INTERACTIVE COMPUTER PROGRAM FOR MEASURING AND ANALYZING MENTAL ABILITY

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to 0 computer based testing systems. More specifically, the invention relates to systems and methods for measuring, analyzing and training improvements in mental ability.

2. Description of the Related Art

Scientists and psychologists have long sought an objective measure of general mental ability that is independent of cultural bias (acculturation). Most pen and pencil PSYCHOMETRIC ("IQ") tests (e.g., Stanford Binet and Wechsler) are biased to the degree that their questions favor prior learning of: procedural skills (e.g., use of math tables enabling faster solutions), strategies (e.g., how to solve certain problems), and language (e.g., alphabet, vocabulary, colloquialisms).

Although IQ tests purport to measure native mental aptitude, or ability, per se, a growing percentage of educational and cognitive psychologists have argued that, "individual differences in tested IQ are attributable to differences in the opportunities afforded by the environment for acquiring the specific skills that are called for by the standardized tests of intelligence".

In an attempt to identify a common factor that accounts for individual variations across a broad range of mental tests, scientists have constructed the term 'g'. The degree to which any test reflects native intelligence, or mental processing skills, versus acculturated learning, is its g-factor, or g-correlation.

A 'g-factor' score results from a factor analysis of a wide range of mental ability tests, and relates to those components of the tests that are most highly correlated in their predictability of test results. However, although g is often used as a synonym for IQ, in fact, it is not a measure of any kind of knowledge or mental skill. That is, g is not related to cognitive content g reflects cognitive capacity, that is, information processing capacities (speed, capacity and efficiency). The knowledge and skill content of performance on mental ability tests is merely an expression of g which reflects the overall capacity of information processes by which knowledge and skills can be learned and effectively applied, such as, in an IQ test.

Over the past 20–30 years Cognitive Science has developed the theory that cognitive ability, i.e., g, is based on the brain's (information processing) speed. Studies have revealed high correlations between highly g-loaded mental tests (e.g, Wonderlic, Ravens and WAIS), and brain-speed, as measured via neural conduction velocity (optic-nerve transmission speed), and chronometric (reaction speed) cognitive tests, for instance.

Underlying g, or basic intelligence, are elementary cognitive processes (ECPs) involved in every stage of cognition from perception to decision-making. More specifically, ECPs are comprised of the following components: the perceptual registration ("apprehension") of the stimuli (bits of information); the identification ("discrimination") of the information; the "selection" and "encoding" of the information, and the appropriate reaction, be it: physical

(sensory-motor), i.e., "simple" reaction-time (RT), or; cognitive, ie, "choice", "discrimination" and "decision" RTs. Cognitive reactions involve the additional ECPs of; "rehearsal" and further "encoding" of appropriately selected information while, short and long term memory files are simultaneously accessed, followed by the "transformation" and "manipulation" of retrieved information for the purposes of making the appropriate choice, discrimination or decision response. Any test that challenges and quantifies elementary cognitive processes is referred to as an elementary cognitive task (ECT).

A simple reaction-time (RT) test involves a single (sensory-motor) response when a certain event happens, such as, pressing a button when a light goes on. A choice RT test involves two or more possible choice responses. For example, "If a red light flashes on the screen, press the R key, and if a green light presents itself, press the G key." A discrimination RT test generally involves the use of short term memory to render a yes/no response. As an example, a string of letters is presented for quick review, quickly followed by a second set of letters, with the requirement that the subject determines whether any letter in the second group was in the first group and respond as quickly as possible.

And, a decision RT test requires the access of short term memory and/or long term memory (LTM) in order to render the correct "split-second" decision. For example, the stimlus may pair a word with a picture on the computer. The Rule might be, "If the word and picture are the same, press the right arrow key, otherwise press the left."

Although "simple," RTs show a relatively low correlation to IQ, choice (and especially) discrimination and decision RTs demonstrate a relatively high (over 50) correlation. In addition, the higher the number of alternative choices, or possible responses, the higher the test's g-factor. A primary indicator of the g-value of an ECT is the length of time required for a correct response. For instance, simple RTs are typically 275 milliseconds (ms). However, choice RT increases as a log function (to the base **2**) of the number of choices (Hick's Law). Typically a four choice test might require 350 to 400 ms. In a decision speed test with a random rule-changing cue, response times typically exceed 1000 ms. RT times around 1000 ms indicate the full engagement of "Working memory" and are considered to be highly g-loaded. However, RTs much over 1000 ms typically reflect non-elementary (meta) cognitive processes, such as, 'thinking' (computations based on learned strategies or procedures, generalizations, etc.).

The functional processing-system serving the elementary cognitive processes is what Cognitive Science terms "Working memory". It is likened to a computer's central processor. The faster the processor, the smarter the computer and brain.

The ideal mental ability test, therefore, would quantify as many ECPs as possible, that is from perception and simple RT, to choice and decision RT.

In response to the need to eliminate cultural bias from the quantification of g a number of electronic and chronometric methodologies have been employed revealing various physiological signatures (electrical, chemical and metabolic) and information-processing capacities of the brain showing high correlations with g.

Various test measurements revealing significant correlations with g include: cognitive chronometric (RT) tests including "Choice RT" and "Discrimination (decision) RT"; "neural conduction velocity"; brain (wave) evoked potentials; brain hemisphere coherence (integration, or