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# Developmental and Cross-Cultural Issues in the Assessment of Attention and Executive Functions

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This paper stresses the need to assess various aspects of attention and frontal/executive functions that are often not sufficiently emphasized in the practice of clinical neuropsychology, yet are a critical component to any educational or rehabilitation intervention. A review of such functions with an emphasis on providing a developmental and cross-cultural context to their evaluation is offered.

# Aspectos Evolutivos y Trans- Culturales en la Evaluación de la Atención y de las Funciones Ejecutivas

En este artículo se pone de relive la necesidad de evaluar aspectos de la atención y de funciones frontales/ejecutivas no suficientemente enfatizadas en la práctica de la neuropsicología clínica, y que no obstante son esenciales para toda intervención educativa o rehabilitativa. Se hace un repaso de esas funciones subrayando la relevancia de considerar el contexto evolutivo y transcultural.

While it is generally agreed that attentional and executive functions are central to all cognitive activity, they have not been sufficiently emphasized or assessed in clinical neuropsychological settings. In addition, the impact of cultural as well as developmental factors on these functions needs far more consideration. In this paper an introduction to basic attentional variables and tools now available to clinicians, that will enable them to undertake a more through assessment of these variables, is provided, together with some thoughts on the relationship and inter-dependence between attentional and executive functions. It is hoped that clinicians, having acquainted themselves with theoretical formulations and assessment tools to investigate these functions, will incorporate them into their clinical practice.

Whereas many excellent studies of attention in children (and adults) and its various electrophysiological and behavioral correlates have been reported (e.g., Luria 1973; Cooley & Morris, 1990; Mirsky, Anthony, Duncan, Ahern, & Kellam, 1991; Cohen, 1993), in practice many clinical reports appear to limit the assessment of attention to digit span and/or observations concerning inter- or intra-task variability (or lack thereof). In the past, one could have

argued that limited availability of clinical instruments that measure different aspects of attention has been partly to blame. Clinicians either did not have access to the necessary experimental apparatus, or the instrumentation required (e.g., tachistoscopes, mainframe computers) was impractical for use in the majority of clinical settings. Given the current availability of compact, reasonably priced and user-friendly computers and sophisticated programs, along with other assessment instruments, it is somewhat puzzling that many neuropsychological assessments and interventions fall short of an adequate treatment of attentional functions. An explanation may be that clinicians often lack the background to understand the various components of these complex functions, and thus fail to explore these critical aspects of performance. This area of study is indeed a complex one and may appear daunting.

In this paper, a brief review of key variables in the assessment of attention is offered; this is meant to provide the guidelines for a process analysis of test data that will hopefully assist the clinician in redressing the current limitations in the assessment of attention and executive functions. Towards the end of this paper a number of currently available instruments that allow for the assessment of various aspects of attentional and executive functions (e.g., reaction and completion times, omissions and commissions, and other scores) are described. Newly available and exciting tools that assess executive functions from a developmental perspective and provide normative data for children and adults (e.g., the NEPSY, the BRIEF, and the D-KEFS, described below) are also reviewed.

Attention and executive functions are complex and a full analysis is beyond the scope of this paper. Emphasis is placed instead on a discussion of how activation and different components of attention can be readily assessed in the clinical setting, the relationship of different aspects of attention to executive functions, and the potential impact of cross-cultural variables. While some empirical work is available on the latter, this is an area that is sorely in need of research.

The next sections of this paper will therefore address (a) a brief overview of how components of attention have been described in a few influential models, (b) a discussion of five identified components of attention, simple measures that are used to assess these components and their relationship to executive functions, and (c) a discussion of the extent to which cultural and developmental influences have been incorporated into the study of attention, along with suggestions for future research. Finally, a brief review of select

tests that measure aspects of the functions of arousal, attention, and executive functions is provided.

## Models of Attention

Numerous animal and human studies have addressed specific aspects of this area of cognition, and various integrated models have been put forth in an attempt to offer a theoretical account of those findings (see Cohen, 1993, for a review.). Theories that have sought to integrate findings from both cognitive laboratories and the study of clinical populations concur in viewing attention as the confluence of a number of separate but inter-related aspects of a neural network (e.g., Luria 1973; Mesulam, 1985). Importantly, the various components of activation and attention are viewed as the necessary *foundation* on which all other cognitive functions rest. Thus no assessment is really adequate without a detailed evaluation of activation, attention, and executive functions. Furthermore, there is evidence that cultural factors, in *addition* to developmental and demographic variables, need to be considered.

Theorists of attention have held varying views regarding ways to parse the components of attention. Posner & Petersen (1990), for example, posited three attentional brain subnetworks (frontal, posterior, and subcortical-frontal) that correspond to the functions of orienting, detecting signals, and maintaining vigilance. Mirsky and his associates (1991, 1996), on the other hand, have gone from positing a four factor model (focus/execute, sustain, shift and encode) to a five-factor model (scan/focus, shift, arouse/exert, encode/retain, and stabilize/steady), which adds the arousal element to the element of sustained attention. With respect to the overlap of attentional and executive components of this analysis. it must be noted that three of the tasks included by Mirsky in his model (1996) (i.e., focus/execute, stability, and sustain) have traditionally been viewed as attentional, while the remaining two (encode and shift) have been traditionally included within the purview of executive functions.

For the purposes of this paper the more traditional division of attentional processes will be utilized: (1) arousal and activation, (2) sustained attention, (3) selective attention, (4) divided attention, and (5) attentional capacity / working memory.

*Arousal and Activation*

Arousal or alertness can be best thought of as a state of efficiency or readiness for processing information and/or emitting a response. A distinction has been made, within this construct, between a generalized versus a more specific state of alertness (Luria, 1973; Posner, 1978; Mesulam, 1985). Generally these are referred to as *tonic* and *phasic* respectively, although other terms have been used such as diffuse/selective, primary/ secondary, and matrix/vector (Mesulam, 1985).

Tonic arousal is directly linked to sleep/wake and circadian cycles and metabolic and drive states, and its primary function is that of internal regulation. The brainstem ascending reticular activating system and cholinergic pathways are primarily involved in its regulation, albeit with modulation from the hippocampus, and cortico-thalamic/basal ganglia (caudate) regulation via the descending reticular activating system. The right frontal areas have been shown to be primarily involved in the cortical regulation of tonic arousal (Posner and Petersen, 1990).

Phasic alertness refers to a response to a primed or specific target (i.e., selective attention). Targets may be externally primed (e.g., pressing the key every time you see the letter A) or internally primed (e.g., looking for a particular article among a pile of articles to add to the reference list). Phasic alertness is usually seen as superimposed on tonic alertness (i.e., the ability to react to a specific stimulus is faster when the individual is maximally awake as opposed to drowsy or hypoactivated). Phasic alertness is thought to be mediated by anterior cingulate structures (Posner and Petersen, 1990), although the basal ganglia, especially the caudate nucleus, have also been recognized as playing a role in its regulation (c.f., Luria, 1973; van Zomeren & Brouwer, 1994).

Both tonic and phasic attention can be assessed using simple computerized continuous performance programs. The Vigil test (similar to the computerized continuous performance task developed by Rosvold, Mirsky, Sarason, Bransome & Beck, 1956), for example, provides measures of reaction time to stimuli, as well as the number of errors of omission and commission. Both cued and uncued conditions are available. In the uncued condition the examinee presses a computer key whenever the letter "K" appears on the screen, while on the cued condition the examinee is instructed to respond to the appearance of the letter "K" *only* when preceded by the letter "A". Each task lasts 8 minutes, which allows for the possibility of

observing difficulty sustaining attention over time due to either distractibility or fatigue. Mean reaction time provides a measure of general alertness, while a graph that tracks response latencies over the duration of the task offers the possibility of detecting fatigue effects. Another graph that plots errors over time allows the examiner to determine loss of efficiency over time. (The program is quite flexible and allows the examiner to set many variables, including the target and inter-stimulus interval).

The cued condition provides a means of addressing phasic alertness. As normative data and research on this subject indicate (Posner, 1978), speed of response is expected to increase, with accuracy decreasing, presumably as a consequence of the stimulus not being fully processed before the response is made. This is known as the speed-accuracy tradeoff.

The importance of conducting speed-accuracy analyses and placing them in a longitudinal developmental context has been highlighted in a study by Armengol & Cegalis (1995). They found, using the Vigil (1995) computerized test of sustained attention, that among children up to about the time of puberty, girls were slower and more accurate than boys. These gender differences disappeared until about the late 40's and mid 50's, when the converse pattern was observed. This study also raised issues regarding the role of hormonal factors in the regulation of this aspect of attention.

Finally, regarding the use of speed as a measure of alertness and intact neurological functioning, it is important to point out that the role of sociocultural factors must be taken into account. It has been demonstrated (e.g., Levine, 1998), that the concept of speed is given different weights according to cultural expectations. Pertinent to the issue of cross-cultural influences on response speed is a study by Arnold, Montgomery, Castañeda, & Longoria (1994), who administered the Halstead Reitan battery to a sample of Mexicans, Mexican-Americans and Americans. While they found no acculturation effects on tasks which required speeded motor performance (finger tapping), on a task of spatial-tactile memory (tactual performance test) Anglo-Americans were faster (though not more accurate). Bornstein (1986) on the other hand, did find cross-cultural differences on finger tapping: eighty percent of his Canadian random sample was "impaired" relative to available normative data. Finally, a multi-center, multi-national study by Levav, Mirsky, French & Bartko (1998) found differences in reaction time by country on auditory continuous performance and the Trail Making test. These findings emphasize the need to obtain normative databases for specific populations being served (see also Pontón & Ardila, 1999).

### *Sustained Attention*

This refers to the capacity to maintain focus over time. This is most clearly exemplified in the ability to persist on tasks and resist distraction to other stimuli (whether external or internal) despite length, lack of immediate appeal/reward, or repetitiveness. Applied examples of this capacity include air-traffic control at one end, or sitting quietly in a classroom listening to abstract verbally presented information.

This function is typically measured by the number of "hits" or correct identifications on continuous performance tasks (CPTs), whether visual or auditory. Vigil, discussed earlier, is one example, although a number of variants exist. In utilizing and interpreting results from these tasks it is important, however, to examine what is demanded of the examinee. While this measure is, on the surface, quite straightforward, it should be noted that task performance can be influenced by a number of variables (e.g., rate of presentation of stimuli, similarity of distractor to target, etc.).

The concept of sustained attention is tied to that of "habituation" and the orienting response. Novelty, a key factor in the orienting response is, by definition, a mismatch between stored representations of a stimulus and the actual stimulus. The rate of habituation indicates the speed with which that cognitive operation is performed. Developmental studies that have focused on the orienting reflex and habituation to a novel stimulus (generally measured through heart and respiration rate, galvanic skin response, and constriction of blood vessels) have consistently demonstrated that habituation rate decreases with age (i.e., the older individual habituates more rapidly, presumably due to an increase in information processing efficiency). In some individuals slow habituation rates may be indicative of birth trauma and brain dysfunction (Lewis & Baldini, 1979).

Since novelty has an alerting effect, in order to maintain focus on a stimulus that has ceased to exert that "appeal" other forms of regulating arousal must be called upon. Cortical structures become critical in persisting on a task in the service of future goals, despite the lack of immediate reward. The role of the descending reticular activating system becomes key in accomplishing this task (Luria, 1973). In the case of children and adults with Attention Deficit/Hyperactivity Disorder, it is the failure of frontal, regulatory systems that contributes to the lack of persistence observed (c.f., Pennington, 1991, 1997; Barkley, 1998).

Sociocultural factors play a significant role in the development of the regulation of alertness and sustained/directed attention. Vygotsky pioneered the study of the social organization of attention. He stressed the fact that the child, from the outset, develops in a social environment, and that the caretaker directs the infant's attention towards relevant aspects of a stimulus. In his own words: "In the early stages of development the complex psychological function *was shared between two persons*: the adult *triggered* the psychological processes by naming the object or by pointing to it; the child responded to this signal and picked out the named object either by fixing it with his eye or by holding it with his hand.. In the subsequent stages of development this socially organized process becomes reorganized. The child himself learns to speak. He can now name the object *himself*, and by naming the object himself he distinguishes it from the rest of the environment, and thus directs his attention to it. The function which hitherto was shared between two people now becomes a method of internal organization of the psychological process. From an external, socially organized attention develops the child's voluntary attention, which in this stage is an internal, self-regulatory process" (Vygotsky, cited in Luria, 1973, p. 262).

Luria (1973) sees this shaping of the orienting reflex as essential in the development of higher forms of attention. He thus states: "This identification of the social roots of the higher forms of voluntary attention, which Vygotsky first recognized, is of decisive importance: it bridged the gap between the elementary forms of involuntary attention and the higher forms of voluntary attention" (1973, pp. 262-263). Luria points out that social attention differs from the orienting reflex and is highly related to the ability to withstand distraction (i.e., to override the automatic orienting reflex). This does not develop until the child is four and a half to five years of age.

The Stroop Test (Stroop, 1935) has also been widely utilized in research and clinical settings to assess this function (see Spreen & Strauss, 1998, and Lezak, 1995 for a description of clinical versions of this task). A computerized version, published in Spain (León-Carrión, 1998) is commercially available. The Stroop test has a long tradition of use and has been analyzed in a number of ways (e.g., McLeod, 1991; Cohen, Dunbar, & McClelland, 1990; Mehworth, Braun & Heathcote, 1992; Schooler, Neumann, Caplan & Roberts, 1997). On this task the subject is timed in his or her ability to read color words, name colors, and to perform a task where the more rapid response to the word needs to be inhibited in order to identify the color of the ink the words are printed in. Not surprisingly, language

proficiency is an important factor, not often considered, in interpreting results of this test (Cox, Chee, Chas, Baungarden, Shuerholz, Reader, Mohr & Denckla, 1997; Armengol & Méndez, 1998; Azoulay & Armengol, 1999).

The influence of sociocultural factors on the performance of this task has also been examined. In studies that have looked at the Stroop test with Hispanic children of various socioeconomic groups (Armengol & Méndez, 1999; Armengol, 2000a) it was found that latencies were shorter for children in the high socioeconomic strata. Children of lower strata in Mexico were closer in their performance on these tasks to American Hispanic children of similar socioeconomic background than to children in Mexico of higher SES. (With regard to executive functions, it was noteworthy that parental education also predicted the ability to self-monitor for errors on the interference task, with the children of more educated parents being more likely to self-correct).

### *Selective Attention*

Selective attention refers to the identification and selection of a specific target, embedded among other distractors. This aspect of attention has been extensively researched (e.g., Treisman, 1969; La Berge, 1995). Measures of this ability in the visual modality include cancellation tasks such as the Mesulam Cancellation Tests (Mesulam, 1985; see Lezak, 1995 for a discussion of other cancellation tasks). These standardized tests require the subject to circle a target letter embedded among other letters, or a symbol embedded among other symbols, under timed conditions.

One finding is that the time it takes to perform a selection task will increase relative to the number of shared features between the target and distractors (LaBerge & Brown, 1989). The clinician must thus be aware that selective attention is influenced by the similarity of targets to distractors and by the speed/accuracy tradeoff demonstrated by the subject. Cancellation tasks, for instance, will pose lesser or greater difficulty depending on the saliency of distinctive features that separate targets from distractors. In the NEPSY the developmental progression of this ability is acknowledged in the choice of targets and distractors, which become more complex for the older children. Cooley and Morris (1991) review developmental studies that have looked at selective attention, making the point that younger children show greater difficulty with these tasks because they tend to perceive stimuli as unitary, whereas as they grow older, they develop the capacity to appreciate their dimensional perspective.

Another clinical instrument that assesses this aspect of attention is TAVIS-2 (Teste de Atenção Visual), a computerized continuous performance task developed by a Brazilian team (Mattos, Duchesne, & Farina, 1997). It assesses three levels of attention, separating the ability to detect the appearance of a single target (which emphasizes sustained attention) versus the ability to select a target from among distractors. Two levels of this task are available, one for younger children, and another for adolescents.

### *Divided Attention*

This is also referred to as distributed attention. It pertains to the ability to shift back and forth between two tasks. Usually tasks that tap this function require the person to monitor two or more of their components, and to provide a response based on one or another. The ability to distribute attention allows for the smooth execution of a number of routine, everyday activities such as driving (where the driver's attention alternates rapidly between choosing the right turns to follow a planned route, traffic conditions, shifting gears, pressing the gas pedal or brake, steering, and perhaps also listening to the radio and conversing with a passenger). In the academic setting, an intact ability to distribute attention is necessary to perform a complex task such as taking notes during lectures, where graphomotor verbal output must be coordinated with decoding and integration of auditory verbal input.

In the example of driving, the various tasks must not only be sampled rapidly to track each one, but the executive function of prioritizing them is critical in determining when, and for how long, each aspect requires conscious control.

For clinicians there are a number of simple tests that assess this function. One is the Trailmaking Test B (Reitan, 1986), where the person must alternate between two tasks, both of which involve tracking automatized sequences (the alphabet and numbers). Another is the Paced Auditory Serial Addition Task (Gronwall, 1976), which requires keeping mental track of information presented by the examiner while performing a mental operation (i.e., adding the last number to the preceding one).

### *Working Memory*

Despite its name, this function has been most frequently conceptualized as an aspect of attention, and it is generally measured with digit span tasks. Its use as a test of memory span dates back to Ebbinghaus and Binet (Zimmerman & Woo-Sam, 1973). Its interest to neuropsychologists, however, lies in its ability to tap into the limited capacity conscious processing system, which has been equated with a central controller or executive to which other more automatic processes are subordinated (Baddeley, 1986). This "central executive" receives temporary input (phonological or visual in most test situations). An important distinction is made (e.g., McCarthy and Warrington, 1990) between span (or number of items a person can consciously retain) and the ability to mentally manipulate this information, even though both aspects are considered under the general rubric of working memory.

Both Brooks (1976) and Armengol (1998, 2000b) have demonstrated the clinical importance of separating forward and backward span. In head-injured survivors, Brooks (1976) found that in 82 severely injured individuals, performance on digits forwards was normal or almost normal, but digits backwards was impaired. Armengol (2000b) showed significant deficits in working memory (i.e., digits backwards) in patients with acute anoxic encephalopathy, in contrast to others who had used combined measures of forward and backward span.

Miller (1956) indicated that an average forward span comprised 7 +/- 2 items. Developmentally, however, the number of items a child can hold in active consciousness increases with age; this is reflected in normative data for span tests on such instruments as the Stanford Binet, the WIPPSI -R and the WISC-III. Indeed, developmental psychologists have extensively studied and described both the development of attentional span and the kinds of operations that come into play in working memory in order to carry out various tasks.

In clinical practice, working memory is routinely assessed, although the analysis of its components (what one might think of as content span versus operational span) is often neglected. In assessing working memory it is important to differentiate between these components. The customary practice of combining digits (and now spatial span) forwards and backwards into a single score, which owes to psychometric considerations (Mattarazzo, 1975)

may the have the statistical advantage of increasing reliability (due to the restricted number of trials for each span length), but obscures very important aspects of this attentional and problem-solving function. Simply making a clear distinction between the child's or adult's repetition of information versus their ability to actively manipulate it would go a long way to redressing this problem.

Cross-cultural studies of working memory have often utilized digit span. Syllable length has been typically found to affect the amount of information the person can recall (e.g., Olazaran, Jacobs & Stern, 1996; López & Taussing, 1991; Hoosain, 1982). Digit span performance thus varies according to the properties of a given language and to linguistic proficiency.

## Discussion

Since attention cannot be reduced to a single, unitary process, clinicians must bear in mind that to properly evaluate the different aspects of attention a single test or procedure will not suffice. Whereas memory and reasoning are typically emphasized in neuropsychological evaluations, underlying attentional factors impacting on those and other abilities (e.g., executive functions, or problem-solving) require much greater emphasis and analysis.

At present, a number of instruments that tap into both attentional and executive functions. are rapidly becoming commercially available. Examples include tests that are closely tied to experimental paradigms, such as several computerized versions of Rosvold et al's (1956) Continuous Performance Task. Examples include the Test of Variables of Attention (Greenberg & Kindschi, 1996), Conners' Continuous Performance Test (Conners, 1995), Vigil (1995), and Teste de Atenção Visual (Mattos, Duchsne & Farina, 1997). A well-normed instrument that utilizes Luria's principles in the neuropsychological assessment of children, the NEPSY (Korkman, Kirk & Kemp, 1998) places a heavy emphasis on the investigation of attention and executive functions.

Others have sought to develop new instruments that systematize the utilization of daily tasks as a way of assessing attention and executive functions. Examples include the Behavioural Assessment of the Dysexecutive Syndrome or BADS (Wilson et al., reviewed in Spreen & Strauss, 1998), the Behavioural Inattention (Wilson et al., reviewed in Spreen & Strauss, 1998) and the Test of Everyday Attention (Robertson et al., reviewed in Spreen & Strauss, 1998). Efforts have also been devoted to providing comprehensive assessment instruments that address various

components of executive functioning and attention. An example is the Delis-Kaplan Executive Function Scale (Delis & Kaplan, in press).

Most important, however, is the issue of the analysis of the data gathered on the part of the clinician. It is only when information is analyzed in the proper context that it becomes useful and relevant. The ability to properly interpret data depends on the clinician's understanding of these basic cognitive processes and the nature of their disruption as a consequence of developmental or acquired brain dysfunction. In addition, understanding how these processes unfold developmentally adds an important level of analysis, and is essential not only in the evaluation of children (c.f., Waber & Holmes, 1985), but also of adults. Clinically, of the cognitive functions, attentional processes are most vulnerable to disruption as a result of systemic and/or neurological injury.

It is noteworthy that some of the most significant contributions to clinical neuropsychology, both paradigmatically as in the understanding of syndromes and with regard to clinical interventions, have been made by investigators grounded in a microgenetic perspective. Such investigators include A.R. Luria and his collaborators, H. Werner (1937), and those who carry on their approach (e.g., Christensen, 1975; Kaplan, 1983). Thus, in assessing the various components of attention clinically it is important to adopt a developmental perspective, particularly as this perspective (whether one is evaluating children, adults or the elderly) offers a very critical understanding of the unfolding of cognitive processes. This becomes particularly important in developing interventions for remediation and rehabilitation. Since maturation profoundly affects the unfolding of all attentional processes, it is to be expected that difficulties or inconsistencies on tasks result from their differential rate of development (see Cooley & Morris, 1990). Alternatively, pathological processes (e.g., seizures versus ADHD) can differentially affect aspects of attention. In terms of treatment and remediation (whether via medication or other interventions) it is imperative that the different components of attention be teased out both at the assessment stage (c.f., Armengol & Cegalis, 1995) and for outcome analysis.

It is also important to recognize that not only do attentional processes affect executive and other cognitive functions, but that the interaction is bi-directional. By this I mean that executive skills, or speed of information processing, can affect performance on apparently straightforward attentional tasks.

For instance, on cancellation tasks (e.g., Mesulam, 1978), the target items that the examinee must identify may be presented within an organized or random array. The former provides a structure to conduct the scanning of the array, whereas the latter places the burden on the examinee to organize a search. Thus, in a person who identifies all targets in an orderly array but misses many in the random array, or takes an exceptionally long time to complete the task, one might suspect difficulties in adopting a systematic search approach.

Rate of target presentation on sequential continuous performance tasks (which differ from cancellation tasks, where all items are present simultaneously) can have an effect on response times. This may lead the person examining the data (especially where computerized administrations are being utilized) to conclude that targets are being missed, and a high number of incorrect identifications (false positives) are being made. Thus, while the person's sustained attention might be intact, processing time may be the issue. It is important that the examiner inspect the individual responses to see whether there is a pattern of slight delay, which is being recorded as a missed target and/or a false positive (for the subsequent target). (See also previous discussion of response rates and sociocultural differences.) Alternatively, the subject may be making anticipatory errors that result in responses to the cue rather than to the target letter.

Many so-called "culture-free" tasks have been found to be affected by social and ethnic factors (cf., Anastasi & DeJesús, 1953; Cole & Bruner, 1971; Pérez-Arce, 1999). Since executive and other functions can significantly affect attentional processes, the role of socio-cultural variables with regard to biological processes such as speed, activation, etc. must also be considered. Cultural differences in tempo have been alluded to earlier (Levine, 1996), and appear to be shaped to some extent by a person's cultural environment. Basic mobilization to respond to tasks is likely to be affected, and the possibility of broad cultural differences in tonic levels of arousal cannot be dismissed out of hand. Phasic alertness will also be influenced by the (typically unconscious) acceptable level of hits to misses set by the individual on selective attention tasks; this too is likely affected by developmental, sociocultural, and gender factors.

Clinicians working with multi-cultural populations must be particularly concerned about how sociocultural factors will impact on the person's performance on such tasks. Much has been written on the cultural relativity of cognitive processes and the need to take into account the impact of culture on cognition (cf., Luria, 1976; Cole & Bruner, 1971; Cole & Schribner,

1974; Kagan & Klein, 1973). This is a concern that has not been sufficiently emphasized in neuropsychological research and practice with ethnically and culturally variant individuals (Pérez-Arce, 1999).

In conclusion, this paper is offered as an encouragement to clinicians to take a more active role in assessing activation and attention and to consider its interaction with executive and other cognitive processes. Some instruments available to facilitate this process have been reviewed. Importantly, developmental and cultural influences on what are often considered purely "biological" (and therefore presumably culture-free) variables (such as indices of tonic and phasic attention) need to be taken into account, and researched further.

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