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THE WILEY-BLACKWELL ENCYCLOPEDIA OF PERSONALITY AND INDIVIDUAL DIFFERENCES

Raymond B. Cattell

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Abstract

Raymond B. Cattell, was born on 20 March, 1905 in West Bromich, England. He died on 2 February, 1998 in Honolulu, Hawaii, and is buried in the Valley of the Temples, Oahu. Having won a full scholarship to the University of London, Cattell completed a B.Sc. (Hons) degree in chemistry and physics in 1924, aged 19 years. Over a remarkable 70-year career, Cattell's many empirical research studies and numerous creative innovations have had an enormous beneficial impact on contemporary scientific psychology. Cattell's many landmark contributions to psychology include the factor analytic elucidation of 1) cognitive abilities, 2) normal and abnormal personality traits, 3) dynamic motivation traits, and 4) affect/mood states; exploration of L-data, Q-data, and T-data media of assessment; the distinction between fluid and crystallized intelligence; as well as many factor analytic and statistical innovations. Cattell was ranked among the top ten most highly cited psychologists of the twentieth century.

Keywords: Abilities, Personality, Motivation, Affects, Factor Analysis, Multivariate Experimental Psychology

Raymond B. Cattell, Ph.D., D.Sc., was born on 20 March, 1905 in West Bromich, a town near Birmingham, England. He died on 2 February, 1998 at his home in Honolulu, Hawaii, and is buried on Oahu in the Valley of the Temples. Cattell grew up in the coastal countryside of Devonshire, England, where he spent a great deal of time hiking, sailing, and exploring the sea coast and hills around Torquay (his first book documented these early adventures: *"Under sail through red Devon,"* 1937). Although Cattell's father was a self-taught engineer and inventor, no one in his family had attended university. However, Cattell's exceptional abilities, especially in the sciences, led him to his earning a scholarship first to attend the Torquay Boys' Grammar School (1915 – 1921), and then a county scholarship enabling him to complete a B.Sc. degree (with first class honours) in chemistry and physics at the University of London, which he finished in 1924, at only 19 years of age (Gillis, 2014).

Cattell was influenced by the tremendous intellectual and cultural upheaval in London after WWI, where he read and interacted with other young free thinkers, such as Bertrand Russell, George Bernard Shaw, H.G. Wells, and Aldous Huxley. In his hometown of Torquay, Cattell had seen with his own eyes the terrible human toll of WWI, as injured soldiers arrived on trains directly from the battlefields in France to the hospital near to his home. After much deep reflection, Cattell came to

the conclusion that solutions to human problems might be found by applying the objective, rigorous tools of science to the new domain of psychology, and understanding more about personality and human nature. He was discouraged by what he found in the current psychology of the day, which was largely made up of experimental psychologists who studied limited physiological issues (e.g. Pavlov's classical conditioning studies), or philosophically-oriented theorists (such as Freud) who developed their own subjective theories based largely on their own clinical work with troubled, abnormal individuals.

In pursuing this goal, Cattell's study of the periodic table of chemical elements (first put forward by Medeleev in 1869) led him to the idea of similarly trying to discover and elucidate the underlying structures of human personality. He reasoned that human personality must have underlying structural dimensions in the same way that the physical world has underlying elements such as hydrogen and oxygen, and that if these basic building blocks could be discovered and measured, they could be used to understand and predict a wide range of behaviors, such as creativity, leadership, altruism, or aggression.

Cattell was interested in the work of Charles Spearman who was, at that time, trying to develop the methods of factor analysis to discover the basic factors of human abilities. Cattell (1984) stated that, *"On a cold and foggy London morning in 1924, I turned my back on the shining flasks and tubes of my well-equipped chemistry bench and walked over to Charles Spearman's laboratory to explore the promise of psychology"*. Thus, he enrolled as a doctoral candidate in psychology at King's College, London under the guidance of Francis Aveling (Child, 1998; Sheehy, 2004) – third President of the British Psychological Society (1926-1929). In 1932, while teaching at University College, Exeter, Cattell also obtained an M.A. degree in education from the University of London.

After receiving his Ph.D. in 1929, and working for several years in non-research teaching and clinical positions, Cattell found that there was very little funding for research in England at that time. Thus, when, in 1936, he received an offer to work in a research laboratory at Columbia University under Edward Thorndike, he left his home country to move to the USA in order to follow his interest in pursuing research into human personality structure. Next, Cattell accepted the G. Stanley Hall Professorship at Clark University (Massachusetts), where he worked on developing objective measures of personality and intelligence (1938-1941). There, he clarified his theory of fluid versus crystallized intelligence, which he presented at the 1942 APA convention. While at Clark, Cattell was a recipient of an honorary Doctor of Science (D.Sc.) degree from the University of London (1939). Subsequently, he was offered an academic post at Harvard University (1941-1945), where his thinking about personality was influenced by the stimulating environment of numerous creative personality psychologists, such as Henry Murray, Robert White and Gordon Allport. During World War II, Cattell worked as a civilian consultant to the Personnel Research Division, developing psychological tests to be used for the selection of officers.

In 1946, Cattell accepted the newly-created University of Illinois Distinguished Research Professorship, which allowed him to focus more on research. He was particularly interested in the University of Illinois because they were currently developing the first electronic mainframe computer (Illiad I), which would make it possible to carry out large-scale factor analyses (Cattell, 1984). Here, Cattell founded the *Laboratory for Personality and Group Analysis* and began a period of intense creativity and productivity. He invited gifted colleagues from around the world who also were excited about contributing to the new science of psychology. Together, they embarked on a comprehensive program of taxonomic research conducted over several decades (1946-1973), aimed at identifying and mapping the underlying dimensions of human personality structure. This expanded to include not only the mapping of the domain of normal personality, but also abnormal

personality, cognitive abilities, motivation, vocational interests, and affect states. Cattell continued his research and writing for another five years in Colorado, followed by his appointment as an Honorary Professor at the University of Hawaii, commencing in 1978 at 73 years of age.

A description of this research can be found in several of Cattell's books such as: *The Description and Measurement of Personality* (1946), *Personality and Motivation Structure and Measurement* (1957), *Personality and Mood by Questionnaire* (1973). In these writings, Cattell described a complex program of personality research that resulted in a comprehensive model of the development and organization of personality over the life span. Cattell's empirically-based model included multiple types of input variables that influence personality (family, culture, genetic, and physiological factors), as well as multiple types of outputs (such as behavioral changes, personality and motivation changes, etc.). Child (1998) noted that Cattell's "*major concern was to map out an integrated theory of human intellectual, temperamental and motivational characteristics within the context of hereditary and environmental influences using multivariate methods of analysis.*" Cattell's books were widely read, and they influenced the design of personality research around the world. For example, Cattell's book published in 1961 (with Ivan Scheier) on anxiety and neuroticism has become the core of modern state-trait theory.

Cattell's scholarly output was enormous at his University of Illinois laboratory, producing more than 50 books, over 550 journal articles and book chapters, as well as constructing more than 30 sophisticated psychometric instruments. As Dennis Child (1998) stated, "*His major concern was to map out an integrated theory of human intellectual, temperamental and motivational characteristics within the context of hereditary and environmental influences using multivariate methods of analysis.*" Based on the peer-reviewed journal literature alone, Cattell was ranked among the top ten most highly cited psychologists of the 20th century (see Haggbloom et al., 2002, Table 1). Cattell's lifelong theoretical and quantitative research was focused on the rigorous scientific discovery, elucidation and measurement of psychological constructs – an admirable pursuit fully deserving of the highest accolade. So significant were Cattell's empirical contributions, and so extensive was the network of international researchers and distinguished scholars who collaborated with him over the years, that this whole genre of psychological research is now referred to as the *Cattellian School of Psychology*.

Psychology has advanced significantly as a result of Cattell's scientifically-oriented endeavors, not only in personality theory, psychometrics and test construction, but also from his innovative contributions to specific theories – for example, his creative conceptualization of the *Data Box* describing the various combinations of persons, tests, occasions, backgrounds, and observers; – the distinction between surface (observed) and source (latent) traits used in factor analysis, path analysis, structural equation modelling, item response theory, latent growth modelling, multi-level modelling, as well as multidimensional scaling; the state-trait distinction ranging all the way from transitory emotional states, longer-acting mood states, dynamic motivation traits, to enduring (relatively stable) personality dispositions; the distinction between fluid (*Gf*) and crystallised (*Gc*) ability – now extended as the Cattell-Horn-Carroll (CHC) theory of intelligence (see Schneider & McGrew, 2012); structured personality-learning theory involving trait change over the lifespan; innovations in factor analytic methodology; multiple abstract variance analysis (MAVA); as well as the multivariate measurement of cognitive abilities (see Cattell, 1987).

Cattell made many advances in factor analytic and other scientific methods (Cattell, 1978). His research was augmented by the presence of a talented group of psychometricians at the University of Illinois at that time, including Ledyard Tucker, Lee Cronbach, Paul Horst, and Henry Kaiser. When Cattell began his scientific research, factor analysis was a new and still-developing

quantitative technique. It was largely through Cattell's empirical work and that of his students and colleagues that factor analysis became perhaps the most widely-used multivariate statistical technique for the elucidation of human personality structure (Nesselroade, 2001). Cattell was responsible for several creative innovations in factor analytic methodology, including the *Scree test* of latent roots to determine the number of factors to extract (Cattell, 1966c), rotation algorithms including both the analytical *Maxplane*, and topological *Rotoplot* programs (used to attain maximum simple structure solutions), as well as the *Procrustes* program to test the validity of an hypothesized factor structure – *Confactor* rotation (comparing separate rotational solutions), the *Taxonomie* program (for locating types), factor pattern similarity and congruence coefficients, as well as *Conspect* reliability (see John Gillis' chapter entitled "*Quixote or Columbus?*" in Miller, 1988). Cattell also showed how the ± 10 *hyperplane count* provided a quantitative index of the degree of simple structure achieved.

Cattell's substantial contributions to factor analytic methodology (Cattell, 1978) and multivariate experimental research (Nesselroade & Cattell, 1988) have significantly advanced psychological science, and have facilitated the development of structural equation modelling. While multidimensional measures of personality traits such as the *Sixteen Personality Factor Questionnaire* (16PF) and the *Clinical Analysis Questionnaire* (CAQ) were derived from a programmatic series of regular (single-occasion) *R-factor analyses*, Cattell also utilized the innovative *P-technique* factor analysis (factoring a single individual's responses over say 300-350 consecutive days of test administrations), as well as the *dR-technique* (differential R-factoring of change scores across different measurement occasions) enabling the discovery and elucidation of state and dynamic trait factors.

Despite his many contributions to factor analytic methodology, Cattell considered structured learning theory and the dynamic calculus for assessing interests and motivational drives to be among his greatest achievements (Cattell, 1984). Thus, Cattell adopted a total approach to his scientific research that was objective, analytical, and replicable. Indeed, Lee Cronbach (1984) at Stanford University judged that, "[Cattell's] thirty-year evolution of ... methodology fed on bold conjecture, self-criticism, unbridled imagination, rational comparison of models in the abstract, and responsiveness to the nasty surprises of data. The story epitomizes scientific effort at its best."

Together with his wife Karen, Cattell built a psychological test publishing company – the *Institute for Personality and Ability Testing* (IPAT) which has produced many sophisticated psychological measurement instruments [the *Performance Assessment Network* (PAN) Indiana, USA is now the parent company]. IPAT researchers have constructed a wide range of psychometric instruments such as the *Sixteen Personality Factor Questionnaire* (16PF), and its downward extensions – the *High School Personality Questionnaire* (HSPQ), and the *Early School Personality Questionnaire* (ESPQ); the *Clinical Analysis Questionnaire* (CAQ) – revised as the *Psychological Evaluation Questionnaire* (PEQ) – which measures both the 16PF normal personality factors as well as an additional 12 abnormal personality factors; the *Objective-Analytic Battery* (OAB) – which provides objective (T-data) tests of 10 major personality factors; the *Motivation Analysis Test* (MAT), which is an objective measure of 10 important dynamic motivational trait dimensions, and its downward extensions – the *School Motivation Analysis Test* (SMAT), and the *Children's Motivational Analysis Test* (CMAT); the *Eight State Questionnaire* (8SQ) – a self-report rating scale which measures eight clinically important emotional/mood states; the *Comprehensive Ability Battery* (CAB) – which measures 20 primary ability factors; and the *Culture-Fair Intelligence Test* (CFIT) – which minimizes the role of language and cultural learning in measuring intellectual ability.

The 16PF questionnaire is the perhaps best known of the many Cattellian psychometric instruments. The 16PF is a self-report (Q-data) measure of 16 primary personality trait dimensions. When the intercorrelations of these primary traits were subjected to second-order factor analysis, Cattell found that the primary traits coalesced into at least five second-stratum personality dimensions preceding the currently popular "Big Five" and the associated Five Factor Model (FFM) that were derived from analysing a restricted subset of only 20 of Cattell's original 36 personality trait clusters – (see Cattell, 1995; Krug & Johns, 1986). Boyle (2008) reported that the putative "Big Five" account for no more than 57% of the normal trait variance, let alone the abnormal trait variance, resulting from the restricted sampling of trait variables, thereby suggesting the need for extraction of additional second-stratum personality dimensions. The primary factors (traits such as warmth, self-control, dominance) have been found to be more powerful in predicting actual behavior. The 16PF remains a highly cited self-report measure of trait constructs and has grown to be one of the most widely used measures of normal-range personality in the world. The 16PF questionnaire has been translated and adapted into many different languages and cultures and is widely used especially in the USA, UK, Europe, Australia, Canada, South America, and some parts of Asia. The 16PF has been used to assist in individual and group counseling, career guidance, employment selection and coaching (including selection for critical occupations such as Antarctic Expeditioners), clinical and counselling psychology, as well as for research.

Cattell made many contributions to the study of intelligence. Important was his attempt to construct a *Culture-free Intelligence Test*. This led to the development of figural matrices tests that are widely used in contemporary studies of fluid abilities (Gf) today. Another significant contribution was the investment theory (Cattell, 1987). Thus, crystallized intelligence (Gc) is said to reflect acculturational learning whereby learning outcomes are organized in the culture to help convert intellectual capacities captured by Gf into a form of intelligence deemed useful within a particular society. These learning experiences are accompanied by systems of reward and punishment that enhance or exclude some classes of behavior from one's behavioral repertoire.

Cattell was proactively involved in promoting international research collaboration. For example, in 1960 he founded the *Society for Multivariate Experimental Psychology* (SMEP), and its flagship journal *Multivariate Behavioral Research*, and subsequently produced two editions of the *Handbook of Multivariate Experimental Psychology*. For many years, the *American Educational Research Association* (AERA) has honored an outstanding researcher with the *Raymond. B. Cattell Award*. Likewise, the *Cattell Early Career Research Award* is given annually by SMEP to a young researcher who has made an outstanding contribution to multivariate experimental psychology and shows promise of continued work of a very high quality.

Cattell received many academic accolades, awards and honors, including the Darwin Fellowship in 1935; the Wenner-Gren Prize of the New York Academy of Sciences in 1950; elected American Psychological Association (APA) Fellow; elected President of the Society of Multivariate Experimental Psychology (SMEP) in 1961; recipient of the Wisdom Award of Honor, 1970; election to the British Psychological Society (BPS) roster of distinguished foreign psychologists in 1981; recipient of the Educational Testing Service (ETS) Award for Distinguished Service to Measurement in 1982; recipient of the APA Award for Psychometrics in 1983; and the Festschrift in honor of Cattell's lifetime contributions to psychological research and practice in 1986 (Miller, 1988). As a mark of respect for Cattell's prodigious scientific achievements, in 2014, the Raymond B. Cattell Scholarship was established by the Department of Psychology at the University of Illinois. Finally, in 1997, the APA announced that Cattell (at age 92 years) was to receive psychology's most prestigious

honor, the American Psychological Foundation Gold Medal Award for Life Achievement in Psychological Science.

However, despite Cattell's indisputable scientific contributions, with no fewer than seven past APA presidents recommending him for the Gold Medal Award, at the last moment the Award was withheld due to an overtly political attack from two hostile critics (see Boyle et al., 2016). Contrary to the asseverations of these critics, Cattell had clearly eschewed racism and fascism (Dreger & Berg, 1998). In an open letter to the APA, Cattell (1997) declared that, *"I abhor racism and discrimination based on race. Any other belief would be antithetical to my life's work"*. John Gillis (Cattell's official biographer) demonstrated unequivocally that these detractors had seriously distorted Cattell's position by taking quotes out of context, inserting their own words between his quotes, and referencing outdated writings from the 1920s and 1930s thereby giving a seriously false and misleading impression (Gillis, 2007). According to Gorsuch (1998), *"The charge of racism is 180 degrees off track. [Cattell] was the first one to challenge the racial bias in tests and to attempt to reduce that problem"* (as early as 1940, he had already devised the *Culture Fair Intelligence Test*). In 1984, Cattell had specifically cautioned that eugenics should be considered only in relation to individual differences (such as eliminating genetically inherited diseases), not racial differences, and that birth control should be entirely voluntary. In addition, Cattell had emphasized that each culture should follow *"its own path to maximize its own values and goals without suppression from any other culture"* (Gorsuch, 1998).

Regarding the unsolicited accusations that resulted in withholding Cattell's Gold Medal Award, in an independent analysis, Lotz (2008) concluded that, *"Cattell was deliberately misquoted on many occasions and labelled as an academic racist. The views he developed in the 1930s were common among his contemporaries when beliefs in racial differences were widely held, and should not be distorted by judgment according to today's standards. General scientific observations should not be read as personal moral statements. He was particularly wronged during the 1990s by certain writers (William H. Tucker and Barry Mehler) who picked out certain references referring to Germany, Hitler or genocide and quoted them out of context."* (p. 136). Cattell was frail and in rapidly deteriorating health at the time of the Gold Medal Award, and passed away before he was able to correct these serious misrepresentations. In a recent (2014) review, Revelle concluded that this *"spoke more about the political correctness of the APA than it did about the beliefs of a very creative and productive scholar."*

Cattell was a humanitarian. Not only was he a scientist with high ideals in the pursuit of truth, but also he was a kind and generous man who had good intentions (as exemplified by the lasting legacy of a school he left for the impoverished children of Cambodia facing poor or non-existent opportunities for even a basic education). Cattell was proactive in mentoring his students and in collaborating with researchers all around the world. He would discuss their research interests with them at length, and encouraged and facilitated their projects. He also was well-known for giving helpful advice and support when they ran into career or personal obstacles.

Cattell had been described by Goldberg (1968) as psychology's *"master strategist"*. Few other psychologists have had as much influence on contemporary scientific psychology as has Cattell. John Horn wrote in 1998 that, *"Cattell's research has contributed immensely to the breadth and depth of modern scientific psychology, both directly and through the hundreds of colleagues and students around the world with whom he worked.... in his remarkable 70-year career, Raymond B. Cattell has made prodigious, landmark contributions to psychology, including factor analytic mapping of the domains of personality, motivation, and abilities; exploration of three different media of assessment; separation of fluid and crystallized intelligence; and numerous methodological*

innovations....[Cattell] must be considered among a very small handful of people... who have most influenced the shape of psychology as a science."

Regarding metrics (see Haggbloom et al., 2002), Hans Eysenck (1985) had previously reported that, "According to the Citation Index ...Of the two hundred and fifty most cited scientists, only three psychologists made the grade, namely, Sigmund Freud in the first place, then the reviewer [H.J. Eysenck], and then Cattell. Thus there is no question that Cattell has made a tremendous impression on psychology and science in general." Dreger and Berg (1998) concluded that there can be little doubt that, "Raymond B. Cattell was one of the half dozen greatest psychologists of the twentieth century."

See Also:

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Biography

Gregory J. Boyle is a Professorial Fellow at the University of Melbourne. Previously, he served as Professor of Psychology at Bond University for over 20 years and was Associate Dean for Research for several years. He is a Fellow of the Australian Psychological Society, and the Association for Psychological Science. He has received the Buros Institute of Mental Measurements Distinguished Reviewer Award, and honored with conferral of a higher Doctorate of Science degree from the University of Queensland. He has more than 200 publications, is co-author of a book on statistical methods, and is Senior Editor of several international psychology handbooks.