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THE PROBLEM OF ASSESSING EXECUTIVE FUNCTIONS

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The capacities for formulating goals, planning, and carrying out plans effectively – the executive functions – are essential for independent, creative, and socially constructive behavior. Although they tend to be vulnerable to brain impairment, they are often overlooked in neuropsychological and neurological examinations. Reasons why there are few formalized examination procedures for evaluating executive functions are suggested. Prefrontal contributions and the importance of other brain areas (e.g., subcortical, right hemisphere) to executive functions are discussed. Assessment techniques are presented for evaluating four categories of executive capacities: (1) goal formulation, (2) planning, (3) carrying out goal-directed plans, and (4) effective performance. The Tinkertoy Test®, which can provide information about these capacities, is described in some detail. Need for further exploration in this area is emphasized.

The executive functions comprise those mental capacities necessary for formulating goals, planning how to achieve them, and carrying out the plans effectively. They are at the heart of all socially useful, personally enhancing, constructive, and creative activities. With the executive functions intact, a person can suffer many different kinds and combinations of sensory, motor, and cognitive deficits and still maintain the direction of his own life and be productive as well. Impairment or loss of these functions compromises a person's capacity to maintain an independent, constructively self-serving, and socially productive life no matter how well he can see and hear, walk and talk, and perform tests.

Yet crucial as the executive functions are for normal behavior, there are not many assessment methods generally available for examining them. With few exceptions we do not have standardized methods for making objective or reliably replicable estimates of gradations of impairment of these functions, for example, or for making intra- and interindividual comparisons. Without assessment techniques that can

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be standardized and that can produce data subject to statistical analysis, much of our understanding of executive functions will remain at an anecdotal level.

The assessment of cognitive functions offers a striking contrast. We have tools for identifying and making fine discriminations between the various cognitive functions that enable us to describe the neuropsychological correlates of a number of neurological disorders in terms of patterns of intellectual strengths and deficits (e.g., Russell 1979; Fuld 1978; Gainotti et al. 1980; McFie 1975), to analyze the components of many cognitive functions (e.g., Cohen 1957a, b; Guilford 1967; Milner 1974), and that give us agreed-upon words and concepts for discussing cognitive phenomena.

A look at some of the important differences between executive and cognitive functions may help us appreciate why systematic measurement of the executive functions has lagged so far behind. It also may suggest some techniques for measuring executive functions and some dimensions that could be assessed.

One distinction between cognitive and executive functions lies in the kinds of question each class of functions calls for. Cognitive functions concern what and how much knowledge, skill, and intellectual equipment a person may possess. When assessing cognitive functions for neuropsychological purposes we ask such questions as "What are the patient's intellectual strengths and weaknesses?", "What abilities have remained intact or are particularly well-developed or deteriorated?", and "How well can he perform this task compared to that?" Executive functions have to do with *how* a person goes about doing something or *whether* he does it at all. Questions dealing with executive functions ask how well the patient maintains a performance rate, how consistently and effectively he self-corrects, how responsive is he to changes in the demands of the task, or does he start and stop activities by himself and if so, how appropriately, and so on.

Our habits of conceptualizing and observing behavior are much more suited to dealing with questions of cognitive deficits than impaired executive functions. The familiar three-dimensional classification scheme for cognitive functions enables us to analyze a person's intellectual behavior in terms of verbal and configural components; sensory modalities; perceptual, response, memory, or concept formation and reasoning activities. Using this scheme, we can make fine discriminations between different kinds of aphasic disturbances, of perceptual disorders, or of defects in reading, writing, or arithmetic for example. On the other hand, executive defects tend to be *supramodal*, affecting the expression of all aspects of behavior. Thus, with the exception of severe forms of pathological inertia, a condition in which the alert, fully sentient and motorically capable patient initiates no behavior and exhibits no interest, defects in executive functions are not readily observable in themselves and so rarely become self-evident. Moreover, lacking a formalized scheme for classifying the executive functions, our observations tend to be haphazard and our thinking about them tends to be unsystematic.

Furthermore, unlike cognitive functions that can be readily elicited in the formal examination setting, the structure of the usual neurological or psychological examination makes it very difficult, if not impossible, to observe some of the most important executive functions, such as initiation of complex goal-directed activity, planning such activity, or carrying out one's plans. The examiner who wants to observe these aspects of executive behavior is in a logically absurd position, for by its very nature the examination places the subject within a structured situation in which the examiner dictates what the subject is to do, with what, and when. The examiner who observes the patient only in a formal examination using only standard neurological or psychological techniques may see what he calls "disinterest", "carelessness", or "impulsivity" on the part of the patient but be unable to appreciate when these are symptoms of an impaired capacity for self-regulation and control that compromises all aspects of the patient's behavior, rather than simply evidence of negativistic or regressive personality traits. Unless the patient demonstrates frank cognitive defects, even the examiner who pays attention to the qualitative aspects of the patient's test performance may be as ignorant about the patient's capacity to take care of himself and be productive in the real world at the end of a formal examination as he was at its beginning.

Although executive functions are part and parcel of everything we do – perhaps because executive functions are part and parcel of everything we do – relatively few clinicians who deal with brain damaged patients address this dimension of behavior in their evaluations or their recommendations for care or treatment. Many simply do not seem to appreciate the importance of the executive functions or the psychosocial incapacitation that can result from their impairments. Those who do not observe the patient in situations in which he must act on his own behalf may not be aware that something is missing from the patient's behavioral repertoire.

This aspect of the problem of assesssing executive functions was demonstrated by Hebb who found that loss of even considerable amounts of frontal lobe tissue had little effect on the scores patients earned on many highly structured tests of cognitive knowledge and skills (1942). In reporting his examination of a near-blind 15-year-old following surgical removal of between 40 to 50% of his right hemissphere and 20% of the left due to multiple abscesses Hebb noted that on most of the tests he gave (excluding those that required vision), his patient performed well within the expected range for a young man of his age, and better than expected on recall of digits forward and backward. Hebb concluded that the patient had "unusually good retention of subjective clarity, responsiveness, memory, and apparent coherence of thought processes". He described the patient's psychological status as "exceptionally good", basing this in part on his observation that the young man "seemed normally alert and responsive, and quite cooperative'. Yet Hebb made nothing of his observation of the patient's "inactivity, and apparent willingness to do nothing for rather long periods", an observation that suggests seriously impaired executive functions with a probable future of chronic social dependency.

The most refined and thoughtful observations and formulations concerning the nature of impaired executive functions have been made of patients with frontal lobe damage (Damasio 1979; Hécaen and Albert 1978; Luria 1966, 1973; Seron 1978). As a rule, patients who have had significant injury or disease of the prefrontal region of the brain, particularly if the orbital or medial regions have been damaged, undergo behavioral and personality changes that prevent them from conducting their lives in a normal, socially responsible manner. Those with mild injuries may experience changes in drive, in the intensity, stability, or flexibility of response, or in social sensitivity that diminishes their capacity to function as fully and interact socially as they once had. Since many of the most handicapping changes these patients undergo involve one or more of their executive capacities, executive functions generally have been ascribed to the frontal lobes.

However, damage to other areas of the brain can also interfere with executive functions. Such deficits are part of the clinical picture of many disorders involving subcortical regions, particularly when limbic structures are involved, as can be the case in anoxic conditions (Falicki and Sep-Kowalik 1969; Jefferson 1976; Muramoto et al. 1979; Pillon et al. 1977); and may be suspected as a result of inhalation of organic solvents (Arlien-Søborg et al. 1979; Gregersen et al. 1978; Tsushima and Towne 1977). Korsakoff patients, whose lesions primarily involve thalamic nuclei and other subcortical components of the limbic system, suffer profound disturbances of executive functions. Despite good retention of both well-learned skills and information and the mental and physical capacity to perform at least all the activities of normal daily living, many of these patients are virtually immobilized by apathy and inertia. The decreased flexibility in regulating movements that many patients with Parkinson's disease experience is not always confined to motor behavior but may be reflected in diminished conceptual flexibility too (Bowen 1976; Albert 1978). Some Parkinson patients display impaired initiative and spontaneity as well. Another group of patients whose executive capacities may be impaired are those with right hemisphere damage (Lezak 1979). Many of these are patients who "talk a good game" and are neither inert or apathetic. Yet they may not be much more active or productive than Korsakoff patients or those with extensive frontal lobe damage. Their ineffectiveness appears to be due to inability to conceptualize all elements of a plan, or to organize all the facets of an activity in an integrated manner so that they are unable to carry out their intentions.

The definition of the executive functions given at the beginning of this paper provides a framework for conceptualizing them in terms of four major classes or functional categories of executive capacities. These are (1) capacities necessary for formulating goals; (2) capacities involved in planning; (3) capacities having to do with carrying out plans to reach the goals; and (4) capacities for performing these activities effectively. These classes involve distinctive sets of behavior. All are necessary for appropriate, socially responsible, and effectively self-serving adult conduct.

The system of executive functions can break down at any stage in the sequence of behavioral events that make up a planned or intentional action. Examination of the four classes of executive capacities by means of interview and observation and by tests and improvised assessment techniques will usually bring to light executive dysfunctions that may not have become evident in the usual clinical examination.

Following is a review of the four classes of executive capacities, of examination techniques that can be useful in identifying some of the ways in which executive functions break down and showing how such breakdowns interfere with the normal expression of behavior. This review is intended to be illustrative and provocative; it is far from exhaustive. I hope that others can use it as a point of departure for their own explorations into this most subtle and most central realm of human activity.

1. Goal formulation

The capacity to formulate a goal, or to have an intention, is bound up with motivation and with awareness of self and how one's surroundings impinge on oneself. Goal-directed motivation differs from the simple arousal states that spur infants, impulsive adults, and subhuman animals. Simple arousal states lead automatically to reactive or instinctive activity. In contrast, persons capable of goal formulation not only can conceptualize their needs and desires before acting upon them but can entertain motives that may be far removed from organismic drive states and much more complex than are impulsive acts or automatic responses to physiological needs or environmental stimuli. The ability to create motives out of past experiences, out of an appreciation of physically or temporally distant needs, or out of one's imagination requires self-awareness at a number of levels including awareness of internal states, an experiential sense of self, and self-consciousness vis-à-vis the social and objective environment. It also requires the ability to identify those aspects of one's surroundings that may have personal relevance.

Persons who lack capacity to formulate goals for themselves may be unable to initiate activities excepting elementary responses to internal stimuli such as bladder pressure, or to external stimuli, such as scratching at a mosquito. It simply does not occur to them to do anything. In extreme cases, persons fully capable of complex activities, such as using table utensils in the socially prescribed manner, may not eat what is set before them without continuing explicit direction and guidance. Less impaired persons may eat or drink what they see but even when hungry will not seek nourishment spontaneously.

A surgeon who suffered cardiac arrest with secondary hypoxia during minor elective surgery drives a delivery truck for his cousin's business. He can make deliveries anywhere within his home town so long as he has explicit instructions about where to go and what to do, but he is unable to handle unexpected situations. When the family he lives with occasionally leaves him alone on a weekend, he may go for as long as two days without eating or drinking anything that requires even minimal search or preparation, although he can make coffee and simple meals when reminded.

Patients who are only mildly impaired may be able to do household chores and engage in familiar hobbies or games without prompting but cannot resume premorbid responsibilities that require appreciation of long-term or abstract goals, or take on new activities by themselves. Without direction, once they have completed their routine activities, they may wander aimlessly or just sit, typically in front of the television or at a neighborhood bar or coffee shop.

Reports by the patient's caretakers, family, and others who may see him in the normal course of day-to-day livng are the best sources of information about a patient's emotionality and motivational capacity. In the examination situation, the examiner should ask the patient about his likes and dislikes, what he enjoys doing and what makes him angry. Most patients whose capacity for motivation is impaired are affectively flat and do not appear to have strong feelings about anything. When these patients give a lively and descriptive answer to inquiries about hobbies or sports, further questioning will usually discover that the patient is reporting premorbid activities which he no longer pursues. The surgeon described above reported an interest in hunting and fishing in the Canadian north woods. Skeptical, I asked, "When did you last go hunting in Canada?" I was not surprised to learn that he was reporting what he had done seven years before although he talked about hunting as if he had just returned from the north woods yesterday.

Awareness of self and surroundings, too, is best evaluated by means of observation and report. Lack of self-consciousness, as manifested in disinterest in appearance and unconcern about childish or crude behavior, reflects impaired self-awareness in once socially functional adults. The surgeon again provides an example. He had been a stylish bachelor but, seven years after the cardiac arrest, was still not buying his own clothes nor did he realize when he needed new ones. He wears what is put out for him and only changes clothes when told.

Questions about the time of day or the season of the year can test not only the patient's orientation but his ability to use environmental cues spontaneously.

On a cold and blustery April 1, I asked a 68-year-old outpatient suffering from moderately advanced multi-infarct dementia what the date was. Although he had just come in from outside – on later questioning he described the weather accurately – and sat facing the window where he could see a bare-branched tree, he unhesitatingly gave the date as "July 1".

The Stanford-Binet scales (Terman and Merrill 1973) contain several items which also test the patient's ability to use cues to interpret a situation. In "Problems of Fact", the patient is told that first a doctor, then a lawyer, and then a priest were seen going into a house. The patient is asked, "What do you think is happening there?" The patient's ability to infer a story from a picture also may reflect on how well he can make sense out of his perceptions. The Cookie Jar picture from the Boston Diagnostic Aphasia Examination (Goodglass and Kaplan 1972) is an excellent one for this purpose because it is a simple line drawing of a number of familiar character types (e.g., mother, mischievous boy) engaged in familiar activities in a familiar setting. The subject can devise a single, integrated story that shows he takes account of the important elements in the picture; he can simply describe the picture on a piecemeal basis which raises questions about his ability to integrate what he sees; or he may talk about only one or two items. In disregarding the rest of the picture he may be demonstrating an impaired capacity to attend systematically to what he sees.

2. Planning

Several capacities are necessary for planning. Not least of these is the capacity for sustained attention. In order to plan, a person must also be able to deal objectively with himself in relation to the environment, and to view the environment objectively, i.e., to take the abstract attitude (Walsh 1978b). Planning also requires the abilities to think of alternatives, to weigh and make choices, and to evolve a conceptual framework or structure which can serve to direct activity.

Defective planning can be identified in patients who have no difficulty formulating goals but lose track of their intentions or activities, do not generate plans, or come up with plans that are unrealistic if not simply silly. It also appears, often in a more subtle manner, in a patient's inability to create a conceptual structure which can give him the blueprint and time schedule, so to speak, for carrying out a plan.

These patients may be well energized and prepared to engage in all kinds of activities but remain virtually immobilized by their inability to plan. Impulsivity also interferes with planning activity. Far from being immobilized, impulsive patients tend to act out, but their acting-out behavior is neither self-serving nor productive.

Again, questioning can bring out defective planning. I usually ask patients what they plan to do when they leave the hospital, where they plan to go and how they plan to get there. If they are vague, I press them for details. However, when asked about familiar activities, a patient can sound good when in reality he performs poorly. Here, too, reports from other observers can be invaluable.

A 35-year old mechanic who had sustained a head injury in a 15-foot fall had not returned to work in the three years since the accident. In a compensation examination he reported that he prepares dinner on the days his wife works. When asked to describe a sample menu, he gave one and included some alternatives, which sounded reasonable. He also indicated that he did the shopping. When I later asked his wife about his cooking, she explained that he accompanies her when she shops and that he always prepares the identical meal exactly the way she had taught him.

Several tests have been widely employed in the examination of planning ability. The Porteus Mazes (Lezak 1976; Walsh 1978a, b) have probably had the most extensive use for this purpose. They were designed to examine processes involved in "choosing, trying, and rejecting or adopting alternative courses of conduct or thought" (Porteus 1959) and have a proven sensitivity to frontal lobe damage (Smith 1960). Rey's Complex Figure Test (Lezak 1976; Messerli et al. 1979; Rey 1941) also elicits planning behavior. Osterrieth's (1944) analysis of approaches to copying the complex figure provides standards for evaluating how systematic is the patient's response to this task. A haphazard or fragmented mode of response may implicate poor planning. The task of copying all nine Bender-Gestalt designs on one page is excellent for enabling the examiner to observe whether and how well the patient plans the layout of his drawings on the page (Lezak 1976). The Bender is also more likely to elicit structure-dependent behavior than most tests used in neuropsychological assessment because it offers the subject no guidelines, only a blank sheet of paper. The structure-dependent patient may ask what to do (e.g., "Where should I put the design?", "Should I count the dots?"), or may simply seek structure by lining his drawings along the paper's edge or by hanging one drawing on another.

3. Carrying out activities

The translation of an intention or plan into self-serving, productive activity requires the capacities to initiate, maintain, switch, and stop sequences of complex behavior in an orderly and integrated manner. Luria's (1966, 1973) depiction of normal activity as the product of organized *behavioral programs* provides a conceptual framework for studying normal purposive behavior and for understanding the disruptions of purposive behavior that occur with certain kinds of brain damage.

Disorders in the programming of activity can interfere with a person's ability to carry out reasonable plans regardless of motivation, knowledgeableness, or skill level. They typically thwart intentional activity but may not interfere with impulsive actions. The patient who is immobilized by these disabilities may be puzzled and dismayed at himself as well. He may display a marked dissociation between his verbalized intentions and plans and his actions.

A 22-year-old man who had successfully completed two years of college before sustaining a severe head injury in a motor vehicle accident wanted to leave his parents' home and live in his own apartment. He knew what was needed to make the move, continued to talk and pester his parents about it, but was unable to undertake even the simple step of walking to apartment buildings in his neighborhood to make inquiries.

At the level of discrete motor activity, these programming disorders can show up in perseverations, impersistence, or discontinuities that interrupt the normal course of sequentially organized activities such as writing, drawing, or speaking. Some persons who are unable to begin or carry out large-scale purposive activities can perform discrete behavioral sequences quite normally. However, when disorders of motor programming affect discrete activities, usually the patient also has difficulty carrying out purposive behavior.

A programming breakdown at the level of discrete activity may become evident in the patient's speech, or any other kind of intentional performance. Generally, the more open-ended and unstructured the task, the more likely will impairments in programming become evident. Thus, tests of verbal fluency (Lezak 1976), free writing or drawing can be used to assess the patient's capacity to produce, maintain, and stop an intended series of responses at will. The ability to shift responses can be examined at the motor level by having the patient copy and maintain patterns of alternating hand movements, write letter series such as *mnmnmn* in script, or draw alternating geometric figures in series (see Christensen 1979; Luria 1966, 1973 for examples). A number of tests have been devised for assessing the capacity to shift at a conceptual level (Lezak 1976). One of the most interesting and illuminating of these is the Wisconsin Card Sorting Test (Milner 1964; Teuber et al. 1951) which calls upon simple concept formation ability and – to some extent – immediate memory as well as the capacity for conceptual flexibility.

Breakdown in the capacity to carry out purposive behavior is often not seen in the usual structured examination because traditional examinations rarely give the patient an opportunity to do much more than what he is told to do. In order to put executive responsibility in the patient's hands so it could be subjected to a standardized examination with reliably objective scoring, I have been asking patients to "make whatever you want" with 50 Tinkertoy® pieces (see table 1). Tinkertoys are children's play materials consisting of brightly colored wood and plastic knobs, dowels, and connecting pieces of varying sizes that can be combined into many different constructions with a minimum of effort in five or ten minutes at most. Most patients enjoy the task and do not seem to feel that it is beneath their dignity. On completion of a construction, I ask the patient to tell me what it is.

The Tinkertoy constructions of 35 unselected patients and of a group of ten normal control subjects were scored for number of pieces used (*np*) and also given a "complexity" score (*comp*) based on seven construction variables (see table 2). On the basis of history, records, or family interviews, 18 patients who required total support and supervision were classified as Dependent (D), and 17 were classified as Not Dependent (ND) because they all could manage daily routines on their own and five of them were capable of working independently. The two patients groups did not differ in age, education, or their scores on the Information subtest of the WAIS (Lezak 1980). The control subjects were younger and better educated than the patients.

Both the *np* and *comp* scores differentiated the constructions of the three groups (see table 3). Moreover, with a single exception, Dependent patients used less than 23 pieces, those who were Not Dependent used 23 or more, and half of the control group used all 50 pieces. The *np* and *comp* scores of the 19 patients who had age-graded scaled scores of 10 or higher on the WAIS Information or Block Design subtests

Table 1
Items used in the Tinkertoy Test.

Wooden dowels			Wooden rounds		Plastic pieces	
Green	(18.9 cm)	4	Knobs	10	Connectors	4
Red	(12.6 cm)	4	Wheels	4	Caps	4
Blue	(8.3 cm)	4			Points	4
Yellow	(5.3 cm)	6				
Orange	(3.2 cm)	6				

were also compared to see whether the differences between the patient and control groups might be due to cognitive deficits. This comparison yielded significant differences between the groups on both the *np* ($t = 3.58$, $df = 27$, $p < 0.01$) and the *comp* ($t = 4.58$, $df = 27$, $p < 0.001$) scores. The lower Tinkertoy Test scores of the patients whose cognitive performances were relatively intact suggest that this test measures more than cognitive abilities. Moreover, patients with high Block Design scores (nine or better) and those with Block Design scores of eight or less did not differ significantly in tendencies to achieve high or low *np* scores (30 or more, 29 or less) using Fisher's exact probabilities test (Finney et al. 1963). These data suggest that level of performance on the Tinkertoy Test is not dependent on constructional ability.

Table 2
Scoring for complexity.

Variable	Scoring criteria	Total possible
np	$n \geq 20 = 1$, $\geq 30 = 2$, $\geq 40 = 3$, $= 50 = 4$	4
name	$+ = 1$	1
mov	mobile = 1, moving parts = 1	2
sym	$\times 2 = 1$, $\times 4 = 2$	2
3d	3-dimensional = 1	1
stand	free-standing = 1	1
made construction(s)	any combination of pieces = 1	1
error	one or more error	−1
Highest score possible		12
Lowest score possible		−1

Table 3
Comparisons between groups on *np* and complexity scores.

Measure	Group			
	Patient		Control	
	Dependent	Non-dependent		F
np				
Mean (*S.D.*)	13.5 (9.46)	30.24 (11.32)	42.2 (10.03)	26.91[a]
Range	0 to 42	9 to 50	23 to 50	
Complexity				
Mean (*S.D.*)	2.22 (2.10)	5.47 (1.77)	7.8 (1.99)	28.27[a]
Range	−1 to 8	2 to 9	5 to 12	

[a] One-way ANOVA, $p < 0.001$

High scoring constructions appeared to involve a number of executive functions, including capacities to formulate a goal and plan as well as initiate and carry out complex activity in pursuit of that goal. There has not yet been adequate opportunity to investigate whether this examination technique may be used to pinpoint the nature of the defects of poorly executed constructions. However, these early observations suggest that patients who have difficulty initiating or carrying out purposive activities tend to use relatively few pieces although they may make a recognizable and appropriately named construction. Those whose deficits are in formulating goals or planning may use relatively more pieces but their constructions are more likely to be unnamed or inappropriate for their names. Patients with extensive impairment involving all aspects of the executive functions use very few pieces to make unnamed or unplanned constructions or to pile pieces together without attempting to combine any. Patients who are pathologically inert usually can be coaxed into responding to at least some standard test items but are most likely to do nothing at all with the open-ended task of Tinkertoy construction.

4. Effective performance

The effectiveness of behavior depends on the performer's ability to monitor, to self-correct, and to regulate the tempo, intensity, and other qualitative aspects of delivery.

Erratic performance is one of the hallmarks of impaired executive functions. It is also a common phenomenon among brain-damaged patients since the integrity of self-correcting and self-monitoring abilities is vulnerable to many different kinds of brain damage. Some patients do not perceive their mistakes and therefore cannot correct them. More interesting are those patients with pathological inertia who perceive their errors, may even point them out and talk about them, but still do nothing to change them. Self-monitoring defects can compromise the worthiness of any kind of performance, from pushing buttons through button holes so forcibly that they tear off, to unpunctuated monotonic speech, to cramped writing that leaves little or no space between words and wanders far from the horizontal.

Assessment of these capacities usually depends upon the observer's sensitivity to them. Scores alone do not tell about the presence or nature of errors and whether the patient was aware of them or tried to correct any of them. Nor do scores reveal performance idiosyncracies that may not lower the number of points earned on a test but, as in the case of cramped writing, could reduce the patient's effectiveness. The examiner can only learn about the patient's effectiveness by watching and listening to him and inspecting his products.

Constructional or drawing tasks in which more of the solution process is overt than is the case with tasks calling for a verbal response can be particularly instructive in bringing to light how the patient errs, self-corrects or not, and monitors his performance. Walsh (1978a) has developed an electrically activated maze, the Austin Maze, to study self-correcting behavior. This test requires the subject to learn a long pathway through a series of buttons that light up green for correct steps and red for incorrect steps along the pathway. Initially, the maze must be traversed by trial and error. The subject's goal is to go through the pathway without any errors, i.e., learn the maze. This device enables the examiner to observe the patient as he works to reduce errors. Observation and comparisons with the patient's performance on learning tests help the examiner determine whether poor performance is due to learning or to executive disabilities.

* * *

Over the last decade in particular, the goals of clinical neuropsychologists have evolved from simply being able to identify the presence of brain damage to understanding the behavioral correlates of brain dysfunction and of brain-behavior relationships generally. The relatively recent upsurge of concern about the often tragic psychosocial consequences of brain damage and what role neuropsychology can play to ameliorate them reflects the continuing maturation of our discipline. As we increasingly come to appreciate that the brain functions we study are always the functions of *somebody's* brain and that that somebody has a life outside of our examining rooms and laboratories, we also become increasingly aware of how disorders of the executive functions debase the quality of the patient's life and the lives of the persons around him. I anticipate that the psychosocial problems attendant upon impaired executive functions will soon become a major concern for neuropsychologists. I suspect that the intractable nature of executive dysfunctions will keep them on our center stage for a long time to come.

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Etre capable de formuler des buts, élaborer des plans et les exécuter effectivement sont "les fonctions exécutives" essentielles à l'existence de conduites autonomes, créatives et socialement constructives. Bien que ces fonctions soient vulnérables en cas d'atteintes cérébrales, elles sont souvent négligées dans les examens neurologiques et neuropsychologiques. Les raisons de cette carence au niveau de l'évaluation formelle sont évoquées. La contribution des aires préfrontales et d'autres aires cérébrales (par ex. les structures souscorticales, hémisphériques droites) aux "fonctions exécutives" est également discutée. On présente des procédés d'évaluation pour quatre catégories de capacités exécutives: (1) la formulation d'un but; (2) la planification de l'action; (3) l'exécution orientée du plan; et (4) la performance effectivement réalisée.On décrit en outre et en détail le Tinkertoy test®, qui semble capable de fournir des informations en relation avec ces capacités. Enfin, la nécessité d'explorations futures dans ce domaine est soulignée.