

Psychometrics: The Measurement of the Soul

Ψυχομετρία: Η μέτρηση της Ψυχής

By

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The term psychometrics has its origin in the Greek words of *psyche* (ψυχή) and *metrisis* (μέτρησης) and translates as “the measurement of the soul.” But as a scientific discipline, psychometrics is not concerned with soul gazing that much. Instead, it examines how a psychological construct, such as intelligence or depression, is best related to, for example, the outcome of a psychological test, a genetic profile, or neuroscientific information. A psychometrician might be involved with designing a psychological test, formalizing a psychological theory, or constructing a statistical model for analyzing psychological data. As such, it is to a large extent a statistically oriented field, with connections to biometrics, econometrics, and mathematical psychology.

To me, it all started back in 1904, when the English psychologist Charles Spearman reported the positive manifold --a pattern of exclusively positive correlations between cognitive test scores. This pattern suggests that pupils who score high in one cognitive domain, such as spelling, tend to also score high in others, such as arithmetic. In 1927, Spearman proposed his famous g-factor theory of general intelligence to explain the positive manifold. This theory suggests that an unobservable mental factor causes observed behavior. Individual differences in intelligence generate variation in test scores. Spearman’s hypothesis was one of the first serious psychometric theories explaining how a psychological construct such as intelligence is best related to observed test scores. The factor analysis technique that Spearman had invented along the way proved to be a valuable statistical method to estimate such an unknown psychological factor from observed performance. (In fact, Spearman’s factor analysis of educational test scores inspired his theory.)

Nowadays, psychological tests are commonplace in, for example, job selection and student placement. Given their importance in selecting individuals, we must carefully analyze their performance. In line with Spearman’s original ideas, psychometricians usually examine test performance using measurement models that stipulate a latent variable as the cause of the observed responses to test questions. Standard measurement models in this context are factor analysis, item response theory, and classical test theory. Psychometricians use these measurement models to answer questions related to the test’s quality. Does the test generate consistent scores under similar circumstances? Is the test fair (i.e., is response

behavior comparable across different subgroups)? And are the scores from different test forms comparable?

Charles Spearman's influence on contemporary psychometrics is undeniable. Yet, the field has also evolved in many ways. Our conceptual understanding led to new psychometric theories. For example, multifactor theories can explain more advanced correlational patterns, and dynamic factor theories can explain how such patterns evolve. Sophisticated statistical models are now in place to model the complex nature of contemporary psychological data. For example, the intricate designs of large-scale educational surveys, with pupils nested in different schools, cities, and educational systems, and tests administered at various times. And the rich data that comes from computer-based testing and monitoring using wearable devices continues to drive statistical innovations.

In 2006, Han van der Maas, a psychologist from Amsterdam and chair of our research group, proposed a serious contender to Spearman's original ideas. His mutualism theory shows that intelligent behavior –and the positive manifold– could evolve during development from mutualistic interactions between cognitive, behavioral, and biological factors rather than from an unknown mental factor. Mutualism theory sparked a new psychometric subfield that defines psychological constructs such as intelligence as complex systems. The local interactions between the elements of these systems form a network. Psychometric network theory asks how psychological phenomena emerge from these local interactions, while psychometric network analysis aims to infer these local interactions from empirical data. Spearman's approach to general intelligence led to factor theories and analyses in nearly all psychological domains. A century later, van der Maas's network approach to general intelligence is doing precisely the same. A network revolution has begun.