BEHAVIOR

From the meeting in Los Angeles of the Human Factors Society

Mercury exposure: A subtle test

In the felt hat industry, workers used to be exposed to high levels of mercury. The resultant mercury poisoning often caused trembling and palsy ("hatters' shakes"), but you don't have to be "mad as a hatter" to have chronic mercury poisoning. There may be subtle — yet serious — effects from exposure to even low levels of mercury, as still occurs in certain industries. Accordingly, "Psychologists and human factors specialists have been challenged to develop tests of central nervous system performance that are not only sensitive to subtle neurotoxic effects, but are also useful in evaluating the practical significance of these effects," say Philip J. Smith and Gary D. Langolf of the Center for Ergonomics at the University of Michigan in Ann Arbor. They reported on one such test that can be used to detect possible neurotoxic effects of exposure to elemental mercury.

The test is simple. The exposed worker is first asked to memorize a short list of digits. Then another digit is presented and the worker is asked to respond "yes" if the digit belongs to the previously memorized list or "no" if it does not. The worker is asked to respond as fast as possible, and the time between the presentation of the digit and the worker's response is measured. Experiments with 26 workers exposed to currently acceptable levels of mercury found that reaction time is related to the worker's level of exposure to mercury. (Monthly measurements of urine mercury concentrations had been collected by medical personnel where the workers were employed.)

The process of responding to the memory task requires several mental operations, one of which is called memory scanning time and is related to response time. The researchers found that memory scanning time increases 118 milliseconds per digit for each milligram of mercury per liter of urine. Another study of 37 different exposed workers confirmed this finding. The apparent mercury-related increase in scanning time is of particular concern, say the researchers, because of its magnitude. Previous research, for instance, has found the mean scanning times for 20 and 38 year olds to be 39 and 63 milliseconds, respectively. The 24-millisecond difference is exactly the same as the predicted difference due to 0.2 milligrams of mercury per liter of urine. And such an increase could have a functional effect. Studies have shown, for instance, that increased scanning time is accompanied by a decrease in short-term memory capacity — which is important in common tasks such as looking up and remembering telephone numbers.

The researchers point out that the workers they studied showed no clinically observable evidence of neurological disturbances. Thus, they say, the reaction time test "may offer greatly increased sensitivity in detecting early, subclinical effects of mercury exposure." These findings, they conclude, "should help to produce a reliable and interpretable basis for reassessing government and industry standards for mercury exposure."

How fast can you read this?

Page layout and design have a great deal to do with both reading speed and comprehension. It has long been believed, for instance, that speed and comprehension are greater when text is arranged in a two-column format than in a full-width format in which lines run across the entire page. This, however, may not be the case for all readers, say Anita K. Kat of the department of reading at Northeastern Illinois University in Chicago and James L. Knight Jr. of Bell Telephone Laboratories in Holmdel, N.J. They explain that the superiority of the columnar format was revealed in the rather restricted context of low-speed reading (about 200 words per minute), and that slow readers use strategies different from those used by speed readers. Speed reader strategies include fewer eye fixations with a wider horizontal extent of text processed by each fixation and smoother and more efficient scanning patterns because speed readers don't double back as often. "Thus," say the researchers, "the rationale supporting columnar layout at slow speed appears to be less valid at high reading rates." They tested columnar and full-width layouts on college students — normal readers and those just completing a speed reading course — and found that any advantage afforded by the columnar format to low-speed readers does not extend to high-speed readers. The data suggest that "a full-width layout can produce a speed improvement of several hundred words per minute in skillful readers" (those whose reading speeds are greater than 275 words per minute).

This is your captain speaking

We won't have to wait till 2001 to talk to our computers. Speech recognition devices are good and getting better, and researchers are figuring out how best to use them. One potential use is in the cockpits of military aircraft. S. Joy Mountford and R. A. North of Honeywell Systems and Research Center in Minneapolis, Minn., compared voice input with keyboard input during a two-task situation (tracking and radio channel switching) and found performance "significantly improved" on both tasks when voice was used instead of keyboard for the channel switching.

Ten university students took part in the experiment. The tracking task required that they keep a moving cross centered on a stationary circle by making the appropriate movements of a control joystick. The channel selection task required that they use either voice or keyboard to select one of three types of radio and then enter a three-digit channel number. Subjects were tested on individual tasks and in a two-task situation. Tracking performance was poorest when the keyboard was used for channel changing. Even when the subjects had a high degree of keyboard familiarization, the researchers found a strong tendency to shift priority to data input at the expense of tracking. Only small decrements in tracking performance were seen when the voice entry mode was used. Furthermore, performance on channel changing was enhanced by using voice inputs.

He murdered his wristwatch

Charles L. Mauro was so incensed by the ridiculous design of the watch that he took it for evaluation to his human factors research staff at C. L. Mauro Associates, Inc., in New York City. The evaluation consisted of asking 14 persons to adjust the watch by one hour. Half attempted the task with access to the instruction booklet, half without. None could reset the watch without the instructions. (The manufacturer actually recommends that owners carry the instructions at all times.) Only 42 percent could reset the watch with the instructions, and it took about 9 minutes to do so. The research staff (Mauro, Hugh M. Bowen, Semra Coskuntuna and David M. Gilfoil) concluded that the watch has "outstanding characteristic complexity" that makes it inaccessible even to Ph.D. scientists, watchmakers and jewelers without the use of instructions. They found that attempts to operate it caused frustration and feelings of inadequacy.

The watch in question, which has Japanese works and a U.S. design, is produced by a well-known manufacturer. It acts as a chronometer, a calendar and an alarm and has three push-button controls that operate eight different functions. The researchers redesigned the watch (on paper) with emphasis on self-evidency. They managed to retain all the sophisticated functions while making them accessible to the average consumer. In other words, a person with a ninth grade education could operate such a watch (if it were produced) with minimal or no use of instructions. Mauro concludes that "placement of such devices on the market calls into serious question the ability of the design and engineering community to utilize the capabilities of technology for the benefit of society's well-being."