue for unconsciously knowing when to stop our right-to-left line scan (to begin reading the next line) is the screen's brightness differential. By locating numbers/text with at least one black space away from the left-hand edge the retinal image is more clearly separated from the screen's boundary. The eye scanning process is made more efficient. I believe that the information is also encoded into memory more effectively under this situation.

<div align="right">Dick Haines</div>

===================== END OF MESSAGE =========================

Subject: Human Factors Workplace Consideration: How Many Screen Colors?

<u>No. 5</u>

"Five - plus or minus two"

For those of you who have only 16, 256 or 2 million colors from which to choose for some application you may be faced with deciding how many different colors are best. The following considerations may help you to decide.

(1) Use color sparingly and only for pre-defined functions. In the cockpit of modern U.S. commercial aircraft cockpits (so-called "all glass cockpit")

we (a 'color' subcommittee of the Society of Automotive Engineers) recommended using a maximum of five different colors. Each color was to be separated from the others on a basis which yielded the greatest perceptual identifiability. Of course you are not cockpit displays and may need more colors.

(2) Use colors that are (a) easily seen under ambient lighting, (b) easily seen against the screen's background color(s), (c) culturally associated with the operation or function being displayed (e.g., liquids = blue; heat = orange), and (d) pleasant to look at.

(3) If possible use a neutral colored background (e.g., light gray).

(4) If possible use no more than five - plus or minus two different colors. E.g., light blue, medium yellow, medium red, white, light to medium green.

<div align="right">Dick Haines</div>

========================= END OF MESSAGE =========================

Subject: Human Factors Workplace Consideration: Display Screen Contrast

<u>No. 6</u>

"Visually speaking, positive contrast is the same as negative contrast"

For those of you who have the option of varying screen contrast, i.e., dark text seen on a lighter background or vice versa, you may wonder which is better. If you have a personal preference for one or the other then stay with it. Laboratory research has been conducted where most of these relevant variables have been controlled. It was found that readability, conspicuity, and informational throughput is virtually the same for positive contrast as it is for negative contrast. There is one caveat. Namely, the image sharpness of the alpha-numeric information must also be matched. In lower priced displays with 5 x 7 character fonts (for example), the image will tend to appear sharper when the text is darker than its background. In more expensive graphics workstations contrast (usually) doesn't matter.

<div align="right">Dick Haines</div>

========================= END OF MESSAGE =========================

Subject: Human Factors Workplace Consideration: Eye Focus and Displays

<u>No. 7</u>

"Age and best eye-focus distance vary with each other directly"

For you who are under the age of 40 with corrected or uncorrected reading acuity to at least 20:20, it is likely that you don't experience any eye focus (accommodation) problems during long hours at the terminal and display. For those of you over 40 yrs. the distance at which high contrast text/numbers/graphics must be located to remain in best focus gradually increases. This distance usually increases exponentially with age and is known as "presbyopia" (literally, "old eye"). If you are experiencing some eye-focus-related problem(s) such as head-ache, neck-ache, eye strain, tearing, etc. there are several possible solutions to try.

(1) Have an eye exam to find out just where your "near point" of accommodation is. Any optometrist or ophthalmologist can do it.

(2) Be sure to keep the screen oriented approximately normal (90 deg.) to your line of sight to help reduce parallax errors.

(3) Locate the screen at a separation distance from your eyes which reduces these symptoms, i.e., try placing it farther away than it now is.

(4) Reduce or eliminate all screen glare since the eye has more difficulty focussing on overlapping images of differing luminance.

(5) Maintain an optimal screen image contrast. You can usually rely on your own sense of what's best to do this.

(6) If symptoms persist feel free to drop in for consultation.

<div align="right">Dick Haines</div>

======================= END OF MESSAGE =========================

Subject: Human Factors Workplace Consideration: Command Language Design Requirement

<u>No. 8</u>

"NASA Standards for Space Station Program are available"

NASA Standard 3000 (Rev. Ed., 1987) provides useful Man-Systems Integration Standards in virtually all human factors areas related to manned space operations. Section 9.6.3.3.8 provides the following "Command Language Design Requirements" (abbreviated).

(1) User Viewpoint... A Command Language (CL) shall reflect the user's point of view such that the commands are logically related to the user's conception of what is being done.

(2) Distinctiveness... Commands shall be distinct from one another.

(3) Punctuation... The CL shall contain a minimum of punctuation or other special characters:

(4) Truncation... The user shall be permitted to enter the full command name or the system specific truncated form.

(5) Standardization... All commands and their truncations, if any, shall be standardized.

(6) Displayed Location... Commands shall be entered and displayed in a standard location on the screen.

(7) Command Prompts... The user shall be able to request prompts as necessary, to determine required parameters in a command entry.

While very general, these requirements are helpful and should be followed whenever possible.

Dick Haines

======================= END OF MESSAGE =========================

Subject: Human Factors Workplace Consideration: Displays and Health Hazards

<u>**No. 9**</u>

"Newer displays pose no radiation health threats"

After the telephone and typewriter, video terminals are approaching the third most frequent machine feature of the workplace/office. It has been estimated that as of 1983 there were over ten million displays in use. Because of the high voltages and driver circuitry involved, concern has been expressed about radiation leakage and related health hazards.

Extensive studies by the National Research Council have shown that the ambient work environment poses more threat from radiation than does the video display terminal (Anon, 1983). Despite occasional "bad press" stating that female office workers have suffered spontaneous abortions, miscarriages and birth defects after using terminals, the Centers for Disease Control (1981) and the U.S. Army Environmental Hygiene Agency (1981) found no causal relationship.

For reasonably current workstations we need not worry about "stray radiation". The effectiveness of the shielding is checked. Nevertheless, it isn't a bad idea to sit at least 18 inches or more from your screen if possible.

Dick Haines

=================== END OF MESSAGE =========================

Subject: Human Factors Workplace Consideration: Room Lighting and Screen Brightness

No. 10

"In lighted rooms light background screens are better"

Some of us use workstations with screens that have backgrounds brighter than the alphanumeric symbols (information) on them. While there is a good deal of personal preference involved here, it is generally better (in terms of attaining good visual contrast) to use lighter backgrounds than that of the screen symbol(s). Why is this so?

The glass face of our screen acts as a mirror for illuminated surfaces and direct light sources located behind and above us. In effect, the screen can reflect these distracting areas of illumination into our eyes and thereby reduce the visual contrast of the screen images. By using a lighter screen under higher room illumination conditions the apparent "mirror" effect is lessened. Conversely, for screens with a dark background and lighter alphanumeric symbol(s), it is perceptually better to darken the room's illumination, all things being equal. Of course all things aren't always equal so that the above should be considered as only a general rule of thumb.

Dick Haines

=================== END OF MESSAGE =========================

Subject: Human Factors Workplace Consideration: Moving a Mouse

No. 11

"Use small muscle groups for finest X-Y mouse positioning"

Do you use a mouse to position a cursor (etc.) precisely? If you do then be aware of the fact that whole arm or even whole wrist motions are not as precise, steady, or repeatable as if just the fingers do the (mouse) moving. Try to keep the palm touching the support surface and move only the fingers (holding the mouse). Of course larger amplitude mouse movements will preclude doing this, in which case do the mouse movements in separate jumps, each with the palm in a fixed location.

Also, it is better to keep the mouse and its base in a location where the elbow is bent about 90 deg. rather than in a position where the arm is more or less extended. The upper arm should be able to swing like a pendulum, i.e., more freely, during mouse movements. Also, the preferred hand (i.e., right hand for a right-handed person) usually supports input control motions in speed, accuracy, and strength that are greater than the non-preferred hand.

<div align="right">Dick Haines</div>

========================= END OF MESSAGE =========================

Subject: Human Factors Workplace Consideration: Screen Labels

<u>**No. 12**</u>

"Labels serve different functions so plan them carefully"

A label is an alphanumeric designation of: (1) the function of a control, display, (2) the identity of hardware, (3) the setting or value of a control, (4) correct procedures and instructions, or (5) a warning of potential hazards. The following recommendations are drawn from Farrell and Booth's (Design Handbook for Imagery Interpretation Equipment, Boeing Aerospace Co., Rept. D180-19063-1, 1984, Section 6.5) and from personal experience.

Location. Each label should be co-located with the control or display element to which it refers. Screen labels, often serving as "electronically programmable switches", need to be positioned on the basis of (1) consistency, and (2) ease of visibility. The preferred location is directly above the control or display. Irrelevant labels (e.g., serial numbers, maintenance instructions) should not be visible unless and until needed.

Content. Labels should consist of common words, readily understood by expected operators, programmers, and users of the computer display. Brevity is important but abbreviations should be avoided if possible. A control label should indicate the action or operating mode that will result from its activation and not the mechanism involved. Never user more than one term for the same thing.

Character Design. Label legibility is as important as is surrounding text, perhaps more so. Recommended character heights (point size) are as follows for four general applications:

Control Panel (Major Functions)	5.6mm	(24 pt)
Intermediate Display Functions	4.0mm	(18 pt)
Control Position	3.2mm	(14 pt)
Instructions	2.4mm	(----)

In summary, labels act as a kind of memory key which, when unlocked, opens still other associations. So plan your labels carefully. If in doubt whether your own label layout/design

is adequate ask three colleagues to tell you what it means (without prompting). If you get 3 out of 3 correct answers keep it. If not, try another one and repeat the process.

Dick Haines

========================= END OF MESSAGE =========================

Subject: Human Factors Workplace Consideration: Display Screen Coding

No. 13

"Careful coding can pay off"

A "Code" is something like a "Label" (see No. 12 in this series) in that it conveys useful information. Colored spots, lines, letters, numbers, arrows, etc. are all codes. This consideration deals only with visual coding. How can visual information be coded? There are many different ways. They include - shape - brightness - number of items - orientation - size - stereo depth - flash rate - color - and others.

Knowledge of how the human visual system works (both its capabilities and limitations) can lead to more nearly optimal coding techniques. Here are a few to put into practice yourself:

Code	Maximum No. of items	Overall Evaluation	Comment(s)
Color	7	good	Efficient use of space
Geometric shapes	13	good	Efficient use of space
Letters and numbers	unlimited	good	Reqs. good resolution and contrast
Size	5	fair	Screen area is needed
Number of dots	6	fair	Easily confused with other coded items
Line orientation	12	fair	Special purposes only
Line length	4	fair	May clutter screen
Brightness	4	poor	Low contrasts can wash out dimmer areas
Flash rate	4	poor	Use sparingly!
Stereo depth	unknown	fair	Needs complex optics

In summary, screen coded information offers excellent informational content when properly planned. So plan your codes carefully. When in doubt, consult a current human factors handbook.

Dick Haines

========================= END OF MESSAGE =========================

Subject: Human Factors Workplace Consideration: Optical Mouse Maintenance

<u>No. 14</u>

"Keep your mouse pad squeaky clean"

Thanks to Bob Brown for this helpful comment re: Consideration No. 11 on the use of an optical mouse. Your mouse' pad or base plate will eventually become greasy and dirty. Both grease and grime will probably require you to press down harder on the mouse to achieve the necessary amount of friction/contact to move it around. What is the solution?

Polish the pad regularly with a high grade automobile polish. Also, keep the felt pads on the bottom of the mouse clean and grease-free. Then apply the suggestions of No. 11.

<div align="right">Dick Haines</div>

========================== END OF MESSAGE ==========================

Subject: Human Factors Workplace Consideration: Human Visual Field

<u>No. 15</u>

"Know more about your full visual field so you can use it better"

For those of you with normal binocular vision (i.e., no color deficiencies, no ocular muscle imbalances, no strong eyeglass optical corrections for nearsightedness (myopia), you possess a truly fantastic field of view (FOV). Looking steadily straight ahead, you can detect a visual object located at least 110 deg arc to each side (horizontal meridian), 55 deg arc up and 60 deg arc downward. Closing one eye will reduce the FOV mainly on the nasal side to about 60 deg arc from straight ahead.

Your retina can correctly appreciate colors only within much smaller (generally oval shaped) areas with yellow and blue being larger (in total area) that the red and green receptive areas. Also, the farther some detail is located angularly from your line of sight, the larger it must be in order to be correctly identified. Work by Virsu and Rovamo and yours truly have shown that properly enlarging peripherally located stimuli (from the average line of sight location) can yield performance that is almost equivalent to that achieved when looking directly at it. So what?

So you may want to rethink placement of border information on your screen in terms of enlarging menus somewhat as well as the cursor and then not having to look over at it just to point. I suggest that your "point and click" time may well go down and your visual scanning requirements may ease considerably. If anybody tries it let me know the results.

<div align="right">Dick Haines</div>

========================== END OF MESSAGE ==========================

Subject: Human Factors Workplace Consideration: Sensory Channel Comparison

No. 16

"Different senses throughput at different rates"

We differentiate stimuli along different dimensions for each sense.   Vision mediates discriminations of brightness, hue, saturation, texture, pattern/shape, etc.   while hearing mediates pitch (frequency) and loudness, etc.   The theoretical information transfer capability of the eye/visual system far exceeds that of the ear/auditory system yet for both we do not begin to utilize the available discrimination capacity.   One estimate is that our brain uses under one percent of information received by the ear (AFSC DH 1-3, pg. DN2B8, 1977). The capacity for absolute (hearing) judgments in a single dimension (e.g., pitch) is just over two bits, while for visual stimuli it varies between 2.1 and 3.1 bits.   Combining two auditory dimensions increases our capacity to 3.1 bits.   A study in which sounds were varied in six dimensions   (intensity, frequency, tone/noise alternation rate,   on/off percent, 2 directions) showed that 150 out of 15,625 permutations   (7.2 bits) could be identified on an absolute basis.   Several studies suggest that employing several dimensions within a given sense modality (when building up sequences or "chunks" of information) can have great potential for increasing channel capacity (cf. G. A. Miller, Psychol. Rev., 63 (2):81-97, 1956).

Perhaps this kind of information will assist some of you who seek to design displayed information more effectively.

Dick Haines

===================== END OF MESSAGE =======================

Subject: Human Factors Workplace Consideration: Screen Cursors

No. 17

"Cursors point and placehold"

"Cursor"... Latin 'cursus' meaning "to run".   A computer screen cursor is a display element that one uses to indicate the position of a user's current operation.   Cursors serve at least 2 functions: (1) pointing, (2) placeholding, i.e., showing the location of the immediately previous operation (or the point at which the user has moved the cursor). Placeholding operations include word processing, data manipulation, data entry and graphics. Pointing involves indicating the user's position in relation to other screen structures (icons, menu bars, etc.).

Common placeholder cursor symbols include black square, underscore (horizontal line), insert (vertical line).   Common pointing cursors include arrows, hand with vertical forefinger, pencil, dotted cross, wrist-watch, hour-glass.

NASA's User Support Environment Document 1000 (now in final preparation and entitled "Space Station Information System Human-Computer Interface Guide" (Version 2.0) gives the following general guidelines for cursor design and use:

1. A cursor should be visible at all times.
2. Cursor shapes shall be unique (relative to all other screen symbols)
3. Different shaped cursors (width, shape, blinking) should be used for different purposes, e.g., an X could indicate when the user cannot interact with the system, a horizontal line could show an entry point in a word processing supported text, etc.
4. A cursor should be distinctive against all backgrounds and easy to locate.
5. Cursor height should be the same as character height.
6. Cursor shape should not change when slued rapidly across the screen.
7. The cursor's motion on the screen should correspond to the direction of input control (mouse, arrow buttons, etc.)
8. The cursor should always appear at a consistent location at boot.
9. Cursor blink rate should be 3 Hz (if used).

If you are doing work for the Space Station program you will likely have to follow these guidelines.

Dick Haines

====================== END OF MESSAGE =========================

Subject: Human Factors Workplace Consideration: User Guidance Prompts

No. 18

"Carefully Planned Guidance Information Can Provide Many Benefits"

Whether a system is familiar or not, users may need guidance through a task. This is particularly true in long and complex programs, control systems, or artificial intelligence logic diagrams (to name just a few application areas). "User Guidance" provides feedback about input errors as well as system feedback indicating actions that are available. NASA's USE 1000 document (May 13, 1988 ed.) lists five kinds of special information (1) Status, (2) Error Handling, (3) Confirmation of Destructive Entries, (4) Prompts, and   (5) On-Line Help & Instructions.

(1) Status... Each message will be given precedence according to its importance (e.g., emergency condition) and may override an existing screen message. Types of "Status" Info. include LOG ON, OPS. MODE, OTHER USERS PRESENT, SYSTEM (DESIGN/OPS) CHANGES. All screen status information shall be located in a specific window and location.

(2) Error Handling... User feedback will be provided to permit him/her to identify and correct the error (and by automatically giving information that

will aid in correcting the error). Auditory and/or visual feedback of the input error will be given within 2 seconds in understandable English text; it should be non-accusatory, specific, brief, and informative.

(3) Confirmation of Destructive Entries... Users shall confirm that they want to perform a "Destructive Command" with a single input action (e.g., replacing/destroying files). The message should be simple and direct such as "THIS COMMAND WILL DESTROY DATA FILE W8. DO YOU WANT TO DESTROY IT?"

(4) Prompts... Every point in a task sequence will have "Next Step" prompts. Prompt icons or words should be unambiguously related to the type of task or process being carried out. Saving the user input keystrokes is important. Thus __/__/__ is ambiguous while "ENTER EVENT DATE AS: DD/MM/YY" is much better.

(5) On-line Help and Instruction(s)... These should be available both on request and (in some circumstances) automatically. If a user makes frequent common-type errors, the system should provide courteous comments about how to correct the errors. More than one way to request help should be provided, e.g., a pull-down help menu, type "help", depress "help" key, click on "help". The systems response should be task/operation specific. For different levels of help the top-most (most basic) should appear first.

As with some previous workplace considerations, you will need to follow these guidelines if you are working on the Space Station Program. Good luck.

Dick Haines

===================== END OF MESSAGE =========================

Subject: Human Factors Workplace Consideration: Video Bandwidth Issues

No. 19

"Bandwidth is Directly Proportional to Resolution x Frame Rate x Gray Scale"

For those of you who deal with such matters, Ranadive (1987, MIT) reported the above relationship. He permitted observers to manually control a robot via a remote, televised image while he systematically varied one parameter at a time. Data was not collected until their training was complete (i.e., asymptotic performance). As long as only one parameter was degraded performance was acceptable down to a point where the task could no longer be accomplished at all. He also found that frame rate and gray scale could be degraded by larger amounts than resolution before the critical performance limit was reached. The study's limiting parameters were:

Resolution: 64 x 64 pixels @ 28 frames/sec @ 4 bits/pixel
Frame Rate: 3 frames/sec @ 128 x 128 pixels @ 4 bits/pixel
Gray Scale: 1 bit/pixel @ 28 frames/sec @ 128 x 128 pixels

This data can serve as a useful starting point in planning for video media transmission studies. It is not known whether varying two parameters at a time would show this same trade ratio. Good luck.

Dick Haines
=======================END OF MESSAGE========================

Subject: Human Factors Workplace Consideration: Controlling Visual Distractions

No. 20

"Looking Away from your Video Terminal is both Good and Bad"

It goes without saying that visual concentration upon one's display screen during those precious creative moments and longer stretches of data input is essential. We also need to look away from time to time to relax our eye's inner muscles (accommodative reflexes) and refresh the retinal image(s) with new vistas (which probably also contributes to our creativity). Yet both of the above conditions are under "voluntary control." This is the important point. Visual distractions are not voluntarily controlled. They should be minimized whenever possible.

If possible locate an opaque screen directly behind your video display screen (X units high and Y units wide) that extends at least X units above and 2Y units to each side. Its color and brightness should be approximately the same as your display screen's.   Its distance may be anywhere from the plane of the screen to several meters beyond. See me if you have any specific questions.

Dick Haines
=======================END OF MESSAGE========================

Subject: Human Factors Workplace Consideration: Choosing Passwords

No. 21

"Use Common Sense in Selecting a Password"

While the following will be controversial perhaps, I offer these general rules of thumb in selecting a password. Memory Considerations: The password should (1) not be so long that you have difficulty recalling it, (2) not be found in a dictionary of your native language, (3) be composed of randomly selected letters and not numbers, (4) not be one's (log-in) name in reverse. If you know a foreign language simply think of a word and transliterate it

into English as your password, e.g. "BIRD" in Russian is PTITSA, easy to recall for someone who knows this language.

Visibility Considerations: (1) Do not use finger stroke sequences that are located high on the keyboard since they are easier to see by others nearby. (2) Select alphabetic keys that can be hidden by one's hands.

Other Considerations: (1) Use letters rather than numbers because of the larger number of permutations offered. (2) It is OK to use repeats of the same character, however, one must count (cognitively) these repeated inputs which takes time.

As Ari Ollikainen, one of the contributors to this consideration, put it, "If one is really concerned about developing an effective password, he or she should consider doing a risk assessment versus the probable threat." My thanks also to Henry Sowizral for his comments. How about these two last names for passwords?

<div align="right">Dick Haines</div>

=======================END OF MESSAGE=========================

Subject: Human Factors Workplace Consideration: Display Screen Windows

<u>No. 22</u>

"Careful window design requires human engineering knowledge"

A "window" is a specific subdivision of a display screen where one set of output is displayed. With the advent of increasingly powerful workstations, windowing opens interesting opportunities for overlapping information stacks with memory-jogging icons for more rapid unstacking. But some general guidelines are needed here.

NASA's USE 1000 (version 2.0, dtd. May 13, 1988) suggests that the default width for any single window shall permit 80 contiguous characters because fastest reading rates have been found for 80 character line lengths. (Duchnicky & Kolers, 1983). NASA's windows (for the Space Station Program) also shall be at least four lines high for the same reason (Ibid.). Windows should be rectangular in shape and framed by a single line border whose line width should expand (or become thinner) as the window expands or contracts. Window names/titles should be centered at the top of each window. A scroll bar shall also be provided to move window text either horizontally and/or vertically. In either case, this bar should be along the side border(s) for vertical scrolling and/or along the top or bottom for horizontal scrolling. This scroll bar should also indicate both the absolute and relative positions of the user in the data file. A textual and/or iconic label should clearly identify each scroll bar.

All the above sounds somewhat familiar doesn't it? But not so simple or clear are such (research) issues as how fast should text scroll? Should a key/mouse input invoke a fixed or variable display response time? Should windows contain tabular data which is larger in area

that the window? Etc? This guideline may be grouped with (No. 12, 17, and 18) dealing with NASA's Space Station Program.

Dick Haines

========================END OF MESSAGE===========================

Subject: Human Factors Workplace Consideration: Multiple Display Interaction

<u>No. 23</u>

"Information Separation and Integration is not Easy to Achieve"

Users often must work with several computer displays while performing a job, particularly in areas of multidisciplinary science. The human-computer interface should aid in such integration by separating (temporal and/or spatial) and by integrating common information.

Multiple Displays Used Near Together in Time... Such information should be contained in separate windows capable of being displayed simultaneously (or almost so) and if a pre-defined task sequence is important then a position reference of one's current location within the displayed sequence should be provided.

Multiple Displays Separated in Time but Functionally Related... Special storage files capable of holding relevant information across applications/ displays should be provided. Windows should be used to manage temporally discontinuous information. Flowcharts or schematics are useful here, particularly if they permit the user to move to any other display to carry out a given step/procedure. Of course, sequenced actions which must be completed before the next can occur should be clearly indicated and automatically stepped by the system.

Multiple Displays of Information Needed during Performance of Simultaneous Tasks... This is known as "multitasking". When the tasks are independent (i.e., do not require integration of information from different screens) each task should be presented using a different sensory modality. For example, an icon search/movement task should not be concurrent since both are spatial in nature. If the icon search task were visual-graphical and the movement task were auditory (e.g., using frequency feedback) then the two tasks could be performed simultaneously (or nearly so). Likewise, if different cognitive processing resources (e.g., verbal vs. spatial) can be used, independently performed tasks can be carried out with relatively good effectiveness.

In summary, knowledge of cognitive and perceptual psychology is very useful in planning optimal screen information layout and control strategies.

Dick Haines

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Subject: Human Factors Workplace Consideration: Performance Error Measurement

<u>No. 24</u>

"Quantifying User Errors can Assist in Developing Good Information Displays"

Claimed advantages of using computationally intensive, complex systems should always be evaluated (i.e., proven) using broadly accepted benchmarks. But where humans are involved "in the loop", there are very few benchmarks. Let us consider performance error measurement as one important component of such a (future?) benchmark.

Human errors may be categorized approximately as follows:

(1)　Procedural... To what degree did the user follow a pre-defined set of steps? Performance would decrease when an incorrect step or non-optimal step was followed. Hierarchical menus are fraught with such errors. "Type", "Frequency", and "Depth" error measures are available with which to quantify procedural errors (cf. NASA's USE 1000 (version 2.0, dtd. May 13, 1988, pp. 4-4 to 4-5).

(2)　Confusion... To what extent did the user mistake one word, function or command for another? A "confusability matrix" compares optimal commands (pre-designed to be followed) with actual responses that each evokes and provides an effective quantification.

(3)　Tracking... To what extent did the user's control of continuously varying parameters diverge from some preplanned track or schedule? The familiar Root Mean Square Error (RMSE) provides a useful measure of variability. Interpreting large RMS values is not easy, however, since either the human and/or the inanimate system may be the cause. If many different users are tested some indication of their pooled variance may suggest whether the system may be "at fault".

(4)　Monitoring Detection... To what extent did the user miss a critical warning/alert/signal? The percentage of such missed warnings over a representatively long work period is often used as a performance measure. Another (somewhat complex) measure is known as "signal detection theory" which yields valuable insights about both user and system contributions to perceived and missed warnings/alerts/signals. Most modern information transfer texts contain signal detection discussions. Perhaps this is enough said for now. Good luck.

<div align="right">Dick Haines</div>

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Subject: **Human Factors Workplace Consideration: Elements of Problem Solving**

<u>No. 25</u>

"Understanding, Paying Attention, Structuring the Problem, Solving are Key"

We all solve problems every day but what are we doing? We reach a goal that is not readily available using cognitive capabilities and available resources. Cognitive psychologists have suggested that there are some basic components to this process. Each is discussed below.

Understanding... involves constructing an internal representation or pattern (mentally) to try to relate concepts or elements to each other in the same way they are related in real life. The following previous work-place considerations relate to understanding (4, 5, 8, 12, 13, 16, 18, 22, 23).

Paying attention... involves not only actively concentrating on what is centrally related to the problem to be solved but ignoring irrelevant information and distractions. Modern-day advertising would have all of us pay attention to their "products and services" most or all of the time. A major challenge is determining what information is important and what is irrelevant and when one category merges with the other. Consult these workplace considerations (1, 2, 3, 5, 6, 7, 12, 13, 16, 18, 20, 22).

Structuring the problem... involves making decisions about how to associate symbols (icons?) with physical things, words with ideas, numbers with magnitudes and relationships. There are a variety of approaches to structure a problem, e.g., a matrix which permits a critical comparison of all permutations, a logical relationship or set of relationships, graphic representations, visual imagery, lists, etc. Workplace considerations (8, 12, 16, 18, 21, 24) each contain elements of problem structuring.

Problem solving... involves attacking the problem following at least one strategy. Creative individuals often are creative because they have more than one strategy to try out, often based on a breadth and depth of past experience (heuristics). Other strategies include random search, systematic random search (algorithm?), means-end analysis, deliberate simplification strategy, backward searching, and others. Perhaps workplace considerations (2, 3, 7, 9, 10, 11, 12, 14, 19, 21) qualify here.

Perhaps this consideration is too academic. On the other hand, perhaps it may help you structure a future problem solving task a bit differently than you might have otherwise.

Dick Haines
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