Guest Editorial

A Point of View

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Changing Conceptions of Intelligence

Theoretical conceptions of the nature of intelligence are near the top of the list in order of importance of problems in the behavioral sciences. If our theory of intelligence is wrong, our theories of education will be wrong, and our theories of society will be wrong. And in the real world, wrong theories do not work.

Sir Francis Galton (1822–1911) was probably the first to propose a scientifically testable conception of intelligence. He viewed intelligence as a general mental ability that is a product of biological evolution and in which individual differences are primarily inherited. Galton's successor in the history of this concept, Charles Spearman (1863–1945), found support for Galton's idea of general ability in the observation that all complex mental tests of whatever variety are positively intercorrelated and therefore must measure something in common—a *general* factor which he termed *g*. He developed a mathematical technique—factor analysis—that could reveal the degree to which each of a wide variety of tests measured the *g* factor that is common, in some degree, to all mental tests. The *g* factor is the sine qua non of all tests termed intelligence tests or IQ tests. In this context, intelligence is *g*—general mental ability: *general,* because it enters into virtually every kind of mental activity, and *mental* because individual differences in the trait are not the result of differences in sensory or motor capacities per se.

The many theoretical implications of the *g* concept of intelligence have not yet been adequately investigated, although scientists are once again giving it their attention and continuing where Spearman left off. A scientific understanding of the nature of *g* was badly hindered by the zeitgeist of radical behaviorism and the philosophy of logical positivism that prevailed in psychology during the half-century from the 1920's to the 1970's. This orientation was a historic necessity in the development of scientific psychology, but it has since outlived its usefulness for the further development of our science. It eschewed all but empirically observable and experimentally manipulable aspects of behavior, focusing on variations in stimulus and response elements in its explanations of behavior, and disparaging any reference to central processes, theoretical constructs, factors, or inferred brain processes. Conditioning and learning were seen as the sole source and explanation for individual differences, in abilities and personality.

Behaviorism gave rise to a view of intelligence that is best termed the *specificity doctrine.* It comprises two main beliefs: (a) human mental abilities, and individual differences therein, consist of nothing other than a repertoire of specific items of knowledge and specific skills acquired through learning and experience, and (b) intelligence tests measure nothing other than some selected sample of the total repertoire of

knowledge and skills deemed important by the test constructor.

These tenets have proven wholly inadequate in attempting to explain phenomena such as (a) one and the same *g* factor emerges from entirely different types of tests with no common content or behavioral skills (e.g., vocabulary and block designs), (b) there are positive correlations between IQ test scores and performance on tasks that involve no learning whatsoever, (c) there is a higher IQ correlation between identical (one-egg) twins reared apart than between fraternal (two-egg) twins reared together, and a higher correlation of adopted children with their biological parents than with their adoptive parents, and (d) there is a negative correlation between IQ and the average latency and amplitude of evoked electrical potentials in the brain.

Recently we have seen a revival of interest in research on laboratory techniques of mental chronometry as a means of exploring the nature of intelligence. The facts already revealed in this research are an insuperable problem for the behaviorist's specificity doctrine of the nature of intelligence and its overly limited view of what it is that our present IQ tests measure. It now appears that the specific knowledge and skills called upon by the item content of IQ tests are not themselves what constitute intelligence, but are merely vehicles for the measurement of *g*, which is essentially a property of the brain, not of behavior per se.

Early attempts in the history of psychology to find a relationship between mental speed (as measured by reaction time) and general intelligence were largely unsuccessful because of technical and methodological inadequacies of the research. In recent years, however, quite striking and consistent correlations have been demonstrated between a variety of types of reaction time (RT) and general intelligence as assessed by standard psychometric tests, often referred to as IQ tests. Measures of "mental speed," in which individual differences in motor skills per se are intentionally minimized by the measurement procedures, are designed to measure the speed of visual information processing (called inspection time or IT), the speed of decision or choice (contrasting simple and choice RT), the speed of retrieval or scanning of information in short-term memory, and the retrieval of information from long-term semantic memory. Each of these "mental speed" paradigms has yielded measurements of various parameters of performance, such as *rate* of information processing (in bits per second) and *intraindividual variability* (among trials) that are moderately correlated with psychometric intelligence. When the various measurements are combined, using optimal weights derived from a multiple regression analysis, the multiple correlation between mental speed measures and intelligence is greatly enhanced. Such combined measures may eventually be able to predict nearly all of the true variance in the *g* or general factor common to all complex tests of mental ability.

The most remarkable aspect of these findings is the extreme simplicity of the various RT tasks for all subjects and the fact that such simple tasks, such as removing one's index finger from a microswitch pushbutton the moment a light goes on, are correlated with scores on untimed intelligence tests composed of highly complex reasoning problems. The RT measurements are also correlated with the amplitude and latency of average evoked electrical potentials in the brain, and RT is highly sensitive to the individual's momentary physiological state, varying throughout the day with body temperature changes and other physiological factors.

Interestingly, intraindividual variability (among trials in a single testing session) in RT is generally found to be the most highly correlated (negatively) with intelligence. RT parameters also show regular changes as a function of age, from childhood to maturity. Individual differences in RT or other simple measures of mental speed can be explained theoretically in terms of a hypothetical construct, neural oscillation, which posits that persons differ in the rate of oscillation between excitatory and refractory phases of synaptic transmission of neural impulses, and that faster rates of oscillation cause faster RTs, lower intraindividual variability, greater information processing per unit of time, and higher observed intelligence.

Although theoretical formulation is still

embryonic, the findings thus far already lend strong support to certain psychologically important conclusions. The consistently demonstrated relationship of IQ to RT measurements clearly indicates that ordinary standard IQ tests indeed tap fundamental processes involved in individual differences in intellectual ability and do not merely reflect differences in specific knowledge, acquired skills, or cultural background. Thus the specificity doctrine is clearly contradicted by the present evidence. This refutation of the specificity doctrine is an important step in our progress toward a better understanding of the nature of intelligence.

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