Neuropsychological Assessment

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Orientation and Attention

ORIENTATION

Orientation, the awareness of self in relation to one's surroundings, requires consistent and reliable integration of attention, perception, and memory. Impairment of particular perceptual or memory functions can lead to specific defects of orientation; more than mild or transient problems of attention or retention are likely to result in global impairment of orientation. Its dependence on the intactness and integration of so many different mental activities makes orientation exceedingly vulnerable to the effects of brain dysfunction.

Orientation defects are among the most frequent symptoms of brain disease, and of these, impaired awareness for time and place is the most common, accompanying brain disorders in which attention or retention is significantly affected. It is not difficult to understand the fragility of orientation for time and place, since each depends on both continuity of awareness and the translation of immediate experience into memories of sufficient duration to maintain awareness of one's ongoing history. Thus, impaired orientation for time and place typically occur with widespread cortical involvement (e.g., in Alzheimer-type dementia, acute brain syndromes, or bilateral cerebral lesions), lesions in the limbic system (e.g., Korsakoff's psychosis), or damage to the reticular activating system of the brain stem (e.g., disturbances of consciousness). However, when cognitive impairments or deficits in attention are relatively mild, orientation can still be intact. Thus, while impaired orientation, in itself, is strongly suggestive of cerebral dysfunction, good orientation is not evidence of cognitive or attentional competence (Varney and Shepherd, 1991).

Assessment of orientation for time, place, and person is generally covered in the mental status examination. Tests of specific facets of orientation are not ordinarily included in the formal neuropsychological examination. However, their use is indicated when lapses on an informal mental status examination call for a more thorough evaluation of the patient's orientation or when scores are needed for documenting the course of a condition or for research. For these purposes, a number of little tests and examination techniques are available.

Inquiry into the subject's orientation for time, place, and basic personal data such as name, age, and marital status is part of all formalized mental status examinations and most memory test batteries (e.g., General Information section of the Randt Memory Scales; Orientation section of The Rivermead Behavioural Memory Test; Orientation test of the Wechsler Memory Scales). Time orientation is usually covered by three or four items (e.g., day of week, date, month, year) and orientation for place by at least two (name of place where examination is being given, city it is in). In these formats, orientation items fit into scoring schemes such that, typically, if two or more of the five or seven time/place orientation items are failed, the score for that section of the test or battery falls into the *defective* range. Time, place, and person orientation can be quite natfor Part II. This device greatly facilitates the recording of this task since many patients move along quite rapidly, particularly on Part I. Dodrill evaluates the performance on the basis of the total time for Part I and the difference between the total time for Parts I and II (Part II minus Part I) (see Table 9–7). The time at which the patient is halfway through each part, when compared with the total time, indicates whether task familiarity and practice, or difficulty in maintaining a set or attention changes the performance rate. A more precise way of documenting response rate changes is to make a slash mark following the color-word named at the end of each minute.

COMPLEX ATTENTION

All visual perception tests require visual attention and concentration for successful performance. Visual search and visual scanning tests involve sustained, focused concentration and directed visual shifting as well (Farr et al., 1986). These tests have proven sensitivity to the cognitive impairments resulting from brain injury.

Persons unused to handling pencils and doing fine handwork under time pressure are at a disadvantage on these tests. The great importance that motor speed plays in the scoring, particularly below age 35, renders them of doubtful validity for many low-skilled manual workers and for anyone whose motor responses tend to be slow. They are particularly difficult for elderly subjects whose vision or visuomotor coordination is impaired or who have difficulty comprehending the instructions (Savage et al., 1973). Storandt's (1976) report that half of the total score value of Digit Symbol is contributed by copying speed alone is supported by Le Fever's (1985) finding that copying speed accounts for 72% of its variance. Thus the examiner needs to be sensitive to motor and manual agility problems when deciding to give these tests. However, I do give one and sometimes both of the symbol substitution tests to patients suspected of having visual perception or visual orientation problems whose defects might show up as rotations, simplification, or other distortions under the stress of this task. For example, I usually give a symbol substitution test to patients with known or suspected right hemisphere damage, particularly if it is right frontal, since these patients are most likely to make orientation errors, usually reversals.

Digit Symbol (D. Wechsler, 1944, 1955, 1981)

This symbol substitution task is printed in the WIS test booklet. It consists of four rows containing, in all, 100 small blank squares, each paired with a randomly assigned number from one to nine (see Fig. 9–11). Above these rows is a printed key that pairs each number with a different nonsense symbol. Following a practice trial on the first ten (WB or WAIS) or seven (WAIS-R) squares, the task is to fill in the blank spaces with the symbol that is paired to the number above the blank space as quickly as possible for 90 seconds. The score is the number of squares filled in correctly. Of all the WIS tests, this is the only one that I time

Table 9–7 Performance of Control and Epileptic Groups and Cutoff Scores on Dodrill's Modification of the Stroop Test

		Control Group (n = 50)	Epileptic Group (n = 50)	Cutoff Scores
Part I	Mean	84.76	115.12	93/94 sec
	SD	20.60	43.91	
Part II–Part I	Mean	123.04	194.68	150/151 sec
	SD	35.77	86.44	

From Dodrill, 1978c.

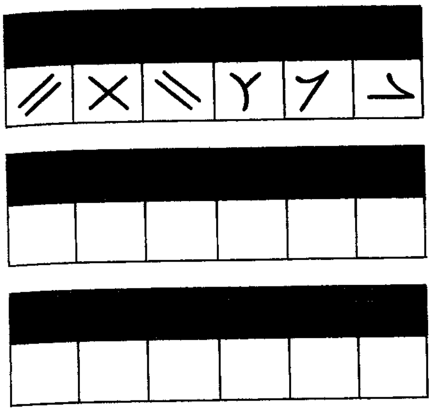

Fig. 9–11 The symbol-substitution format of the WIS Digit Symbol Test.

openly, for in this case the importance of speed must be stressed.

To make this test more interpretable when it is given to older persons or others who appear to be motorically slowed, Edith Kaplan, Fein, and their colleagues (1991; Milberg, Hebben, and Kaplan, 1986) have developed the *Symbol Copy* test, in which the subject simply copies the symbol above each empty square into that square, thus bypassing the visual search and shifting and the memory components of this test. In this manner, the Digit Symbol performance can be compared with a somewhat purer visuomotor task to allow evaluation of its more cognitive aspects. Dr. Kaplan and her colleagues also recommend that the examiner note how far the subject has gone at 30 sec and 60 sec as rate changes, particularly at the beginning or toward the end of the 90 sec trial, may indicate such performance problems as sluggishness in developing a set when beginning a new task, or very low fatigue or boredom thresholds.

A variety of format alterations are described in the literature, such as symbol sets in which the symbols are more or less familiar (e.g., arrow, diamond, or lambda) (Glosser, Butters, and Kaplan, 1977) or sets with fewer symbol pairs (Salthouse, 1978; Teng, Wimer, et al., 1989). Most have been developed with specific research questions in mind. Their clinical usefulness is limited because of a lack of adequate norms, although they may be applicable to specific cases. The variations on Digit Symbol provided by the *Repeatable Cognitive-Perceptual-Motor Battery* present a format in which the symbols are sufficiently similar to produce a correlation of .87 with the Wechsler format (Kelland et al., 1992). Comprehensive norms are provided by D'Elia, Boone, and Mitrushina (1995) and Heaton, Grant, and Matthews (1991). Norms for blue collar workers stratified by age are given by C. C. Ryan, Morrow, and their coworkers (1987).

Test characteristics. For most adults, Digit Symbol is a test of psychomotor performance that is relatively unaffected by intellectual prowess, memory, or learning (Erber et al., 1981; Glosser, Butters, and Kaplan, 1977; Murstein and Leipold, 1961). Motor persistence, sustained attention, response speed, and visuomotor coordination play important roles in a normal person's performance, but visual acuity does not (Schear and Sato, 1989). Estes (1974) points out that skill in encoding the symbol verbally also appears to contribute to success on this test, and may account for a consistently observed feminine superiority on symbol substitution tasks (e.g., A. Smith, 1967a; W. G. Snow and Weinstock, 1990). *Perceptual organization* components show up on this test (A. S. Kaufman, McLean, and Reynolds, 1991; Zillmer, Waechtler, et al., 1992); but a *selective attention* factor was most prominent for seizure patients (P. C. Fowler, Richards, et al., 1987). The natural response slowing that comes with age seems to be the most important variable contributing to the age differential on this test. Incidental memory is another component of this test (see pp. 463–465 for assessment procedures and evaluation).

Test-retest reliability tends to run high, with correlation coefficients in the .82 to .88 range (Matarazzo and Herman, 1984; Wechsler, 1981; Youngjohn et al., 1992) and remains at these levels or higher for older adults (J. J. Ryan, Paolo, and Brungardt, 1992; W. G. Snow, Tierney, et al., 1989). The level of test-retest reliability varies with different clinical populations, being very unstable for schizophrenics (.38) but at the normal adult level for patients with cerebrovascular disorders (G.

Goldstein and Watson, 1989). Practice effects in older (age 75+) subjects were negligible (J. J. Ryan, Paolo, and Brungardt, 1992). A small sample of younger (average age in the 30s) control subjects showed a 7% gain on retest following a 15-month interval (R. E. Miller et al., 1984), but 115 healthy subjects representing the full adult age range averaged only about a 5% gain with a three-week retest delay (Youngjohn et al., 1992). Yet no practice effects appeared when this test was given four times with intervals of one week to three months (McCaffrey, Ortega, and Haase, 1993).

Age effects are prominent (Jarvik, 1988; A. S. Kaufman, Reynolds, and McLean, 1989; Salthouse, 1978), showing up as early as the 30s (Wechsler, 1981) with raw scores dropping sharply after the age of 60 (Ivnik, Malec, Smith, et al., 1992b). Women consistently outperform men (A. S. Kaufman, McLean, and Reynolds, 1988; W. G. Snow and Weinstock, 1990). Storandt (1976) found no relationship between cognitive ability as measured by WAIS Vocabulary scores and Digit Symbol performances although Digit Symbol and the WAIS-R Vocabulary test were found to be related ($r = .50$). Education contributed significantly to performances by seizure patients (Kupke and Lewis, 1989). However, Digit Symbol correlations with other WAIS-R tests ranged from .44 to .21 (Wechsler, 1981), suggesting that mental ability does not contribute greatly to success on this test.

Neuropsychological findings. This test is consistently more sensitive to brain damage than other WIS battery tests in that its score is most likely to be depressed even when damage is minimal, and to be among the most depressed when other tests are affected as well. Because Digit Symbol tends to be affected regardless of the locus of the lesion, it is of little use for predicting the laterality of a lesion except for patients with hemi-inattention or a lateralized visual field cut, who may omit items or make more errors on the side of the test form opposite the side of the lesion (Egelko et al., 1988; E. Kaplan, Fein, et al., 1991; Zillmer, Waechtler, et al., 1992). Glucose metabolism shows a bilateral increase in posterior areas, right-sided more than left (Chase et al., 1984). Aphasics typically earn greatly lowered scores due to exceedingly slow but relatively error-free performances (Tissot et al., 1963). However, slowing mixed with caution does not warrant a diagnostic decision.

Digit Symbol's nonspecific sensitivity to brain dysfunction should not be surprising since it can be affected by so many different performance components (Butters and Cermak, 1976; Glosser, Butters, and Kaplan, 1977). Failures on this test may be the result of different factors or their interplay, or of a sore shoulder or stiff fingers.

This test is extremely sensitive to dementia, being one of the first tests to decline (Storandt and Hill, 1989) with little overlap with control subjects' scores; and it declines rapidly with disease progression (Botwinick, Storandt, and Berg, 1986; Larrabee, Largen, and Levin, 1985). L. Berg, Danziger, and their colleagues (1984) found Digit Symbol to be a good predictor of the rate at which dementia progresses. It is also one of the few WIS tests on which Huntington patients performed poorly before the disease became manifest (M. E. Strauss and Brandt, 1986). Lower scores distinguish patients with rapidly growing tumors from those whose tumors are slow-growing (Hom and Reitan, 1984). Digit Symbol performance is correlated with coma duration in head trauma patients (Correll et al., 1993; B. Wilson, Vizor, and Bryant, 1991) and tends to run below the other WIS performances in these patients (Crosson, Greene, et al., 1990). It is also likely to be the lowest WIS score for chronic alcoholics (W. R. Miller and Saucedo, 1983). Elderly depressed patients also perform slowly on Digit Symbol, making its use in the differential diagnosis of depression versus dementia questionable, except when a test of incidental memory for the digit-symbol pairs follows the Digit Symbol test (see pp. 463–465) (R. P. Hart, Kwentus, Wade, and Hamer, 1987).

Digit Symbol proved to be an effective measure of cognitive improvement in medically treated hypertensives (R. E. Miller et al., 1984). And again, the good news that for previously sedentary elderly persons, Digit Symbol scores improved significantly (an average of 6 raw score points) after aerobic training of three hours a week for four months (Dustman, Ruhling et al., 1984).

Symbol Digit Modalities Test (SDMT) (A. Smith, 1982)

This test preserves the substitution format of Wechsler's Digit Symbol test, but reverses the presentation of the material so that the symbols are printed and the numbers are written in (see Fig. 9–12). This not only enables the patient to respond with the more familiar act of number writing but also allows a spoken response trial. Both written and oral administrations of the SDMT should be given whenever possible to permit comparisons between the two response modalities. When, in accordance with the instructions the written administration is given first, the examiner can use the same sheet to record the patient's answers on the oral administration by writing them under the answer spaces. Neither order of presentation nor recency of the first administration appears to affect performance (A. Smith, personal communication). As with Digit Symbol, 90 sec are allowed for each trial; but there are 110 items, not 100. The written form of this substitution test also lends itself to group administration for rapid screening of many of the verbal and visual functions necessary for reading (A. Smith, 1975).

Test characteristics. The SDMT primarily assesses complex scanning and visual tracking (Shum et al., 1990) with the added advantage of providing a comparison between visuomotor and oral responses. Manual speed and agility contribute significantly to SDMT performance, but visual acuity is not an important factor (Schear and Sato, 1989). A significant performance decrement in one response modality relative to the other naturally points to a dysfunction of that modality. Glosser and her coworkers (1977) and Butters and Cermak (1976) compared symbol-substitution test formats that differed in familiarity of the symbols and in whether a digit or symbol response was required. All subjects, normal controls as well as brain damaged patients, performed both the familiar and unfamiliar digit response tests more slowly than those calling for symbol responses (e.g., Digit Symbol). This phenomenon was attributed, at least in part, to absence of an orderly sequence in the stimulus array.

The adult normative population was composed of 420 persons ranging in age from 18 to 74 (see Table 9–8). When applied to 100 patients with "confirmed and chronic" brain lesions, these norms correctly identified 86% of the patient group and 92% of the normal population, using a cutoff point of −1.5 standard deviations below the age norm (A. Smith, 1982). Smith considers scores below the 1.5 SD cutoff to be "indicative" and those between 1.0 and 1.5 SDs below the age norm to be "suggestive" of cerebral dysfunction. A −1.0 SD cutoff gives a somewhat high (9% to 15%) rate of false-positive cases (Rees, 1979). More complete norms are available in the test manual, which includes child norms, and in the compilation by D'Elia, Boone, and Mitrushina (1995).

The oral format can be particularly useful with patients whose attentional disorders tend

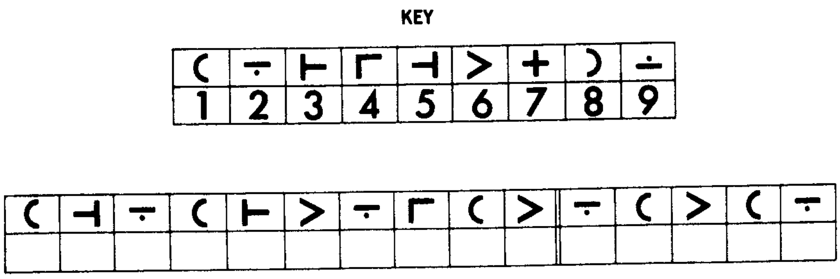

Fig. 9–12 The Symbol Digit Modalities Test (SDMT). (By Aaron Smith, Ph.D. © 1973 by Western Psychological Services. Reprinted by permission)