

GALTON: The First Psychometrician?

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Ever wonder how many brush strokes it takes to create a painting? Or how to measure boredom, attraction to the opposite sex, the efficacy of prayer, or the intelligence of earthworms? Sir Francis Galton wondered about these things and set out to develop procedures and instruments by which such questions could be answered and replicated. In fact, he counted *everything* that appeared to have any form of regularity.

He counted brush strokes while sitting for his own portrait at two different times in his life. Karl Pearson suggested his "pained" expression was due to his concentration while counting. It took about 24,000 strokes for each painting.

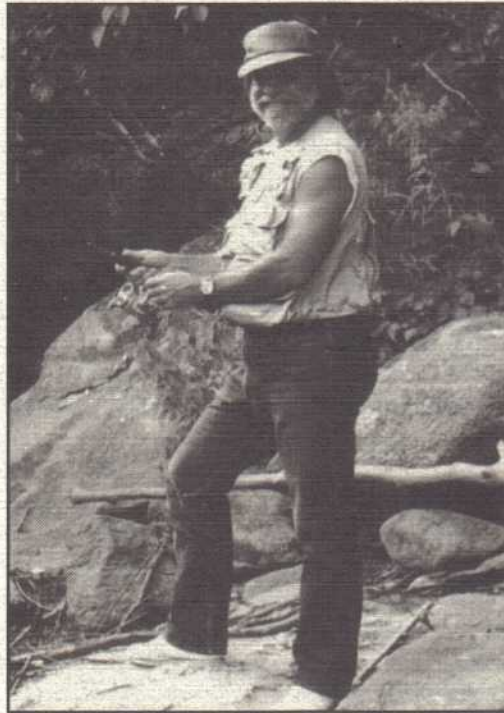
He counted spikes of flowers on trees. By counting the spikes of flowers on a typical tree, and then the number of trees along a one mile stretch of road, he estimated that the number "one million" could be represented as the flowers on a row of trees ten miles in length.

He counted the fidgets of persons sitting through a boring lecture. He investigated the "instances in which men who are more or less illustrious have eminent kinfolks." This was the basis for his argument that genius is hereditary (Galton, 1869). One conclusion was that great commanders tend to be small because their relative chance of being shot varies as the square root of the product of their height and weight.

When looking at facial features, he wondered whether persons with differentiated mental characteristics also have differentiated physical features. He actually attempted the development of composite portraits for "ideal criminal" classes. He also looked at the numbers of attractive, indifferent, and repellent-looking women. The objective was to form a "Beauty Map" of the British Isles.

Galton's work produced many "firsts." His investigation of points of similarity between twins was the first use of control groups in psychological research. His research into variations in weather conditions resulted in the first published meteorological maps of Europe. His work on fingerprint characteristics led to the legal use of fingerprint identification.

He counted earthworms on a rainy sidewalk when he was helping Charles Darwin investigate the intelligence of



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worms. He examined the degrees of vividness of mental imagery, and the instances of phantasmagoria, causes of snoring, and on and on. He seems to have always carried a notebook and some type of ingenious device capable of pricking a piece of paper by which he recorded, unobtrusively, various aspects of events occurring around him. He even performed arithmetic by taste and smell.

What, you might reasonably ask, is the purpose of this article? It was written because it provides some relatively obscure, yet fascinating, information on the early history of psychometrics. For some years now I have taught a course in psychometrics. An important feature of the material covered in the course is the historical context within which the models and methods we employ have evolved. However, my lectures never included anything about Galton other than his development of regression and

correlation. A little-appreciated fact is that Galton's original version of regression analysis consisted of reading the "inclination" off a graph of medians, labeling it r as a coefficient of "reversion," and then using it as an "index of co-relation." Correlation, as we know it, was actually a byproduct of regression. (See Pearson, 1930, Vol. IIIA, Chap XIV.)

My approach to the history of psychometrics is fairly standard. It begins with the classical German psychophysics of the 1800's with Weber, Wundt, and Fechner, moves into the 1900's ability testing movement with Cattell, Binet, and Spearman, and then into the psychological scaling methods associated with Thurstone. Modern test theory texts are introduced where standard presentations include something like "the field of psychometrics has a history of growth and development extending over some 75 years since the early work of Binet in France and Spearman in England" (Thorndike, 1982, p 1). And "psychometric methods" is simply defined as "procedures for psychological measurement" (Guilford, 1954, p 1). Standard stuff.

But, while working on a project tracing the role that residuals have played in the evolution of scientific models, I stumbled across some early research of Galton's. Practically everything a reasonable (or obsessed) person might want to know about Galton appears to be covered in the four volumes

of The Life, Letters and Labours of Francis Galton by Karl Pearson. In particular I became intrigued with his reference to "psychometric experiments" and I subsequently set out to track down the original use of the word "psychometrics." That effort resulted in this paper.

Galton's interests in mental operations led him to propose a "new instance of psychometry" (Galton, 1879, p 149). In his article, "Psychometric Experiments," he defined "psychometry" as the "art of imposing measurement and number upon operations of the mind." He then argued that "until the phenomena of any branch of knowledge have been subjected to measurement and numbers, it cannot assume the status or dignity of a science."

There are two interesting points in these quotes. First, I assumed psychometry was simply a term coined by Galton and that it represented some transference of Galton's experiences in the German psychophysics labs to the realm of "mind." It turns out that there was a "science of psychometry" during the mid-to-late 1800's devoted to the investigation of mental divining of qualities and properties of objects or persons by a "psychometrician" (Buchanan, 1854).

Second, his quote is remarkably similar in spirit to William Thomson's circa 1883 famous dictum about measurement and science. See Merton et al. for what Baron Kelvin of Largs, or Lord Kelvin (William Thomson at the time) said, and how and why it differs from what is engraved in the facade of the University of Chicago Social Science research building. Actually, the statement's sentiment can be traced back to John Arbuthnot (1692). His work illustrated what he called the psychometric side of anthropology.

For his 1879 article Galton repeated an experiment in "mental operations" four times, under different circumstances, at intervals of about one month. The experiment consisted of recording the "thoughts arisen through direct association" with a list of 75 words. He did not publish his lists because "they lay bare the foundations of a man's thoughts with curious distinctness, and exhibit his mental anatomy with more vividness and truth than he would probably care to publish to the world." This is a good example of the honest and open writing style so characteristic of the period. In other words, he conducted experiments in what we now call free-association. This could well be the earliest investigation of free-association, a psychoanalytic technique developed from the 'talking cure' and Freud's interpretation of dreams (Berg and Pennington, 1966, p 594)). He threw his resulting thoughts into a "common statistical hotch-pot" (This sounds like our word "hodgepodge" and our analysis called the "shotgun approach"). Galton determined (a) the rate at which ideas were formed (50 per minute), (b) the frequency of recurrent associations (about one half), (c) the frequency within periods of his life that associations could be attributed (showing "in a measurable degree, the large effect of early education in fixing our associations"), and (d) the character of associations that occurred (verbal, sensory, "histrionic").

The significance of this article is that it is, I believe, the first published investigation in the field that we presently know as psychometrics. Although he had notes titled "Psychometric Inquiries 1876," and published "Psychometric Facts" in *Nineteenth Century*, March 1879, p 425-33, they were not of a statistical nature. Granted, Galton's psychometric research differs somewhat from what we, as psychometricians, typically mean when we say we are conducting psychometric analyses, but his work is compatible with our current approach to psychometrics. That is, psychometrics is the quantification of psychological phenomena.

What else does Galton have to offer? When addressing mental tests he states:

"There are many faculties that may be said to be potentially constant in adults though they are not developed, owing to want of exercise. After adequate practice, a limit of efficiency would in each case be attained and this would be a personal constant (emphasis added); but it is obviously impossible to guess what that constant would be from the results of a single trial. No test professes to do more than show the efficiency of the faculty at the time it was applied, and many tests do even less than this" (Galton (1885), in Pearson, Vol. II, pp. 371-2).

This quote contains the kernel of the classical true-score concept, including notions of reliability and validity. Note also that the quote appears 20 years earlier than the seminal work on measurement error by Spearman. Galton, the first psychometrician?..Yes.

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Professional interests: developing interesting graphical representations of multivariate data (visualizing an eigenvector), and applying psychometric models in situations where the results have an obvious practical utility (scaling flute performance).

Personal interests: woodcarving, sketching, and motorcycling.

Last book read: Arthur Koestler, *The Sleepwalkers*.

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