there may be fewer students per school than there are cells in the design. An *incomplete blocks* design would be useful in this situation, enabling the researcher to be sure that treatment effects can be separated from the differences among schools.

Traditional experimental design considers only the design of the current experiment; design in industrial production has expanded to consider how to design sequences of experiments to optimize the production process, with the design of each experiment depending on the results of the previous experiment. Such sequences of designs might be of use in discovering how to optimize intelligence with the least cost of experimentation.

FURTHER READING

Classic sources on important considerations in experimental and quasi-experimental design include Campbell and Stanley (1966), Cochran (1983), and Cochran and Cox (1957). The last is like many contemporary sources in that statistical as well as design considerations are an integral part of the text. Most recent texts on experimental design and analysis differ from prior works—not in the types of designs discussed but in the use of a more comprehensive statistical approach via general linear models. Typical of the newer approach are books by Woodward, Bonett, and Brecht (1990) and Maxwell and Delaney (1990). An excellent nontechnical work illustrating research design and the interpretation of statistical tests is Huck, Cormier, and Bounds (1974). The design of sequences of experiments to optimize industrial output is illustrated in the work of Box and Draper (1969). Maddala (1983) discusses selection models, as well as other useful new approaches to design and analysis developed in the field of economics.

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DAVID RINDSKOPF

EYSENCK, HANS J. (1916–) One of the most famous and controversial psychologists of the latter half of the twentieth century and the leading exponent of the London school of biological and quantitative psychology established by Francis GALTON, Charles SPEARMAN, and Cyril BURT, Hans Jurgen Eysenck has made prolific and influential empirical and theoretical contributions to differential psychology, most notably in the area of research on personality and human mental ability. In his studies of personality, he applied the quantitative methods developed by the London school, particularly factor analysis, along with the hypothetico-deductive use of experimental methods involving the constructs of Ivan Pavlov and Clark Hull. Eysenck's prolific research is cited in many areas of the psychological literature, including extraversion, neurosis, behavior therapy, critiques of psychoanalysis and Freudian theory, sexual behavior, the psychology of politics, smoking and health, measurement and theory of intelligence, behavioral genetics, race differences, and creativity and genius. He has even examined parapsychology and astrology from an objective and scientific standpoint. Modgil and Modgil (1986) have edited a fairly comprehensive volume of critical commentaries on Eysenck's varied contributions.

Born in Berlin, Eysenck was the only child of comfortably well-off, cultured parents. His father was a stage actor, his mother a movie actress. Graduating from the Gymnasium in Berlin in 1933, the year that Hitler came to power, he left Germany in protest and spent a summer in England at the University of Exeter, followed by a few months in France at the University of Dijon. In 1934 he enrolled at University College, London, majoring in psychology under Sir Cyril Burt. He received his bachelor of arts degree in 1938 and his doctorate in 1942, whereupon he was appointed chief psychologist at the Mill Hill Emergency Hospital (London) during World War II (1942–1945). He then became psychologist at the Maudsley Hospital, London's leading psychiatric facility (1945–1950), followed by promotion to reader in psychology and director of the Psychology Department of the Institute of Psychiatry of the University of London (1950–1955). From 1955 to 1984 he was professor of psychology at the institute. As emeritus professor since 1984, he remained as active as ever, researching, writing books and articles, giving invited lectures around the world, and editing the international journal that he founded in 1980, *Personality and Individual Differences.*

Eysenck's contribution to intelligence consists of his own considerable research output in addition to the strong theoretical influence he has had on his colleagues and on many other researchers who have made significant contributions. Eysenck takes a "hard science" approach, viewing intelligence not as a thing or a denotative noun, but as a theoretical construct similar to the basic concepts of physics, for example, mass, gravitation, and potential energy. He insists that neither the subjective nor the behavioral manifestations of intelligence—reasoning, memory, learning, problem solving, and the like—can constitute a proper definition of intelligence nor does Spearman's *g* (general ability), which merely reflects the fact of individual differences in intelligence. Rather than being a definition or an explanation, *g* is a phenomenon itself in need of explanation. This must involve constructs beyond subjective and behavioral phenomena. While acknowledging the importance of factor analysis for analyzing the correlational structure of abilities represented in a battery of diverse tests and for measuring independent components of mental ability, such as *g* and various group factors, Eysenck was among the first to recognize the impotence of factor analysis for understanding the causal basis of intelligence differences. The causal question, he argued, must appeal to the methods of behavioral genetics and neurophysiology.

Following D. O. HEBB, Eysenck emphasizes the essential distinction between three classes of phenomena associated with cognitive performance, referred to as Intelligences A, B, and C. Intelligence A is the biological substrate of mental ability, the brain's neuroanatomy and physiology. Intelligence B is the manifestation of Intelligence A and everything that influences its expression in "real life" behavior. Intelligence C (first so labeled by P. E. Vernon) is the level of performance on psychometric tests of cognitive ability. Eysenck dismisses Intelligence B as unsuitable for scientific study because it represents such a complex interaction of Intelligence A with variation in a host of cultural, educational, and other social and psychological influences in the course of the individuals' development, as well as being confounded by personality and motivation, thereby making it (Intelligence B) essentially unmeasurable and unamenable to the purposes of scientific formulation. Intelligence C, however, being based on psychometric tests of ability, does allow quantitative and statistical treatment of data and is indeed essential for the study of mental ability. Tests vary widely in the degree to which they reflect Intelligence A or Intelligence B, however. Verbal tests with culturally and educationally loaded items, for instance, are closer to Intelligence B, while certain nonverbal tests of reasoning and problem solving using simple pictures or geometric forms that are highly familiar to all examinees may better reflect Intelligence A. The components of variance in reaction time and inspection time that are correlated with Intelligence C probably come even closer to Intelligence A, and physiological measurements derived from the average evoked potential, the rate of glucose uptake in the brain detected by positron emission tomography (PET), and nerve conduction velocity in the brain (which are all correlated with intelligence quotient [IQ]) are the closest to Intelligence A. In the latter part of his career, Eysenck focused on the empirical relation between Intelligence C and its biological basis, or Intelligence A.

In the 1950s, Eysenck revived Galton's hypothesis that mental speed is what underlies individual differences in *g*. Measurement of the time that individuals take to solve single test items of varying difficulty permitted the analysis of test performance into three main sources of variance: speed, continuance (i.e., persistence of effort), and error checking. Because only speed can be truly regarded as a cognitive variable, the other two variables really being aspects of personality, Eysenck and his coworkers focused their research on mental speed, as measured by choice reaction time, inspection time (a measure of purely perceptual speed), and the latency and waveform of brain-evoked potentials. As evidence accumulated showing that trial-to-trial intraindividual variability in these measures is more highly correlated (negatively) with *g* than is speed itself, Eysenck promulgated the hypothesis that *g* reflects the rate of errors in the neural transmission of information through the cortex. In other words, the level of a person's intelligence depends on the probability that neurally encoded messages will be transmitted to their destinations in the brain without degradation or distortion by random "noise" in the nervous system. This theory has some empirical support from studies of reaction times and evoked potentials and is under continuing investigation.

(*See also:* EEG EVOKED POTENTIALS.)

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