



Santo Di Nuovo
Maria Sinatra
(Editors)

How to Measure Mind

A Historical and
Epistemological Approach to
Psychological Assessment

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Preface

In 1981, in his book *The Mismeasure of Man*, Jay Gould outlined two main errors in the measurement of human mental faculties: reification, i.e., the tendency to treat abstract concepts as objective entities, and forced ranking, i.e., ordering the variations of complex issues on a gradual scale. The measurement of the intellectual quotient (IQ) is the core example of these scientific fallacies, with both social (e.g., racism) and applicative consequences.

Since the publication of that critical and controversial book, the measurement of mental functions has made significant technical progress. Many relevant advances in psychometrics have overcome shortcomings in the reliability of assessment instruments. Not as much progress has been gained, however, from debates surrounding the motivation and the meaning of measuring the mind. We still have to deal with the theoretically defined problem of the objectification of mental faculties (e.g., intelligence, personality, adaptation) – and with the difficulties arising from the influence of subjectivity both on the object being measured and the mind measuring it. In addition, the question remains: What are the consequences of measuring complex and interdependent functions and scaling these measurements for psychometric instruments?

The prevailing methods in laboratory research – to which psychotechnics were linked from the beginning – are inadequate for analyzing the phenomena that occur in contexts in which means to control the intervening variables are limited and the measurement error strongly increases, for example, with the assessment in fields such as neuropsychological rehabilitation, education, and training, social and organizational psychology, clinical psychology, and psychotherapy. In these fields, many of the measurement instruments, although technically reliable, have less external validity than necessary for applicative purposes. How can we preserve objectivity in such fields of psychological measurement? Can new technologies help to tackle this old challenge?

Our collective work about the measurement of mind does not focus on the “how,” i.e., the technical aspects of psychological assessment and testing, which have been well treated in many textbooks, nor on listing the countless instruments available, whose constantly updated information is better found online in the catalogs of publishing houses.

The authors of this book approach their subjects from their respective different theoretical and experiential backgrounds, while also referring to their national traditions; they take a general perspective to explore the “why,” i.e., the meaning behind measuring mental functions using psychotechnics. They adopt a historical and epistemological approach and con-

sider how measuring the mind was born and developed within the affirmation of psychology as an empirical science. The main question addressed in the book is thus: Can subjectivity be assessed using an (allegedly) objective methodology and psychometric techniques?

The topics cover the debate between objectification and subjectivity, present from the very beginning of the history of psychology and persisting – though often little considered – in contemporary methodology. This debate applies to both laboratory techniques and the psychometric tests initially derived from them. Why, and to what extent, is testing a part of experimental psychology? To successfully use tests within it, we must evaluate their epistemological boundaries and the possible developments, including those recently linked to artificial intelligence. We consider the different assessment methods of cognitive and personality aspects and the purposes leading to their detection and modification over time. We devote attention to new technologies suitable to supporting psychological evaluation and its applications in the educational and rehabilitative field. Maria Sinatra's introductory chapter reaches back to the birth of scientific psychology, furthering the implications of the subject-object relation in pre-Wundtian times.

Horst Gundlach's contribution summarizes the development of psychotechnics in Germany in the 19th century, focusing on the figure and the work of Walther Moede, a pioneer in this field, to exemplify some problems and conflicts that exist to the present day in the measurement of psychological functions outside the laboratory.

Luigi Traetta deals with the experimental techniques used in Wilhelm Wundt's laboratory to understand the epistemological reasons underlying the dual concept of the observer and the observed as well as the issue of observing the self as an object.

Santo Di Nuovo retraces the history and methods of psychometric tests from the early instruments to the present advancements, discussing the alleged objectivity of measuring the mind through psychological testing. The question remains: How to assure an objective assessment of subjectivity in psychological research and applications?

Herbert Fitzek addresses the methodological question from a qualitative point of view, thus explaining the role played by in-depth interviews in their relationship with self-observation in morphological psychology.

Alessandro Di Nuovo and Daniela Conti expose the new frontiers of psychometrics, i.e., how artificial intelligence can help to build computerized adaptive testing, and to what extent artificial agents may be suitable in psychological assessment.

Finally, the chapter by Pierpaolo Limone presents the intriguing journey "from subject to object and vice versa" in the processes and techniques of e-learning evaluation, outlining both the history and epistemology of eval-

uation aimed at educational goals, which form the grounds for establishing suitable e-learning procedures so common during the current pandemic.

We hope that the book will be useful to scholars who want to deepen their understanding of the historical and epistemological roots of psychological assessment as well as to psychologists who want to rediscover the role of psychotechnics in their professional practice.

Santo Di Nuovo and Maria Sinatra

Chapter 4

Psychometrics: From the Past to the Present

Santo Di Nuovo

The Early “Reactive” Psychological Instruments

In 1902, Titchener wrote that the psychological experiment with humans consists of introspection, or a series of introspections, conducted under standard conditions. This aspect differentiates experiments with humans from those with animals or natural objects, typical of laboratory research, using methods shared with other disciplines (e.g., physiology, physics, and chemistry).

The early attempts to quantify individual responses to standard stimuli (i.e., the test as a diagnostic “reactive”) were developed to measure the differences among persons in responding to standardized stimuli, administered under standardized conditions. In these psychological tests, introspection was the basis for understanding the required task and giving verbal or performance responses to the stimuli. The psychometric criteria introduced the specific aim of comparing these responses with a “norm”: an aim not included in the first psychological experiments in the laboratory.

A boost to psychometrics came at the end of the 19th century from Francis Galton (1883), who, in his “anthropometric” laboratory (Figure 4.1), aimed at measuring psychophysical behaviors in samples of thousands of people, through his “reactive” such as reaction times to visual and auditory stimuli.

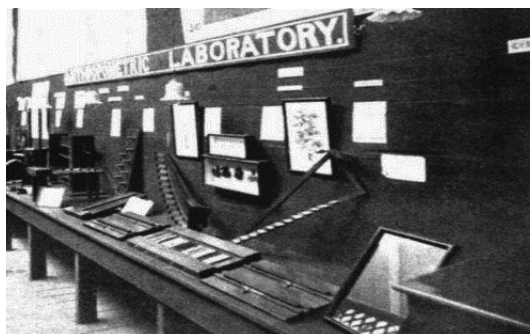


Figure 4.1 Galton's anthropometric laboratory in London. Late 19th century. Source: Pearson, K. (1914–1930). *The life, letters and labours of Francis Galton*. Cambridge University Press.

James McKeen Cattell (1890) imported Galton's methods to the United States, wanting to affirm the scientific nature of psychology on a par with disciplines such as physics and chemistry. He first defined mental tests, which were not limited to behavioral responses but included verbal answers to verbal stimuli.

Yet several issues, both theoretical and practical, emerged from these initial attempts to measure the human mind using the test as a "portable laboratory." The theoretical issues concerned the possibility of "objectively" quantifying aspects of human subjectivity, overcoming the simple observation of behavior typical of the studies with animals. Doubts arose about the predictive value of mental tests on the expected abilities. A pertinent example derived from academic achievement: children with high levels of intelligence as measured by the test were poor learners and vice-versa.

Moreover, the first mental tests measured only a part of the mental abilities useful for a complete diagnosis, since they were based almost exclusively on reaction times. Therefore, success in academic learning and emotional adaptation to the context were only partially connected to the specific skills measured by the tests, as this success depends on other variables *not* included in the "reactive."

Furthermore, Cattell's test subjects were prevalently university students, i.e., with a high level of education and in whom the relationship between what the tests actually measured (the speed of cognitive response) and academic achievement is not particularly relevant. To overcome these initial limitations, the aim of measurement should regard less psychophysiological functions and more cognitive and/or emotional (i.e., more introspective) competencies. Another goal should be to study in a more targeted way the different phases in which these capabilities develop. These goals were very different than those of the laboratory research behind the tests, and far from the behavioral approach typical of the first attempts to "measure" the human mind.

Attempts to Measure Intelligence: From Mental Age to IQ, Including Criticisms

At the beginning of the last century, Alfred Binet and Théodore Simon (1905, 1908), a psychologist and a physician, appointed by the French Ministry of Education, prepared a test aimed at discriminating students who had differentiated educational needs.

In France, as in Italy, tests on developmental functions were sought in that period to meet the problems of public education, urged on by progres-

Chapter 6

The New Frontiers of Psychometrics: From Computerized Adaptive Testing to the Use of Artificial Agents and E-Assessment

Alessandro Di Nuovo and Daniela Conti

The Introduction of Computerization in Diagnosis: Advantages and Limitations

A study sponsored by the European Commission (Scheuermann & Björnsson, 2009) summarized the advantages and critical issues of the new and widely used approaches to computer-based assessment, mainly in the educational field. The study highlighted the necessary technical requirements and their costs/benefits for a transition from paper-pencil tests to computerized testing.

Computerized testing has remote origins (for a review, see Drasgow & Olson-Buchanan, 1999; Olson-Buchanan, 2002). One of the first attempts was presented in a doctoral thesis by Lichtenwald (1986), who studied the reliability and validity of the computer version of the Peabody Picture Vocabulary Test-Revised by comparing it with the paper version.

Computerization first became an aid in the scoring of psychodiagnostic tests through the optical recognition of answer sheets. The Minnesota Multiphasic Personality Inventory (MMPI) evaluation developed by the Mayo Clinic in Rochester was already pioneered at the end of the 1950s. This automatic scoring method spread rapidly, resulting in significant advantages in terms of speed and precision compared to manual calculation through evaluation grids. Furthermore, the electronic storage of all results produced by individual administrations in open databases allows the constant updating and refining of calibrations and standardizations of the psychometric tools in specific cultural and social contexts.

In formulating the diagnosis, computerization allows a psychopathological profile of the subject to be produced and compared with the clusters predeter-

mined by the same computer program, thus making it possible to calculate the likelihood that each new patient falls into one of the psychopathological categories. The first computerized tests were based on these clinician-modeled principles, which emulated the diagnostic procedure generally followed by clinicians, for example, the DIAGNO II, derived from CAPPS – Current and Past Psychopathology Scale (Spitzer & Endicott, 1969) and the CATEGO, based on the PSE – Present Status Examination (Wing et al., 1974).

In the 1980s, the introduction of personal computers and simple programming languages, like BASIC, favored the spread of computerized testing. The most important international test publishers promptly adapted their publications to the new market, albeit not without controversy on the part of those who (even today) dispute the online administration and postal return of computer-formulated profiles. The argument is that this procedure removes essential components of the diagnostic work from the awareness of the psychologist practitioners.

Regarding administration, it was highlighted that – despite the increased reliability thanks to the higher level of standardization and the reduction of bias and “halo effects” – the use of a computer significantly substitutes the interaction between the psychologist and the user. But this interaction is necessary for the evaluation of nonverbal aspects, which complement the psychometric measurement of skills and personality traits and are useful for the overall “understanding” of the subject under examination.

To avoid a passive and naïve use of automation, a conceptual step forward to allow the computerized tool to plan and propose alternatives based on the data of the problem and environmental conditions was requested, resulting in a push toward the individualization and contextualization of psychological testing, which was soon picked up with the possibility of automating the adaptation of the computerized tool to the individual subject under examination, mainly in performance tests.

“Adaptive” Testing

The first computerized adaptive testing (Sands et al., 1997) continued an established concept of individualized instruction for diagnostic purposes. Specifically, the computerized test could perform a progressive adjustment of the tests to the current state of knowledge and performance of the subject, so that it doesn’t propose tests that are too difficult or too easy but starting from the baseline determined at the beginning of testing, and progressively adapted to the level reached.

The same criterion is used (but at the discretion of the evaluator) in *dynamic testing*, which was the same method used – even previously – by Binet