

CogScreen-Insomnia Edition: Operations Manual

- CogScreen-Insomnia Edition is a computer-administered and scored cognitive test battery designed to assess specific neurocognitive changes associated with insomnia and the treatment of insomnia. The CogScreen subtests included in the Insomnia edition were selected to provide a sensitive and repeatable measure of attention, short-term memory, visual-perceptual functions, working memory, and executive functions. Several of the measures were selected because they are analogues of conventional (non-computerized) tests that have been shown to be sensitive to insomnia and sleep deprivation.

Historical Background

CogScreen was initially designed to meet the needs of the Federal Aviation Administration (FAA) for a neuropsychological instrument that could detect subtle changes in cognitive functioning: “changes which left unnoticed may result in poor pilot judgment or slow reaction time in critical operational situations” (Engelberg, Gibbons, & Doege, 1986, p. 1589). The Aeromedical Edition of CogScreen (CogScreen-AE) meets the FAA’s requirement for a sensitive and specific neurocognitive test battery for use in the medical recertification evaluation of pilots with known or suspected neurological and/or psychiatric conditions.

The initial validation sample for CogScreen was a large U.S. aviator normative sample consisting of 584 commercial aviators. Validity studies have demonstrated expected relationships among CogScreen measures and analogous paper-and-pencil neuropsychological tests. Factor analytic studies have demonstrated that CogScreen measures generate expected and meaningful cognitive constructs. Criterion-related studies have demonstrated high levels of sensitivity and specificity in comparison to conventional (i.e., non-computerized) neuropsychological instruments.

Construct validity was evaluated by comparing CogScreen performance with performance on analogous paper-and-pencil cognitive and neuropsychological tests. For example, the CogScreen Symbol Digit Coding measure and the conventional Symbol Digit Modalities Test correlated .80 ($p < .001$). Similarly, Pathfinder Combined correlated .73 ($p < .001$) with Part B of the Trail Making Test (Horst & Kay, 1991).

CogScreen test batteries have been used in a wide range of biomedical research applications. Versions of CogScreen have been used to study the effects of antihypertensive drugs on the orthostatic reflex with and without hypoxia (Kay, Eberle, Kaufman, & Hordinsky, 1995). The FAA’s Civil Aeromedical Institute has used CogScreen-AE to examine the effects of low-dose alcohol on cognitive performance and to evaluate the influence of age on cognition and pilot flight performance (DeLarocca & Schroeder, 1992). In the latter study, CogScreen-AE was found to be significantly correlated with flight performance skills in a 727 simulator. For the past 10 years, researchers have been utilizing CogScreen subtests in a wide range of applications. CogScreen test batteries have been used in studies of sleep apnea (Kay et al., 1990),

diabetes (Zawadzki, Tatman, Grimes, Sobel, & Kay, 1991), and in a study of Eosinophilia Myalgia Syndrome (Clauw, Morris, Starbuck, Epstein, & Kay, 1993). Keyboard version of the test have been used to track changes in cognitive functioning during balloon trial occlusion of the internal carotid artery (Spector, Kay, Geyer, Deveikas, & Sullivan, 1991). The test has also been used by researchers investigating the effects of HIV seropositivity on the cognitive functioning of military aviators (Mapou, Kay, Rundell, & Temoshok, 1993) and in a nonpilot HIV population (Mapou et. al, 1995). Moore (1994) continues to use CogScreen in a longitudinal study of repatriated Vietnamese Prisoners of War. The United States Air Force (USAF) Enhanced Flight Screening (NEFS) program (King & Flynn, in press) features the use of CogScreen. All USAF pilot candidates take CogScreen-AE before receiving any military flying training. Their performance is archived for comparison purposes in the event that any individual sustains a head injury or other neurological insult.

Advantages of Computer Based Testing

The computer based version of the Trail Making Test Part A (i.e., CogScreen Pathfinder) has a number of advantages over the paper-and-pencil version.

Pathfinder is designed for repeated administration and has multiple forms. There is only one form of TMT Part A. Studies have demonstrated a large practice effect for the conventional test. In contrast, Pathfinder has been demonstrated to be highly stable. Following two training/familiarization sessions performance on Pathfinder has been shown to be highly stable, yet sensitive to the effects of a sedating antihistamine (Kay et al, 1997).

Kay, G.G., Berman, B., Mockoviak, S.H., Morris, C.E., Reeves, D., Starbuck, V., Sukenik, E., Harris, A.G. (1997) Initial and steady-state effects of diphenhydramine and loratadine on sedation, cognition, mood and psychomotor performance. Archives of Internal Medicine, 157:2350-2356.

Pathfinder provides measures of speed, accuracy, efficiency (i.e, thruput or correct reponses per minute), and total time to completion of task. In contrast, the TMT Part A only provides a measure of total time to completion of test.

Computer based testing provides better standardization of task presentation, more accurate measurement of response speed (millisecond timing resolution compared to a human operated stop watch), facilitates data collection and storage, and reduces errors in the transcription of scores.

CogScreen is well-established as a research tool in laboratories around the globe. CogScreen has been selected for a National Institute on Aging study (AG12713) investigating the impact of aging on cognition and flight performance. The Federal Aviation Administration has also used CogScreen in studying the impact of aging on cognition and flight performance (DOT/FAA/AM-94/23), head trauma recovery, the impact of HIV infection on neurocognitive functioning and the effect of shiftwork on cognition.

CogScreen was used in an FDA funded study evaluating the potential CNS effects of aspartame. Military laboratories are using CogScreen in aviator selection research, hypoxia research, sleep deprivation research, and cognitive aging research. Pharmaceutical companies have employed CogScreen in studies of the cognitive effects of antihistamines, hormone replacement therapy, oral diabetes medications, antihypertensives, cholinesterase inhibitors, sleep deprivation, jet lag and stimulants.

Description of CogScreen-Insomnia Edition

CogScreen-Insomnia Edition consists of a series of computerized cognitive tasks, each self-contained and presented with instructions and a practice segment. The CogScreen-Insomnia subtests are described in Table 1.

CogScreen testing software takes advantage of the many benefits offered by computerization, including improved standardization of administration and scoring, superior timing recording, and the presentation of dynamic and multiple test stimuli. The program automatically generates 12 alternate test forms, which are designed for repeated administration to the same individual. The program administers each test item and automatically records the response to the item and the speed of the response. The Insomnia Edition software generates two reports; (1) a text-based log of test items, individual item responses, and basic summary statistics; (2) an Excel spreadsheet consisting of subject and session identifiers and summary statistics for each of the CogScreen-Insomnia subtests; and a CSV (comma separated values) file for ease of incorporation of data into large mainframe database programs.

CogScreen-Insomnia Edition was designed for Windows-based personal computers running the Windows-XP Professional operating system. To accomplish “near” real-time testing in a Windows environment CogScreen places considerable demands on the operating system and hardware. CogScreen-Insomnia Edition also requires a CRT monitor (17” to 19”) and a light pen. The light pen serves as the primary response input device. The light pen reduces the potential advantage of having prior computer and keyboard experience. Furthermore, the light pen allows the respondent to maintain focus on the screen at all times.

Description of CogScreen-Insomnia Edition Test Measures

In general, each CogScreen subtest generates measures that represent response speed, response accuracy, and response thruput (number of correct responses per minute). Several subtests generate additional (“process”) measures that capture important qualitative and process-oriented performance characteristics.

1. Speed Measures

Speed is presented in terms of the median reaction time on correct trials of CogScreen tasks. By limiting speed measures to correct trials, the influence of lapses (long responses) and unintended (brief) responses is minimized. However, research with normal respondents has demonstrated no significant difference between median reaction

times generated from correct trials and all trials. The median, rather than the mean, is used because the median reduces the impact of outlier response times.

Timing accuracy is a key feature of CogScreen. The software employs timing routines capable of better than one millisecond timing accuracy. However, within the Windows (multitasking) environment time intervals need to be protected from internal and external "events" that can distort real time. CogScreen constantly monitors all event timing and is designed to terminate testing if timing delays are detected. In addition, prior to each administration of CogScreen-Insomnia a System Performance test critically evaluates the ability of the computer and operating system to meet the timing and video display requirements of CogScreen.

Speed scores on CogScreen are expressed only to the 100th of a second (i.e., .01 seconds). The limitation in timing resolution is a function of the video monitor's retrace rate which is approximately 17 msec. To maximize timing accuracy CogScreen links the timing of response to the video retrace location. Outside laboratory testing has determined that CogScreen provides 10 millisecond timing resolution.

2. Accuracy Measures

Accuracy is presented as the percentage of correct responses relative to the total number of items that were administered:

$$\text{Accuracy} = (\text{Number of Correct Responses} / \text{Total Number of Items}) \times 100$$

The total number of items includes correct responses, incorrect responses, and lapses (i.e., failures to respond within time limits). Scores on CogScreen accuracy measures tend to be high (i.e., above 90%), except on Shifting Attention Discovery, and on the Symbol Digit Coding Immediate and Delayed Recall measures. To maintain high levels of accuracy, most normal respondents slow their response speed to these tasks.

3. Thruput Measures

Thruput measures, a term coined by Thorne (D. Thorne, personal communication, December, 1991), are derived scores that express response efficiency and reflect the number of correct responses-per-minute. The thruput formula selected for CogScreen is the formula most frequently used by performance psychologists (D. Thorne, personal communication, May, 1991). The formula used in CogScreen for calculation of thruput measures is:

$$\text{Thruput} = ([\text{Accuracy}/100] \times 60 \text{ seconds}) / \text{Median Response Time Correct Trials}$$

The following is an example taken from the Manikin subtest: where Manikin

Accuracy = 80%, Manikin Speed = 2.40 sec.

$$\text{Manikin Thruput} = ([\text{MAN Accuracy}/100] \times 60) / \text{MAN Speed}$$

$$\text{Manikin Thruput} = ([80 / 100 \times 60]) / 2.40$$

$$\text{Manikin Thruput} = 20$$

It should be noted that the same Manikin Thruput score (i.e., 20 correct responses/minute) could have been obtained by responding with 100% accuracy with an average speed of 3.00 seconds/correct response. As with other summary scores, thruput measures provide

less specific information than individual speed and accuracy scores. Nevertheless, throughput appears to provide a useful measure of the efficiency of mental processing.

4. Process Measures

This category of measures contains various response error, qualitative, and process-oriented measures that cannot be classified as speed, accuracy, or throughput (Kaplan, 1988). The process measures in the CogScreen-Insomnia battery come from three subtests: Pathfinder Number, Pathfinder Combined, and Shifting Attention Discovery Condition. Each Pathfinder subtest generates a coordination score (Pathfinder Number Coordination and Pathfinder Combined Coordination) that reflect dominant-hand coordination and/or steadiness. Three process scores are obtained from the Shifting Attention Discovery task and reflect the number of rules (category shifts) completed (Shifting Attention Discovery Rule Shifts Completed), the number of times the respondent failed to maintain set after correctly identifying the active rule (Shifting Attention Discovery Failures to Maintain Set), and the number of perseverative errors (Shifting Attention Discovery Perseverative Errors).

CogScreen-Insomnia Subtests

The following is a brief overview of the five CogScreen-Insomnia subtests.

1. Backward Digit Span (BDS).

For the BDS test the respondent is presented from 3 to 6 digits, one-at-a-time, and then is instructed to enter the sequence in reverse order. For the respondent to advance to a longer sequence they must correctly complete one of the two sequences at the prior sequence level. Performance measures include accuracy (BDS Accuracy; BDSACC), the total number of correct sequences (BDSTOTAL), and the longest correct span (BDSMSPAN). Mental functions addressed by this test include visual attention and working memory.

2. Visual Sequence Comparison (VSC)

VSC simultaneously presents the respondent with two alphanumeric strings, one on the right and the other on the left half of the screen. The respondent selects [SAME] or [DIFFERENT] for each pair, indicating whether the same characters are presented in the same order for both sequences. The strings vary in length from four to eight items. For each pair, the strings may differ by one or two items. Half of the 20 sequence pairs present the same sequence, and half present a different sequence. Performance measures include the speed (VSC Speed; VSCRTC) and accuracy (VSC Accuracy; VSCACC) of responses, and the number of problems correctly completed per minute (VSC Throughput; VSCPUT). Mental functions addressed by this test include visual attention, working memory, verbal-sequential processing, and visual-perceptual speed.

3. Symbol Digit Coding (SDC)

SDC is a computer analogue of the conventional symbol-substitution task found in the WAIS-R Digit Symbol subtest (Wechsler, 1981) and the Symbol Digit Modalities Test. Nine symbol-digit pairs are displayed continuously throughout the test near the top of the

screen. The respondent is instructed to remember the symbol-digit pairs for a subsequent memory test. In the center of the screen, a line of symbols in random order is presented with blank spaces directly beneath each symbol. The respondent selects the associated digit for each symbol. As each row is completed, a new row appears. Performance measures include response speed (SDC Speed; SDCRTC), response accuracy (SDC Accuracy; SDCACC) the number of items completed correctly per minute (SDC Thruput; SDCPUT). This subtest measures attention, visual scanning, working memory, and speed of information processing.

3. SDC Immediate Recall Task (SDCIR)

SDC Immediate Recall Task presents an immediate recall trial of the symbol-digit pairs. After the 90-second trial of the SDC task, nine symbols are presented in random order. The respondent's task is to recall the corresponding digits. A measure of recall accuracy (SDC Delayed Recall Accuracy; SDCDRACC) is the only score for this task. This task provides a measure of short-term visual paired-associate memory.

4. Matching to Sample Test (MTS)

MTS presents a checkerboard (4x4) made up of purple and yellow squares. The checkerboard disappears and is replaced by two similar checkerboards, one of which is identical to the original checkerboard pattern. The respondent presses the lightpen to the checkerboard that is identical to the one previously shown. There are measures of response speed (MTS Speed; MTSRTC), accuracy (MTS Accuracy; MTSACC), and efficiency or thruput (MTS Thruput; MTSPUT). This test provides a measure of immediate visual memory and visual attention.

5. Divided Attention Test (DAT)

DAT consists of two components: (a) a visual monitoring task only (DAT Indicator Alone), and (b) the simultaneous presentation of the visual monitoring task (DAT Indicator Dual) and the previously described Visual Sequence Comparison task (DAT Sequence Comparison).

DAT Indicator Alone Task

For the DAT Indicator Alone task, the respondent watches a cursor move vertically within a circle that is divided into central, upper, and lower sections. When the cursor crosses into the upper or lower sections, the respondent's task is to press a box marked "CENTER" with the light pen. DAT Indicator Alone Speed (DATIRTC) is the median amount of time the indicator spends in the upper and lower section of the circle prior to being centered by the respondent. DAT Indicator Alone Premature Responses (DATIPRE) represents number of premature centering responses. Premature responses are indicated if the respondent presses the "CENTER" key before the cursor moves into the upper or lower sections.

DAT Indicator Dual Task

The second DAT task is the Visual Sequence Comparison task, which is performed simultaneously with the visual monitoring task. Response speed is measured for both the monitoring task (DAT Indicator Dual Speed; DATDRTC) and the visual sequence comparison task (DAT Sequence Comparison Speed; DATSCRTC). Accuracy (DAT Sequence Comparison Accuracy; DATSCACC) and number of items correctly completed

per minute (DAT Sequence Comparison Thruput; DATSCPUT) are measured for the sequence comparison task in the dual condition. DAT Indicator Dual Premature Responses (DATDPRE) represents the number of premature centering responses in the simultaneous condition. When the two tasks are presented simultaneously, the test assesses divided attention, working memory, and visual-motor and visual-perceptual speed. A comparison of performance under single and dual task conditions for sequence comparison, visual monitoring of the indicator, and premature responses yields information regarding the respondent's capacity for multitasking.

6. Pathfinder (PF)

PF was adapted from the TMT. After viewing a number or letter displayed in the center of the screen, the respondent's task is to select one of the four quadrants containing the next character in a previously specified sequence. Three of the four characters are updated following each response. There are three different sequencing rules. PF Number requires number sequencing, PF Letter requires letter sequencing, and PF Combined requires sequencing an alternating series of numbers and letters. The performance measures for each task include: (a) the median response time to complete each sequential step (PF Number Speed, [PFNMRT]; PF Letter Speed, [PFLMRT]; and PF Combined Speed [PFCMRT]); (b) response accuracy (PF Number Accuracy, [PFNACC]; PF Letter Accuracy, [PFLACC]; and PF Combined Accuracy, [PFCACC]); (c) thruput (PF Number Thruput, [PFNPUT]; PF Letter Thruput, [PFLPUT]; PF Combined Thruput, [PFCPUT]); and (d) coordination measures indicating the respondent's proximity to the center of the target numbers and letters (PF Number Coordination, [PFNCOOR]; PF Letter Coordination, [PFLCOOR]; and PF Combined Coordination [PFCCOOR]). There is also a measure of the total time taken to complete each sequence (PFNTOT, PFLTOT, and PFCTOT). PF measures number and letter sequencing skills, the ability to systematically apply an organizing principle, immediate memory, motor coordination, visual scanning, and the ability to shift mental set.

7. SDC Delayed Recall Task

SDC Delayed Recall Task presents a 20-minute delayed recall trial of the symbol-digit pairs. After the 20-minute delay period, nine SDC symbols are presented in random order. The respondent's task is to recall the corresponding digits. A measure of recall accuracy (SDC Delayed Recall Accuracy; SDCDRACC) is the only score for this task. This task provides a measure of long-term visual paired-associate memory.

8. Shifting Attention Test (SAT)

SAT requires respondents to alter their responses depending upon changing rules. SAT begins by training the respondent to select from among four response boxes, each of which contains an arrow, according to one of three easily learned rules: The first rule requires the respondent to select a box based on the color of its border; the second rule requires the respondent to select a box based on the direction of the arrow; and the third rule requires the respondent to match the color of the arrow. After learning the three response conditions, the respondent begins the fourth condition, SAT Instruction. In this condition, the respondent is presented with an instruction identifying the active rule before the presentation of each subsequent stimulus. In the fifth condition, SAT Discovery, the

respondent's task is to discover and then apply the active response rule, which changes after a variable number of correct responses. The respondent uses trial-and-error to ascertain the active rule. For all SAT tasks, measures of response accuracy, speed, and thruput are generated. In addition, for the SAT Discovery task, the subtest records the number of rule shifts completed (SAT Discovery Rule Shifts Completed; SATDIRUL), failures to maintain set (SAT Discovery Failures to Maintain Set; SATDIFAI), and perseverative errors (SAT Discovery Perseverative Errors; SATDIPER). SAT is a test of concept formation (attribute identification), mental flexibility, sustained attention, deductive reasoning (rule-learning), vulnerability to response interference, working memory, application of novel rules, visual scanning, choice visual reaction time, and perseverative tendencies.

9. Dual Task Test (DTT)

DTT has two tasks that are each presented independently and then simultaneously for a measure of divided attention and multitasking capability.

DTT Tracking Alone Task

DTT Tracking Alone is a visual-motor tracking test. This is the only CogScreen-AE subtest that requires the respondent to use the keyboard. The respondent's task is to maintain a cursor in the center of the screen by pressing the left and right arrow keys. Without the active tracking effort of the respondent, the cursor disappears off the screen (a "boundary hit"). Response measures for this task include the mean absolute tracking error (DTT Tracking Alone Error; DTTAABS) and the number of boundary hits (DTT Tracking Alone Boundary Hits; DTTAHIT).

DTT Previous Number Alone Task

The second task is a previous number exercise in which the respondent is shown a 1, 2, or 3 that is then replaced by either a 1, 2, or 3. The respondent's task is to recall the previous number shown and select that number (with the light pen), while simultaneously encoding the current number for the next stimulus presentation. For this task, the performance measures are DTT Previous Number Alone Accuracy (DTTPAAC), DTT Previous Number Alone Speed (DTTPARTC), and DTT Previous Number Alone Thruput (DTTPAPUT).

DTT Previous Number Dual Task

DTT Previous Number Dual is the final task of DTT that simultaneously presents the tracking and previous number tasks. Measures are generated for both components of this task. DTT Tracking Dual Error (DTTDABS) and Tracking Dual Boundary Hits (DTTDHIT) are provided. DTT Previous Number Dual Accuracy (DTTPDAC), Speed (DTTPDRTC), and Thruput (DTTPDPUT) are also provided. Comparison of single- and dual-task performance can be used to determine the amount of deterioration resulting from multitasking. DTT measures sustained attention, visual-motor tracking, divided attention, and working memory.

10. Kay Continuous Performance Test (KCPT)

KCPT is a measure of vigilance. Symbols are presented at a fixed interval for 12 minutes. Respondent presses the space bar whenever a Heart appears as the symbol. For each 2-minute period there is a measure of the number of correct hits (HITSB## - where ## is the number of the block), a measure of omission errors (OMISSB##), a measure of errors of

commission (COMISB##), and reaction time for correct hits (HITRTB##). There are also summary measures for the 6 blocks that comprise the entire KCPT; correct hits of the heart targets (HITS6), total omission errors (OMISS6), total commission errors (COMIS6), reaction time for correct responses (HITRT6), and two measures of signal detection, d-prime (DPRIME6 – a measure of perceptual sensitivity) and beta (BETA6 – a measure of risk taking).

CogScreen-Insomnia Materials

The CogScreen-Insomnia materials consist of operating manual, light pen, light pen interface box and cables, and software.

Appropriate Populations

Reliable administration of CogScreen-Insomnia requires respondents to have at least eighth-grade reading level ability and normal or corrected vision sufficient for reading on-screen instructions and accurate viewing of the visual stimulus items. Color vision does not appear to be a necessary condition for completion of CogScreen-Insomnia. Hearing must be sufficient for the respondent to hear the lightpen feedback tones and the Shifting Attention Test feedback tones. Test administrators need to ensure that a respondent's difficulties on CogScreen-Insomnia are due to cognitive deficits and are not due to problems with vision, motor coordination, hearing adequacy, or educational limitations.

Professional Requirements

The administration of CogScreen-Insomnia does not require formal training in neuropsychology or clinical psychology. Testing may be accomplished by a trained person with a background in the fundamentals of test administration. The test administrator needs to study, and be familiar with, the administration procedures outlined in this manual. As with all psychological tests, the training of test administrators and the administration of CogScreen-Insomnia is the responsibility of a qualified professional.

Interpretation of CogScreen-Insomnia Edition requires professional training in Neuropsychology (cf. Standards for Educational and Psychological Testing, American Psychological Association & National Council on Measurement in Education, 1985). Interpretations regarding the presence of abnormal cognitive functioning may be made by psychologists who are not clinical neuropsychologists. However, more specific neuropsychological interpretations, such as inferences regarding brain dysfunction, require a background in clinical neuropsychology and a foundation in cognitive psychology.

Test Security

Test security is vitally important for CogScreen. In fact, aviation safety could be seriously compromised if CogScreen is misused. For example, an unethical user might allow a pilot to practice taking CogScreen to assist him or her in passing the test. To avoid

compromising test security, the user needs to protect the software and access to the computer and the CogScreen program. Each CogScreen-Insomnia Edition license can only be used on one computer.

Installation

Prior to installing CogScreen-Insomnia Edition follow the instructions for installation of the USB light pen. After calibrating the light pen, install the CogScreen-Insomnia software.

1. Light Pen Installation

Your light pen kit includes the following components:

- | Disk containing light pen setup and driver software
- | Fastpoint Universal Light Pen
- | Fastpoint PXL-2000 USB light pen interface
- | extension cable and adapter for the light pen
- | display adapter cable
- | USB cable
- | light pen holder – for mounting to side of monitor
- | Fastpoint user's guide
- | FTG Data Systems applications guide

Please refer to Figure 1 and follow the setup directions in the Fastpoint user's guide.

Monitor Connection

Begin by turning off the power to your monitor and computer. If the monitor is on top of your computer, remove it and place it to the side of the computer at desk level. The monitor must be at desk height for administration of CogScreen.

1. Turn the computer around so that the back panel faces you.
2. Locate the outlet on the computer into which the monitor cable is plugged.
3. Remove the display adapter cable from its package (it has three square connectors; one labeled VID. FROM COMPUTER, one labeled VID. TO MONITOR, and one labeled External Interface).
4. Disconnect the monitor cable from the computer's back panel.
5. Plug the cable connector from the monitor into the connection labeled VID. TO MONITOR.
6. Plug the display adapter cable connector (labeled VID. FROM COMPUTER) into the outlet in the back of the computer where the monitor cable was previously connected.
7. Plug the display adapter cable connector (labeled External Interface) into the light pen interface outlet.
8. Secure the connection by tightening the connector screws.

Light Pen Connection

1. Remove the light pen from its package.
2. Plug the extension (cream-colored) cable's RJ-11 (telephone jack) into the

front of the light pen interface and the other end into the extension jack. Plug the light pen's RJ-11 (telephone jack) into the open end of the extension jack.

When positioning the light pen holder, you should consider the physical configuration of your system, the length of the light pen cord, and your planned use of the light pen. The right-front side of your monitor may be a convenient area for placement of the light pen holder. However, you should position the holder in a location that works best for your use of the light pen. When you decide where the light pen holder should be positioned, peel off the backing from the adhesive pad, affix the pad to the light pen holder, and then firmly press the light pen holder in the desired location.

Light Pen Software Installation

The light pen software will install the drivers needed to use the light pen with Windows applications, including CogScreen-Insomnia Edition.

The manufacturer's current light pen driver is Version 1.05.002 available at the following web site: <http://www.fastpoint.com/driver/driver.html> .

Download the current driver (1.05.002). This is a self-extracting program that will create a Folder on the PC and install the software. Accept the default settings.

After the driver software is loaded on your PC, connect the USB cable from the interface box to a free USB port on the PC. The New Hardware wizard should be instructed to look for the driver in the location where the Lightpen Driver files have been installed. Once installed, the Power light on the Light Pen Interface will flash green informing you that the light pen is installed. You can now use the light pen in place of your mouse or other pointing device.

2. CogScreen-Insomnia Edition Software Installation

1. Set your video display to 1024 x 768 (right click on the desktop, choose Properties, Settings, Screen Area and move the cursor to the 1024 x 768 setting
Set the Display DPI setting to Normal Size (96 DPI). [Note: This setting is often located in Control Panel -> Display -> Settings -> Advanced.
2. Insert the CogScreen disk. If the auto-run feature is active the installation process will begin automatically, otherwise;
Open Windows Explorer, find the CD drive where the Install file is located and double-click on the CogScreen Setup icon.
3. Carefully read and follow all on-screen instructions.
4. The new PC's being used in the Insomnia projects should install the software seamlessly. Older systems may require resetting (or restarting) the PC several times, depending upon how recently you have updated your operating system and Window's Explorer software. For example, if necessary, CogScreen installer will automatically install and update MDAC (Microsoft Data Access).

5. After the software is installed you will be instructed to folded a sheet of 8.5 x 11 inch paper in half (to the dimensions of 8.5" x 5.5") and hold the paper up to the screen. You will use the arrow keys (initially the down arrow and right arrow) to size the border on the screen to a box equal in size to the folded sheet of paper.
6. You will be notified that CogScreen installation is complete. The computer should be restarted. This may occur automatically, or you will need to restart manually [Start-Shut Down-Restart].
7. Activate the license:
 - a) double click on the CogScreen icon
 - b) leave admin as the UserName
 - c) type in cogscreen as the password
 - d) click okay
 - e) click on the Tools tab at the top of the screen
 - f) click on Order Tests
 - g) in the lower left hand box of the window that appeared is a Transaction Code
 - h) e-mail the transaction code (e.g., avd8 85rb 94rr mn10) exactly as it appears – don't mistake a zero for an O (compare upper and lower case symbols) to cogscreen@aol.com
 - i) a License Key will be returned to you by e-mail.
 - j) to enter the License Key follow the same steps as above (#7) and then type in the License Key – exactly as it appears in the e-mail – in the License Key location in the lower right portion of the window.
 - k) you will be asked for Company Name – enter the name of your site.
 - l) cancel out of the Order Tests window
 - m) click the File tab and Login Again
8. Set the Admin Settings:
 - a) repeat steps 7a through 7e
 - b) click Admin Settings
 - c) click Add User
 - d) enter full name of User
 - e) enter a user name – remember it is Case Sensitive
 - f) select Security Level – is this user going to be administering the test battery? If yes Select Examiner - if the same person will be accessing reports and having access to Admin Settings then you will ALSO have to repeat the process a second time using a different User Name.
 - g) enter Password – 6 characters minimum – Case Sensitive

NOTE: When you log in as an Examiner you can administer the tests
 When you log in as Professional you can create the Excel file and change Admin Settings
 A person who performs both of these roles will have 2 UserNames – they can use the same Password for both names

WARNING:

CogScreen won't run if other applications (e.g., word processors, spreadsheets, etc.) are running.

CogScreen won't run if certain type of "Processes" are running – in the background. Processes that conflict with CogScreen are Virus Detection software, System Update programs, Instant Messenger, some Firewall Programs, some Calendar / Reminder programs, etc.

You can find most of these problems on your "task bar" – the little icons in the lower right hand corner of your desktop (next to the time display).

To turn off these applications right click on the application with the mouse and choose to close, exit or shutdown the application.

If after turning off these applications CogScreen still indicates that "applications are running", you may need to open the Task Manager (Ctrl-Alt-Del) and turn off Processes that aren't necessary to the running of the Operating System. Windows typically doesn't allow you to turn off system critical components. You simply click on the process you want to terminate and then hit Delete.

READY TO START THE TESTING PROGRAM

- 1) Double click on the CogScreen Icon
- 2) The Program will Launch (Note: the correct version is 1.0.112)
- 3) Enter an "Examiner" Username and an "Examiner" Password (case sensitive)
Click OK
- 4) The Select Examinee screen appears
- 5) Examinee Name Field – Insomnia uses the following convention
NOTE: This field is case sensitive.

The screenshot shows the 'Select Examinee' window of the CogScreen-PL application. The window title is 'CogScreen-PL' and it has a menu bar with 'File', 'Tools', and 'Help'. The main area contains the text 'Select Examinee' and 'Enter the following information about the examinee.' Below this are input fields for 'Name' (split into First, MI, and Last) and 'Date of Birth' (split into MM, DD, and YYYY). A message 'All Input Fields Are Required' is displayed. At the bottom right is a 'Next' button with a blue arrow icon. The status bar at the bottom shows '14 Tests Remaining on License' and the date/time '10/23/2003 11:16 AM'.

- 6) Examinee Date of Birth Field
- 7) If this is a new examinee you'll see an Examinee Not Found message
 - a. If it's an old Examinee you'll be shown the number of the next Session
 - b. If it's an old Examinee and you receive the Examinee Not Found message, you've misspelled the name, incorrectly entered the birthdate, or you're not accessing the Database (maybe you're on a different computer) – correct errors and re-start the case
- 8) The next screen is the Demographics Screen. The Examinee Name (reordered to Last, First, MI), Date of Birth (actually date of enrollment), Age (ignore), and test date are already displayed.

Demographics

Name Last First MI

Date of Birth Age Test Date

Session Number Examiner's Initials

The following demographic input is optional.

Years of Education Sex

Subject ID

14 Tests Remaining on License | 10/23/2003 11:19 AM

- a. Check the Session Number and make sure that the session number shown is the correct session for this visit.
- b. The years of education and sex fields are optional.
- c. Enter participant's Insomnia ID number (an ID number is required)

9) Start Test screen is displayed – to begin testing click on the Start Tests button

The screen will turn black for a moment and then you will see the Light Pen Quick Check screen. This screen verifies the light pen calibration and if necessary runs a fresh calibration. Press the light pen tip to the center of the small square in the middle of the screen. Proceed with calibration if the calibration test is initiated.

The next screen is the System Performance Test, click Next to begin. You will see a small box traveling diagonally across the screen and you may hear various clicking or beeping noises. At the bottom of the screen the Max time: and Average time: are displayed. For the Insomnia project computers these numbers are expected to be under 20. A score less than 50 (msec) is passing.

The screen will show whether or not the system passed.

If the system doesn't pass. Press Alt-F1 and first retry the System Performance Test F8. If it fails a second time press Alt-F1 and then the Esc key to end the session. Something is malfunctioning in the computer...seek technical assistance.

NOTE: System Performance test failure generally indicates that some process is interfering with timing on the PC. A PC Magazine utility (EndItAll2) can be used to eliminate such hidden processes.

The next test is the sound test. If your headphones or speakers have a volume adjustment you can set the volume to a comfortable level at this time – otherwise you're going to have to set the volume outside of the CogScreen program. (i.e., play some sounds with a different Windows program and adjust the volume using the volume icon in the lower right-hand task bar).

Prior to testing an Introductory series of screens are presented. These give the examinee a chance to interact with the lightpen.

COGNITIVE TESTING BEGINS NOW

If the subject repeats test instructions more than two times a notice will appear:
CONTACT THE TEST EXAMINER.

To proceed with testing the Examiner types in Alt-F1. After the completion of Insomnia training sessions the Examiner will always select option 2 (Run the Exercise).

When the TESTING IS COMPLETED screen notice appears the subject has completed the battery.

The screen will not respond to button presses.

If the examinee didn't complete some of the subtests the screen will indicate that testing was not complete and the number of incomplete tests. If this occurs during the Insomnia project it is probably necessary to have the subject complete the incomplete subtests.

Exiting the Test Session

The examiner types in the following word: **m a i n**
and then presses: [Enter]

The screen will go blank and then the Examiner's Observations screen will appear.

Examiner's Observations

- 1) Check boxes that apply for problematic behaviors observed during the test session.
- 2) If computer or software failures occurred (e.g., power outage) indicate in the appropriate field.
- 3) Describe the examinee's mood during the testing.
- 4) Provide other pertinent observations.

Click Next

Exit CogScreen

If the entire test battery was not completed two options will appear:

- 1) Examinee will return to complete remaining subtests later.
- 2) Examinee requires no further testing.

If the first option is chosen the CogScreen results may not be available until the subject completes the entire test battery.

Accessing CogScreen-Insomnia Data

- 1) Login in using a Professional level Username and Password.
- 2) Examinees are listed in the box on the left.
- 3) To view demographics double click on the Examinee's name and the session (s) completed by the subject will appear. Incomplete sessions appear as a clear page – Completed sessions as a filled (i.e., lined) page.
- 4) Demographics may be edited directly on the Demographics screen on the right side.
- 5) To create an Excel spreadsheet (and a csv file) click the Reports tab and the Spreadsheet option.

The Excel Spreadsheet is named: CogScreenIE.xls and is located in the CogScreen\Reports folder (e.g., C:\Program Files\CogScreen\Reports\). The comma separated values file (CSV) is named: CogScreenIE.csv

When the spreadsheet option is chosen CogScreen automatically adds all completed test sessions to the spreadsheet.

In addition, CogScreen generates a Source Data file. This is a date-time stamped text file that contains all item and response information for each test session. This text file can only be linked to the subject by using the date / time information. The subject's identifying information is NOT written to this unencrypted file. The text file is located in the following folder:

C:\Program Files\CogScreen\Reports\

The file extension for these files is .dat

The first four characters of the file name are the year, e.g., 2003

The next two characters of the file name is the month, e.g., 01

The next two characters of the file name are the day of the month, e.g., 19

The last four characters of the file name are the time that testing began, e.g., 1318 (1:18 pm)

For this example the data file name is: 200301191318.dat

General Instructions for Test Administration

CogScreen-Insomnia Edition is designed to be largely self-administered. However, some interaction between the respondent and the test administrator is necessary.

Double-click on the CogScreen icon on the Windows Desktop. Log on as an **Examiner**. Enter the Username and the corresponding password. If you have correctly logged on as an Examiner the Select Examinee screen will appear.

Complete the demographic screen. Carefully check the displayed session number. Determine if the displayed session number is the intended session number for this examination. Start the test.

For the first test administration it is necessary to describe and demonstrate the use of the light pen. Use of the light pen usually requires minimal training. Instruct the respondent to hold the light pen in the same manner as a pen or pencil. Inform the respondent that the tip of the light pen is to be tapped with the tip perpendicular to the face of the monitor and not at an angle. It is important that there is an adequate amount of slack in the light pen cord so that the cord is not taut. These conditions will allow the user to comfortably operate the pen. The functioning of the light pen is also dependent upon the examiner keeping the monitor screen and the tip of the light pen clean. Instructions for cleaning the light pen can be found in the light pen manual.

It is recommended that the test administrator remain with the respondent throughout the initial training session. This allows the administrator to determine if the respondent is having any difficulty reading the text, operating the light pen, or following instructions. The examiner should feel free to provide explanation and demonstrations as needed during the training session.

For subsequent sessions the respondent will generally take the tests independently, once the examiner has initiated the test session. However, it is important to remain nearby to answer questions that may arise, to deal with equipment-related problems, or to assist the respondent if the Contact the Test Administrator! prompt appears.

Except during the Training Sessions, it is important to refrain from coaching the respondent or providing feedback on response accuracy, other than that which is provided automatically by the program (note that feedback is provided only during practice segments). In answering questions, the test administrator should be careful not to distract the respondent during response intervals that are being timed. Comments to respondents are best made between subtests or between the practice and test segments. Respondents may also want to know if they should focus more on speed or accuracy during certain subtests. Respond by encouraging performance that is “as fast as possible without making mistakes.”

Discontinuing Testing

Rarely, an examinee becomes incapable of continuing with the test battery. If this happens, simultaneously press <Alt>+<F1>. This can't be done when a test is actually running. However, during the test instructions and upon completion of practice items it is possible to halt testing.

Generally this feature is active when there is a [NEXT] box appearing in the lower right hand corner of the screen.

Press Alt-F1

You will see the following message:

Test Examiner:

For the subtest [Current Subtest]

Please enter one of the following options

F1 - To skip the subtest for now

F8 - To restart the subtest from the beginning now

F10 - To remove the subtest from this session's test battery

Esc – To end this session

Of these options it is unlikely that you will use any of them except for <Esc>. The Testing Completed message (and number of missing tests) will be displayed. Exit from CogScreen by typing <m a i n> and then the [Enter] key. Proceed to complete the Observations Screen and indicate the reason why the session was terminated. On the second Observation screen indicate whether the subject will be returning to complete the session.

Contact the Test Examiner

This message will appear whenever the respondent fails two consecutive attempts to complete a practice session at the minimum required level of proficiency or requests to

repeat instructions more than once. At this point, the test will not proceed without the intervention of the administrator. To proceed with the test, the administrator removes the Contact the Test Administrator! message by simultaneously pressing the <Alt> +<F1> keys.

The following menu appears:

Please enter one of the following options:

- 1 - To repeat instructions.
- 2 - To run exercise.
- 3 - To skip exercise.

If a determination is made that the respondent has failed to comprehend test instructions, read the instructions aloud to the respondent and/or offer further explanation of the task. It is important that the administrator NOT teach test-taking strategies (other than those presented in the test instructions). During instructions and practice, it is permissible to explain where to look on the screen, what to look for, and how responses are made for a particular subtest.

If the respondent is still not capable of performing the subtest, then the subtest will still need to be run. Select option 2.

Testing Environment

The administrator needs to be sensitive to the human factors involved in computerized testing and to specific factors involved in the use of a light pen. Place the monitor directly on the surface of a desk or table. The height of the monitor, when placed on top of a computer case, makes it difficult for the respondent to comfortably use the light pen. Also, respondents with bifocal lenses typically find it more difficult to read the screen when the monitor is placed on top of the computer. By placing the monitor directly on the table top, the computer case is removed from the respondent's direct view and access. Respondents who are uncomfortable with computers will feel less threatened when facing the monitor by itself. During the standardization of CogScreen, computers were placed either on the floor or to one side of the monitor.

The table or desk used for the monitor should be deep enough to allow the respondent to rest his or her arms or elbows on the desk while taking the test. This reduces the fatigue that can occur when operating a light pen without an arm rest. In addition, the respondent needs to be able to position the monitor at a comfortable distance for reading. As previously stated, the light pen cord needs to have adequate slack to prevent the cord from pulling during the test.

The respondent does not need access to the keyboard during CogScreen and therefore the keyboard should be placed out of reach (e.g., to the side of the monitor or further back on the desk).

Other test environment requirements are common to cognitive testing in general. The chair should be comfortable and should allow the respondent to sit close enough to the desk to allow easy access to the monitor. The room should be free from visual and auditory distractions. Observe the respondent from behind to further prevent distracting the respondent. The feedback tones can be played through speakers or headphones. If more than one subject is taking the test in a room the use of headphones is a necessity. The volume on the speakers or headphones should be set to a comfortable level for the examinee.

Other Menu Items and Options

In the Professional mode the following tabs are available.

Delete Session

Delete Subject

Reports

 Spreadsheet

Tools

 Admin Settings (for obtaining passwords, etc.)

 Screen Calibration – for use if you change monitors

 Order Tests – for licensing

 Switch Edition – N/A for Insomnia project (provides access to other CogScreen tests and test batteries)

Help

 CogScreen Manual – N/A for Insomnia Edition

 Contact Information – how to reach CogScreen

 About

Validation of CogScreen-Insomnia Subtests

With few exceptions, CogScreen subtests are based upon well established and extensively validated tests from the fields of cognitive psychology and neuropsychology. The existing literature on these tests supports the validity of these measures (Gazzaniga, 1994; Kane & Kay, 1992). When the underlying cognitive construct of an analogous pair of tasks is assessed through different performance measures, the unique variance added by computerization may suppress the validity coefficients. The conventional neuropsychological tests being compared to CogScreen subtests were not administered in a computerized format. The following sections present selected CogScreen-Insomnia subtests in terms of the subtest's historical background, relationship to existing computer or analogue tests, and construct validity.

- (1) Visual Sequence Comparison (VSC). VSC is a test of simultaneous letter and number sequence comparison that is fairly unique to CogScreen. VSC Thruput was most highly correlated with WAIS-R Digit Symbol ($r = .46$). VSC Thruput performance also significantly correlated with CVLT Short Delay and Long Delay ($r = .22$ and $.21$, respectively), and Part A and Part B of the TMT ($r = -.33$ and $-.35$,

respectively). VSC Speed correlated with CVLT Hits on the delayed recognition trial ($r = -.25$) and the SRT ($r = .19$).

- (2) Symbol Digit Coding (SDC). SDC is related to the WAIS-R Digit Symbol subtest and the SDMT. These are popular neuropsychological measures that have consistently been shown to be among the tests most sensitive to the presence of brain dysfunction (cf. Lezak, 1995). The correlation between SDC Thruput and the WAIS-R Digit Symbol subtest was .67. SDC Thruput was also correlated with Comprehension ($r = .19$) and Block Design ($r = .30$). SDC Thruput correlated significantly with performance on numerous neuropsychological tests, including immediate and delayed recall of the CFT ($r = .20$ and $.23$, respectively), Parts A and B of the TMT ($r = -.37$ and $-.44$, respectively), PASAT Series 2 ($r = .27$), CVLT indexes ($r = .17$ through $.32$), and TPT indexes ($r = -.20$ through $-.27$).
- (3) Symbol Digit Coding Delayed Recall (SDCDR). The paired-associate nature of the SDC subtest lends itself to testing of unintentional or incidental learning of symbol-digit pairs. An incidental memory procedure is described by Kaplan, Fein, Morris, and Delis (1991). However, because CogScreen is a repeatable test, the respondent is explicitly instructed that immediate and delayed recall of symbol-digit pairs will be tested. SDC Delayed Recall Accuracy correlated with WAIS-R Digit Symbol ($r = .23$). Support for this test as a measure of visual memory comes from its significant correlations with immediate- and long-delay recall indexes of the Complex Figure Test ($r = .26$ through $.28$). Significant correlations were also found between SDC Recall Accuracy and California Verbal Learning Test indexes ($r = .22$ through $.24$) and Tactual Performance Test indexes ($r = .17$ through $.25$).
- (4) Pathfinder (PF). PF is analogous to the Trail Making Test, a popular and well-validated neuropsychological test (cf. Lezak, 1995). PF Combined Speed correlated significantly with Part A ($r = .38$) and Part B ($r = .51$) of the TMT. PF Combined correlated with a number of WAIS-R subtests including Arithmetic (Thruput; $r = .25$), Digit Span (Thruput; $r = .24$), Vocabulary (Thruput; $r = .25$), Picture Arrangement (Accuracy; $r = .27$), and Digit Symbol (Speed; $r = -.38$). PF Combined also correlated with performance on a number of neuropsychological tests, including SRT (Thruput; $r = -.25$), and indexes of the CVLT (Speed and Thruput; $r = .17$ through $.20$). PF Number Speed and PF Letter Speed also significantly correlated with Parts A and B of the TMT, though not as strongly ($r = .17$ through $r = .21$, respectively). PF Number Speed correlated with WAIS-R Digit Symbol ($r = -.22$), Picture Arrangement ($r = .21$), PASAT Series 1 ($r = .17$), and CVLT List B ($r = -.21$).
- (5) SAT was designed to be a measure of executive function and shares design characteristics with the WCST, the Stroop Test (cf. Lezak, 1995), and the BCT. These tests have been extensively validated as measures of executive functions that include concept formation, rule-learning, attribute identification, and application of novel rules in a systematic manner (Perrine, 1993). The rule application phase of SAT is encompassed in the Arrow Direction, Arrow Color, and Instruction Conditions. Measures derived from these tasks were highly correlated with the WAIS-R Digit Symbol subtest ($r = -.39$ through $-.49$), and had lower, though still significant, correlations with the WAIS-R Information subtest ($r =$

.22 through .26). Thruput measures for these SAT tasks were also correlated with BCT-III and BCT-IV ($r = -.17$ through $-.27$); TPT ($r = -.19$ through $-.26$); and Parts A and B of the TMT ($r = -.20$ through $-.42$). SAT Discovery Accuracy had marginally significant correlations with several WAIS-R subtests, including Picture Completion ($r = .16$), Block Design ($r = .22$), and Object Assembly ($r = .19$). SAT Discovery Thruput correlated with Information ($r = -.22$) and Picture Arrangement ($r = .18$). SAT Discovery correlated strongly with a number of neuropsychological tests considered to be measures of executive functions, including the copy trial of the CFT (Accuracy; $r = .20$), TPT measures (Thruput; $r = .17$ through $-.24$), and Part A and B of the TMT (Thruput; $r = -.20$ and $-.32$, respectively). As anticipated, SAT Discovery Accuracy correlated significantly with indexes derived from the WCST, including Categories Completed ($r = -.19$), Perseverative Responses ($r = -.17$), Non-Perseverative Errors ($r = -.28$), Trials to Complete First Category ($r = -.26$).

Summary of convergent and discriminant validity

In summary, CogScreen-Insomnia measures were only minimally correlated with measures of intelligence from the WAIS-R. The correlations between CogScreen and WAIS-R subtests were highest for analogous tasks, such as between WAIS-R Digit Symbol and SDC. The correlations between CogScreen measures and conventional neuropsychological tests demonstrate CogScreen's ability to assess specific cognitive functions. For example, conventional neuropsychological measures that assess rate of information processing and sustained attention (e.g., PASAT) were well correlated with several CogScreen measures designed to assess these same functions, including PF Combined, and SDC. Tests of visuospatial processing and visual memory (e.g., CFT and TMT) were correlated with CogScreen measures such as VSC. Indexes from the WCST and BCT, which assess ability to form abstract concepts and to shift and maintain set, were correlated with SAT Discovery.

Subtest Interpretation Guidelines

1. Visual Sequence Comparison

Visual Sequence Comparison appears to measure speed and accuracy of visual-perceptual processing. The test was performed very poorly by individuals referred because of aviation performance problems. The test correlates with WAIS-R Digit Symbol and Parts A and B of the TMT.

2. Symbol Digit Coding

Performance on CogScreen Symbol Digit Coding may be interpreted in the same manner as one would interpret the WAIS-R Digit Symbol or the SDMT. As with the conventional paper-and-pencil versions of this task, SDC measures attention, working memory, and information-processing speed. SDC Thruput correlated significantly with the WAIS-R Digit Symbol subtest, Part B of the TMT, and with immediate recall indexes from the CVLT. The motor requirements of CogScreen SDC appear to be minimal for normal respondents. Performance on SDC Thruput correlated .18 with dominant-hand finger tapping. SDC also generates a measure of associative memory, SDC Delayed Recall Accuracy. This

measure correlates with performance on conventional neuropsychological measures of verbal and visual memory, as well as with the incidental memory indexes from the TPT. SDC Speed and SDC Thruput loaded on the Visual Perceptual and Spatial Processing factor.

3. Pathfinder

Like the TMT, Pathfinder measures visual scanning, number and letter sequencing, motor functioning, and the ability to systematically apply a novel organizing principle. This interpretation is supported by factor analytic studies and construct validity studies. PF Number, Letter, and Combined Speed loaded with SAT Arrow Direction Speed to form a visual scanning and sequencing factor. PF Speed measures also had high correlations with Parts A and B of the TMT and other measures of attention, including WAIS-R Digit Symbol, the PASAT, subtest IV of the BCT, the SSPT, and the SRT. Aviators with performance problems scored much worse than neurologic patients and normal aviators on PF Letter and Combined Speed. In cases where performance on the PF Combined measures is poor and performance on PF Number is relatively normal, the result may be interpreted as indicating a deficit in the systematic application of a novel sequencing rule or principle. In addition to measures of speed and accuracy, Pathfinder provides coordination scores that are based on how close the subject presses the light pen to the center of the target number or letter. In most cases, the two coordination scores (i.e., PF Number Coordination, and PF Combined Coordination) will be equivalent. The mean coordination score for each PF task was approximately 1.4 in the U.S. pilot normative sample. If the respondent shows a marked difference in coordination across forms, it suggests the possibility that motor functioning was perturbed by the cognitive demands of that particular form.

4. Shifting Attention Test

The Shifting Attention Test was designed to incorporate features of a number of different tests of executive function into a single computerized measure. The first three tasks, SAT Border Color, SAT Arrow Direction, and SAT Arrow Color, are primarily measures of visual scanning, perceptual speed, and reaction time. Reaction times are so short and the number of trials so few on the Border Color task, that the response speeds are considered unreliable. Consequently, measures are not derived from the Border Color task. Errors are rarely made on any of these three conditions, except by respondents who have failed to read the instructions. Performance on the SAT Arrow Direction, Arrow Color, and Instruction measures should be interpreted as indicating an individual's ability to learn and apply rules in a systematic manner. These SAT measures correlated with WAIS-R Digit Symbol, the PASAT, subtest IV of the BCT, the SSPT, the SRT, portions of the TPT, and the TMT. These measures were also correlated with several indexes from the WCST, including the percent of conceptual responses, the number of nonperseverative errors, and the number of trials needed to complete the first category. Individuals with brain dysfunction have been found to perform poorly on the SAT Arrow Color Speed and SAT Instruction Speed.

Performance on the SAT Discovery task should be interpreted as reflecting the individual's ability to form concepts or identify attributes. Performance on SAT Discovery Rule Shifts Completed correlated with general intelligence as well as with scores on the copy trial of

the CFT, subtests III and V from the BCT, the TPT, and the TMT. SAT Discovery Accuracy was also strongly correlated with performance on the WCST. Furthermore, SAT Discovery Accuracy was one of the measures that entered into the discriminant function equation that identified the presence of brain dysfunction.

5. Shifting Attention was ranked as highly aviation-relevant by pilots in the Phase C study. Pilots referred because of poor aviation performance obtained low scores on measures of concept formation (SAT Discovery Rule Shifts Completed, SAT Arrow Color Speed, and SAT Instruction Speed). Poor performance on the SAT Arrow Direction Thruput was one of the factors in the Russian study that discriminated optimal pilots from nonoptimal pilots. It is interesting to note that factor analysis showed SAT Arrow Direction measures to form a visual scanning factor along with PF Letter, PF Number, and PF Combined measures.

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