

# This Week's Citation Classic®

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Kaiser H F. The application of electronic computers to factor analysis.  
*Educ. Psychol. Meas.* 20:141-51, 1960.  
[Bureau of Educational Research, University of Illinois, Urbana-Champaign, IL]

The use of computers in factor analysis with an emphasis on theory is treated in detail. Particular emphasis is given to the number-of-factors question. [The *Social Sciences Citation Index*® (SSCI®) and the *Science Citation Index*® (SCI®) indicate that this paper has been cited in over 225 publications.]

Henry F. Kaiser  
School of Education  
University of California  
Berkeley, CA 94720

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The above paper is a symposium talk, not a report of research. It is cited so much because it mentions, as nothing more than an aside, my rule for the number of factors in factor analysis. This rule is in extensive use in the scientific community.

In the late summer of 1959, Cletus J. Burke, distinguished professor of psychology at Indiana University, phoned me and asked that I prepare and read a paper at a symposium he was organizing for the fall meeting of the American Psychological Association at Cincinnati. My topic: computers in factor analysis. I accepted immediately, as I, a mere assistant professor of education at Illinois, was flattered to be approached by so eminent a scholar. This was not to be a research paper; my job was to pontificate wisely about my topic. In this role I was to be something of a Premature Elder Statesman.

But I did not prepare my talk immediately. At the time, I was working hard on an involved research paper for these Cincinnati meetings. Indeed, it was not until the Friday evening before the Monday morning I was to read the paper that I dictated it. My devoted secretary, Joyce Fasnacht, came into the office and typed my Golden Words on Saturday morning.

An interesting sidelight: I dictated the words "primordial" and "cloacal." When typed, I had no idea what they meant. Upon consulting a dictionary, I found that I had used them correctly. Was this subconscious knowledge?

Upon arriving in Cincinnati Sunday morning, I immediately started polishing my talk. I stayed up until 4 a.m. Monday morning with this task. At 10 a.m. I read the paper. It was a great success. Burke told me that I had neatly captured the spirit of the use of electronic computers, bouncing around great batches of data without pausing over the details.

When I returned to Urbana-Champaign, I set out to prepare my talk for publication. In this task, I was helped immensely by my colleague, N.L. Gage, who had just the right touch in converting my paper from oral presentation to written presentation.

The paper was accepted for publication by *Educational and Psychological Measurement* with no difficulty and appeared in print in early 1960.

Almost all of this paper is of no interest today; other than a certain spirit about the use of computers, substantively it is long since out of date. It is a *Citation Classic* because I mentioned, in passing, my formula, derived in 1957 but not then published, for Cronbach's coefficient alpha of a principal component: "One remarkably simple result is that for a principal component to have positive Kuder-Richardson reliability (coefficient alpha) it is necessary and sufficient that the associated eigenvalue be greater than one." This is the theoretical justification for far and away the most popular rule of behavior for determining the number of factors in factor analysis, the most difficult problem in all of factor analysis.<sup>1,2</sup> It is the default option in most computer centers throughout the world and it has been used literally hundreds of thousands of times in practice.

1. Gorsuch R L. Determining the number of factors. *Factor analysis*. Philadelphia: Saunders, 1974. p. 130-60. (Cited 325 times.)
2. ———. *Factor analysis*. Philadelphia: Saunders, 1986. (In press.)

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