I.2 CNS Function and Assessment of Minor Dysfunction

Student to friend: “The human brain is amazing. The only time mine stops functioning is when I’m called on in class.”

Theories about learning disabilities have suggested possible dysfunctions in each of the major parts of the brain. For example, because the reticular formation, or reticular activating system, filters stimuli to the cerebrum, it has been suggested that some problems in attentiveness are due to cerebral over-stimulation caused by dysfunction in this system. However, because the majority of current theories about learning disabilities are concerned with cerebral cortex dysfunctioning, we will focus our brief discussion on this area of the CNS (see Feature 1).

Cerebral Cortex

Although the roles of the two hemispheres of the cerebral cortex differ, some functions of the body, such as vision and hearing, involve both sides of the brain. For instance, the left hemisphere receives stimuli from the right visual field of each eye, and the right hemisphere receives stimuli from the left visual field of each eye. Motor movements also involve both sides: movement on the right side of the body is controlled by the left hemisphere and vice versa.

For most people, the left hemisphere is primarily concerned with language functioning and analytic thought; the right hemisphere is primarily, although not exclusively, concerned with nonverbal functioning, and processes information as a whole. Functions related to most fine arts (drawing, music, dance) are associated with the right hemisphere. While the right hemisphere tends to have nonverbal functions, it apparently can assume some language functions. For example, if a child is born with a defect in the left hemisphere or if the left side is damaged before about age 12, the right hemisphere may take over language functions.

When the left hemisphere is damaged to the point where language is affected, learning and performance are subsequently affected (problems may arise with reading, writing, and verbal communicating). When the damage is in the right hemisphere, it affects spatial imagery (understanding math concepts and performing fine and industrial arts).

Each hemisphere has (1) four major regions (the temporal, frontal, parietal, and occipital lobes), (2) separators between the regions (such as the angular gyrus, the lateral sulcus), and (3) related association areas. Efforts to map out regions of the brain related to specific behaviors have pinpointed areas in the cortex responsible for certain functions. For example, the parietal lobe is associated with reading and writing, and dysfunctions in areas of this lobe are thought to engender specific learning disabilities in reading and writing.

References are included at the end of this reading for those interested in further information about brain function as it relates to learning disabilities.

Assessing Minor CNS Dysfunction

If a differential diagnosis is meant to identify learning disabilities that are caused by a neurological problem, it is necessary to show that the CNS dysfunction is minor. (If there is a severe neurological problem, other diagnoses, such as gross brain damage or cerebral palsy, are more appropriate.) Such a differential diagnosis requires valid measurement of specific indicators of minor neurological dysfunction or immaturity. Unfortunately, although major CNS dysfunctions usually are identified with relative ease, it is not so easy for minor ones. To explain why this is so, and to further exemplify the problems of differential diagnosis, we turn to a brief discussion of assessing minor neurological dysfunctioning in general, and the concept of “soft signs” in particular.

Neurological Soft Signs

In medicine, the term signs refers to objective evidence of disease, such as detection of a specific virus. When a sign is found, the illness can be diagnosed readily.

Since the late 1940s, it has become increasingly commonplace for practitioners to diagnose minor neurological dysfunctions by finding “soft signs.”
This trend has occurred because objective signs are not present for minor neurological dysfunctions. What are called soft signs (or sometimes equivocal, borderline, or ambiguous signs) are not signs at all; they are symptoms. For instance, in general medicine, symptoms, such as nausea and dizziness, are subjective and may occur along with many types of illness. They may be interpreted differently by different professionals. What professionals do agree about with regard to the behaviors called soft signs is that these symptoms resemble those seen in brain-damaged individuals (see Feature 2).

**Neuropsychological Assessment**

Assessment of neurological soft signs primarily involves tasks of motor and sensorimotor integration (see end of reading for references). Findings from this type of assessment can be differentiated from findings that are considered more direct indications

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**Feature 1  Major Areas of the Brain and Their Functions**

The brain and spinal cord are the two major components of the CNS. Brain activity is determined by the biological structure and electrochemical transmissions of the nervous system. The brain consists of the brain stem, cerebellum, and cerebral cortex (cerebrum). The functions associated with each are:

1. **brain stem**—integrates heart and breathing rates, regulates motor reflexes, and houses the reticular activating system, which instigates electrical activity in the cerebral cortex

2. **cerebellum**—coordinates the voluntary muscle system and is involved in controlling balance and coordinating muscle movement

3. **cerebral cortex**—controls all conscious activity. It consists of two halves, the left and right hemispheres, which have different functions but are almost the same in construction and metabolism. They are connected by the corpus callosum, a large group of fibers, which serves as the channel of communication between the two halves.

![Diagram of brain and spinal cord](https://example.com/diagram.png)

of brain status. For example, direct electrophysiological measures, such as the electroencephalogram (EEG), are useful in detecting gross brain dysfunctions. Unfortunately, such direct measures have had limited effectiveness in identifying minimal dysfunctions.

To improve assessment of CNS functioning, neuropsychological test batteries have been developed. These procedures attempt to go beyond assessing motor and sensorimotor integration by including measures of higher-level cognitive skills. With the rise in use of such batteries as standard ways to measure CNS dysfunction, there appears to be a tendency not only to expand the number and types

### Feature 2  Soft Signs

Of the many procedures that may be used in a standard neurological exam, two examples follow.

As one check of oculomotor functioning, the examiner holds a finger in front of the youngster's eyes and then slowly moves it into the peripheral vision area on one side of the head and then on the other. Those tested are instructed to follow the movement only with their eyes and not move their heads. Anyone over the age of 5 is supposed to be able to do this successfully. Anyone older who persists in moving his or her head is seen as responding abnormally. One such abnormal response is called nystagmus, which is a condition in which both eyes slowly drift toward the periphery and then suddenly snap back (Curtis, Jacobson, & Marcus, 1972).

As a check on tactile and kinesthetic perception, those tested are asked to close their eyes. The examiner then touches the child on the left hand, on the right hand and left side of the face, and on the left hand and right side of the face. After each touch, the youngster is asked to identify the place of stimulation. The sequence is repeated four times. Again, those over 5 are supposed to be able to identify such stimuli with no more than one error out of the 12 touches.

Neurologists, of course, use medical terms in referring to tests for soft signs. For example, the second test described above is known as the test for simultanagnosia. Other soft-sign tests look for choreiform movements, mild dysphasias, borderline hyperflexia and reflex asymmetries, finger agnosia, dysdiadochokinesis, graphesthesias, and so forth (Schain, 1972).

In using tests to detect soft signs, neurologists are looking for responses that are significantly, but not grossly, less than those expected for the age. The degree of performance deficit considered a problem, however, is not well established, and there is not yet a set number or pattern of soft signs that must be found before a diagnosis of learning disabilities can be made.

The logic behind the use of soft signs is reflected in a statement by William Gaddes in his 1985 book, Learning Disabilities and Brain Function: A Neuropsychological Approach:

> The confusion in defining MBD [Minimal Brain Dysfunction] stems from the common difficulty of identifying any borderline phenomenon. . . . Intense and localized brain damage in specific areas will produce predictable deficits in adult behavior. . . . As we move along the continuum toward normal brain structure and function, however, we pass through a large number of children and adults who are not "brain damaged" and who, for no known reason, show many behavioral deficits similar to the brain-damaged patients, but in a much less intense way. These behavioral impairments (e.g., visual reversals, poor finger location, asymmetry of finger tapping, and a-stereognosis) are the soft signs, and their presence suggests very strongly that the person's brain and central nervous system has some minimal areas of dysfunction, although a standard neurological examination may have turned up nothing. (pp. 84–85)

Reviewers of research on soft signs indicate major problems in using these measures as indicators of minor CNS dysfunctioning (Taylor & Fletcher, 1983). Current evidence suggests caution when such measures are used to diagnose learning disabilities.
of tests but also to expand the number of soft
signs.
In general, neuropsychological assessors at-
ttempt to measure
1. gross and fine motor coordination, including inte-
grated motor acts (such as tying shoes, button-
ing, placing the finger on the nose)
2. oculomotor functioning (such as eye-muscle con-
trol, relative diameter of the pupils)
3. postural control, gait, reflexes, and tremors (such
as walking a straight line on tiptoes without awk-
wardness)
4. auditory and visual perception and related cogni-
tive skills (such as recognition and discrimination
of stimuli, reproduction of rhythmic patterns, dis-
crimination of right and left, understanding and
following simple commands, ability to make sim-
ple generalizations and deductions)
5. tactile and kinesthetic perception (such as ability
to locate and discriminate sensations, movement
detection)
6. speech and language functioning (such as artic-
ulation, ability to repeat and initiate verbal re-
sponses)
7. memory (such as immediate recall of verbal and
nonverbal stimuli—with and without interference)
8. general looks and demeanor (such as physical
characteristics)
In addition, some degree of effort often is made to
assess basic skills in reading, writing, and arith-
metic.
What neuropsychological assessors are seeking
is any evidence of abnormal CNS functioning, in-
cluding performance below expected age level.
What they are measuring is overt behavior. When
the behavior is not up to expectation, the part of the
brain that is responsible for such behavior may not
be functioning appropriately. Such a conclusion is
likely to be most valid when other reasonable ex-
planations can be ruled out. It helps if it can be shown
that the behavior is not the result of psychological
and sociocultural factors (such as emotional dis-
turbance, or growing up in economically deprived
circumstances). Another problem involves age or
developmental expectations. For some of the behav-
iors being measured, there are disagreements
about the point at which performance falls below
what should be minimally expected of young chil-
dren, especially those under age 7.

Summing Up
Each day individuals are diagnosed as having learn-
ing disabilities. When the intent of the diagnosis is to
identify those whose current learning problems are
caused by CNS or psychological dysfunction, then
the diagnosis should be based on valid evidence of
such dysfunction. Unfortunately, despite the com-
pelling nature of the clues, current assessment pro-
cedures cannot always be relied upon to provide
conclusive evidence of such dysfunctions.

Currently, research is being directed at improving
methods to assess neurologically and psychologi-
cally based problems, and researchers remain opti-
mistic about a breakthrough. For example, there is
optimism about the promise of new devices for
studying the brain, especially those that use com-
puter technology (see Chapter 2).
While we await necessary advances in assess-
ment, efforts to diagnose the causes of learning dis-
abilities must proceed. Current regulations in the
United States acknowledge this. Thus, in identifying
those who should be diagnosed as having learning
disabilities, regulations stress criteria related to se-
vere underachievement and developmental immatu-
rety, rather than focusing on CNS and psychologi-
cal dysfunction. That is, present practices look more
at symptoms than at causes in pursuing procedures
for screening, placement, and correction. These
practices were discussed in Chapter 3.

Further Readings
Should you be interested in further information
about brain function and assessment as related to
learning disabilities, see the following.
and the brain. Chicago: National Society for the
Study of Education.
Few CT scan abnormalities found even in neuro-
logically impaired LD children. Journal of Learning
Disabilities, 18, 132–35.
Gaddes, W. H. (1985). Learning disabilities and
brain function: A neuropsychological approach.
New York: Springer-Verlag.


