

Creative Abduction, Factor Analysis, and the Causes of Liberal Democracy



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Abstract

The ultimate focus of the current essay is on methods of “creative abduction” that have some guarantees as reliable guides to the truth, and those that do not. Emphasizing work by Richard Englehart using data from the World Values Survey, Gerhard Schurz has analyzed literature surrounding Samuel Huntington’s well-known claims that civilization is divided into eight contending traditions, some of which resist “modernization” – democracy, civil rights, equality of rights of women and minorities, secularism. Schurz suggests an evolutionary model of modernization and identifies opposing social forces. In a later essay, citing Englehart’s work as an example, Schurz identifies factor analysis as an example of “creative abduction”. The theories of Englehart and his collaborators are reviewed again in the current essay. Published simulations and standard statistical desiderata for causal inference show the methods Englehart used, factor analysis in particular, are not guides to truth for the kind of data Schurz recognizes as common in political science. Recent work in statistics, philosophy and computer science that makes advances towards such methods is briefly reviewed.

Keywords: *Clash of Civilizations, Factor Analysis, Creative Abduction, Reliable Causal Discovery*

1 Introduction

Among his philosophical essays, Gerhard Schurz’ essay (2013) on “The Clash of Civilizations” is singular. There, Schurz undertakes an empirical consideration of efforts in political science that attempt to explain and predict the development of civilization and human conflict on a grand scale. The theme and the phrasing – a *clash of civilizations* – marking conflicts in our time between Islam and “the West” was introduced in 1990 by Bernard Lewis, the distinguished historian of Islam,

and taken up two years later by Samuel Huntington, the late Harvard political scientist, in an essay in *Foreign Affairs* (1993), soon expanded into an influential book *The Clash of Civilizations and the Remaking of the World Order* (1997). Huntington's work in that book, and his work on ethnic – especially Latin – immigration to the United States, essentially lays out arguments for what became Donald Trump's perspective on foreign policy and immigration. For that reason alone, it seems especially appropriate now to continue Schurz' discussion. More broadly, I want to consider in what respects and where this sort of very macro political science is scientific at all. That question is tied to the statistical methods of political science and political economics, which are chiefly regression, factor analysis and sundry computational classification methods, none of which are sound methods for their usual, if tacit, aim: discovering causes and predicting the effects of policies. Using work on the development of modernity as an example, one of Schurz more recent essays considers factor analysis as a method of "creative abduction." I agree with his description of the ambition of the method, and the appropriateness of the ambition, but I disagree with his assessment of the value of factor analysis to that purpose. Schurz regrets that philosophers of science have not paid much attention to factor analysis. My regret is related but different. The grand philosophical tradition from Aristotle to Descartes to Leibniz to Bacon to Mill (and many in between) was concerned with methods for discovering the "hidden springs" of nature. I view factor analysis as an historically second (after regression) step towards that goal, but one that put a false foot forward. Contemporary research carried out by a handful of philosophers, statisticians and computer scientists are providing demonstrably more reliable methods for "creative abduction." My regret is that contemporary philosophers of science no longer care about the questions, and that few social scientists know of the emerging answers.

So this essay is in three parts: first, a reconsideration of some of the theories of social and political development that Schurz addresses; second, a discussion of defects in the methods used to justify those theories; and third, a review of the methods developed in the last decade or so for "creative abduction," methods that avoid some of the defects of factor analysis.

2 *From The Clash of Civilizations to The Evolution of Just Society*

In the wake of the Iranian revolution, the OPEC oil embargo of the 1980s, the first Intifada, and the first Gulf War, no clairvoyance was required to expect a developing conflict between middle eastern Muslim societies and European and American powers. While American political commentators took these developments to be about oil and Israel, Bernard Lewis placed them in a wider and more ominous context, within a litany of Muslim hostilities specifically to American and European culture, founded on history, mythology, religion and religious liberties, and the sexual aspects of culture, that is, the condition of women in marriage, society and the conduct of domestic life. In contrast to Lewis' rather reserved analysis, Huntington expanded and botanized, dividing the world more or less geographically into eight antithetical "civilizations," from the more aggressive of which (e.g., Islamic, Orthodox (i.e. Russian) and Confucian (i.e., Chinese)) the West should protect itself by controlling immigration and preparing for defensive war. Huntington saw these groups as the contemporary manifestations of historically fundamental attitudes, absorbing western technology but not its values, retaining their characteristic views of religion, government, liberty and the sexes. The takeaway from his essay is that the coming great clashes will be between civilizations, not nations except as they have embraced one or another trans-national civilization.

Huntington's botany and predictions of conflict, and Huntington himself, generated a lot of discussion. Huntington held a distinguished position in political science, but he was politically right-wing on international matters. His nomination to the National Academy of Sciences was blocked by the efforts of Serge Lang, nominally on objections to Huntington's use of mathematics, but one suspects in part on political grounds. Huntington had actively supported the Vietnam war; Lang, and his mathematical allies against Huntington, actively opposed it. Passions ran deep during and after that war.

Part of Huntington's theory was obviously troubled. One can roughly measure the size of conflicts by the number of lives lost. Just preceding Lewis' essay, one of the two most destructive wars since Vietnam was between Iraq and Iran, both part of "Islamic Civilization" even if one side, Iraq, was aided by American and European powers. The human cost was between 1.2 and 1.5 million lives. The other was a genocide internal to Cambodia. In the very years Lewis and Huntington wrote, the civil war in Rwanda, a conflict on ethnic, not "civilization," lines,

killed more than 800,000 people. The number killed in the contemporaneous war in Bosnia, which arguably came closer to fitting Huntington's clash of civilizations, was dramatic smaller, about 100,000. The lives lost since in Islamic terrorist attacks in Europe and the United States are tiny by comparison, although the lives, chiefly civilian, lost in Afghanistan, Pakistan and Iraq from the American and European response are much, much larger. Brown University's Watson Institute estimates that 210,000 civilians had died by 2015, and of course more since.

Edward Said (2001) provided one of the more useful responses to Huntington, which was essentially: where is the data? How did Huntington know that Bin Laden was not just a very successful freak in Islam, as Jim Jones was in Christianity? Where were the interviews with actual people, actual Muslims around the world? But in fact there was a body of data. The World Values Survey, conducted in waves since the late 1980s, asks the same questions in appropriate languages of people in many nations – in the later surveys from 96 nations. The questions address general conditions (e.g., health and education), economics and distribution of wealth, marriage and roles of women, politics, religion, etc. It is frankly amazing that such data has been collected in waves over many years, and aside from more localized PEW studies, it is the best survey of world values we have. Huntington did not use it, and Said, a professor literature, apparently did not know of it, but others have, notably Ronald Inglehart and his collaborators. Inglehart finds the results of the Survey in loose agreement with Huntington's botany of attitudes, and with his claim that the effects of modernization diverge according to traditional cultures (Englehart and Baker, 2000). Huntington's work, and Inglehart's, is naturally set inside the enormous political science literature on "modernization" – what it is, how it develops, what hinders its development, and where and when it will go in the world. That is where Schurz placed it. Inglehart published his views over many years, using the standard methods of quantitative social science, factor analysis and regression, applied to data of the World Values Survey. (A summary of Inglehart's views (In collaboration with Christian Welzel) is given on the World Values Survey website, <http://www.worldvaluessurvey.org/WVSContents.jsp>). Attending to the work of Inglehart, Schurz addressed a formal statistical assessment of the world structure of values and their development. I summarize a book-length statement of the theory by Englehart and Welzel (2005).

Englehart and Welzel extract two latent factors – traditional vs ra-

tional secular values, and survival versus self-expression – from responses to 10 questions, extracted from a much larger number of questions so that changes could be compared across survey waves with different questionnaires. The 10 questions and the latent factors they are claimed to measure are given in Table 1 from Inglehart and Welzel:

Traditional values emphasize the following (Secular-rational values emphasize the opposite):

- a God is very important in respondent's life. .91
- It is more important for a child to learn obedience and religious faith than independence and determination. (Autonomy index) .88
- Abortion is never justifiable. .82
- Respondent has strong sense of national pride. .81
- Respondent favors more respect for authority. .73

Survival values emphasize the following (Self-expression values emphasize the opposite):

- Respondent gives priority to economic and physical security over self-expression and quality of life. (4-item Materialist/ Postmaterialist Values Index) .87
- Respondent describes self as not very happy. .81
- Homosexuality is never justifiable. .77
- Respondent has not and would not sign a petition. .74
- You have to be very careful about trusting people. .46

Table 1 Two Dimensions of Cross-Cultural Variation: Aggregate-Level Analysis Factor Loadings (cf. Inglehart & Welzel 2005, Kindle Locations 1379-1382)

The scores of nations are segmented in any number of ways, for example by national income as in Figure 1, from the same source. And even mapped closely to Huntington's civilizations, as can be seen in Figure 2.

Their story is that agrarian societies are characterized by concern for everyday survival and security, deference to authority, religiosity, and

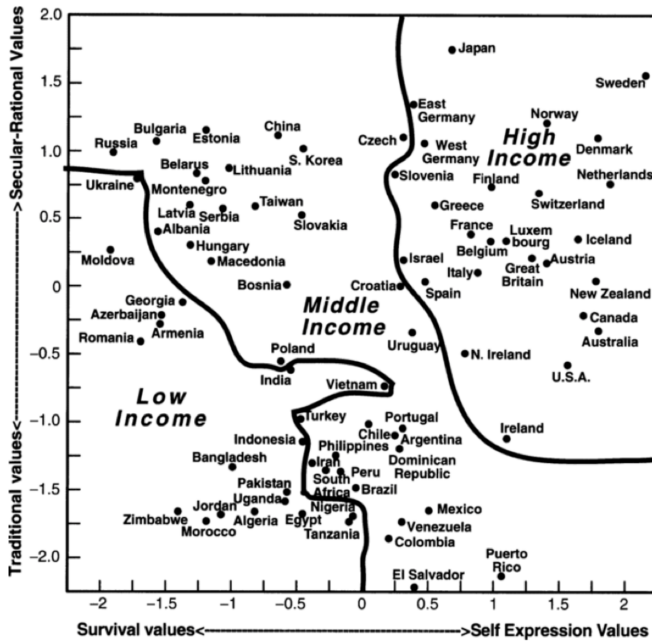


Figure 1

restriction of women. Industrialization brings people together in larger urban groups, where secular and “rational” values emerge – less religion, more planning, more tolerance of diversity and less worry about individual survival. Emerging self-expression values allowed by increasing material security promote democratic institutions. Post-industrial societies develop welfare states, liberal democracies and high tolerance, even enthusiasm, for individual liberties and diverse tastes – “self-expression values.” Think 16th century England; 19th century England; post-World War II Scandinavia, or maybe Haight-Ashbury in the sixties. In their words:

”Socioeconomic development brings increasingly favorable existential conditions and diminishes external constraints on intrinsic human choice. Favorable existential conditions contribute to emerging self-expression values that give individual liberty priority over collective discipline, human diversity over group conformity, and civic autonomy over state author-

ity. The emergence of these values transforms modernization into a process of human development in which the underlying theme is the growth of autonomous human choice, giving rise to a new type of humanistic society that has never existed before. Rising self-expression values provide a social force that operates in favor of democracy, helping to establish democracy where it does not yet exist, and strengthening democracy where it is already in place, improving the effectiveness of democratic institutions.”

”Democracy is the institutional reflection of the emancipative forces inherent in human development, and self-expression values are the best available indicator of these forces.” (Inglehart & Welzel 2005, Kindle Locations 7110-7113; 7126-7127)

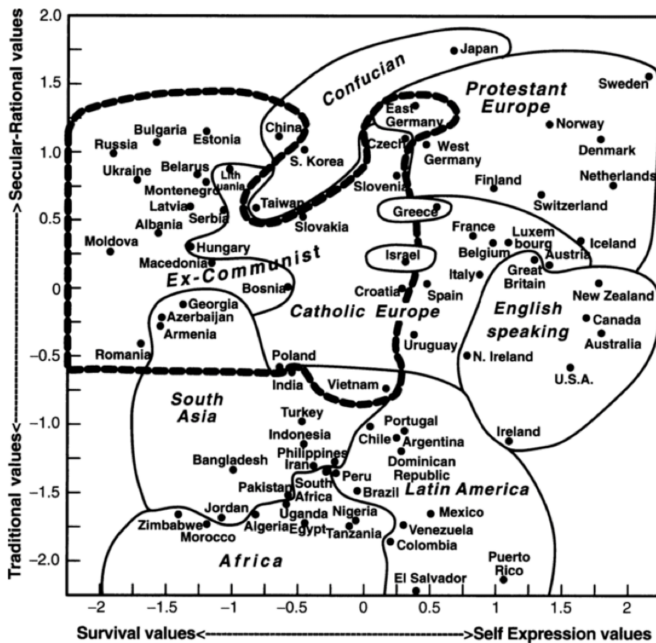


Figure 2

Inglehart and Welzel try to make good on this claim by forming scales of liberty/self-expression and democracy and using them in an unusual set of regressions. Standardly, one would like to include other measures, no-

tably economic development, and do a time-lagged multiple regression, but only after checking whether the distributions of variables are Gaussian and whether the relations linear, adjusting statistics appropriately if they are not, and checking that there is no confounding by unrecorded variables. The authors do something different. In the late 80s and early 90s of the last century a number of new democracies emerged, chiefly because of the collapse of the Soviet empire. The authors have measures for democracy before that period, democracy and self-expression values in the midst of that period, and democracy and self-expression after that period. They do separate regressions, controlling for economic development, of self-expression on democracy in one period and democracy on self-expression in a second period and a third pair of regressions taking earlier values into account:

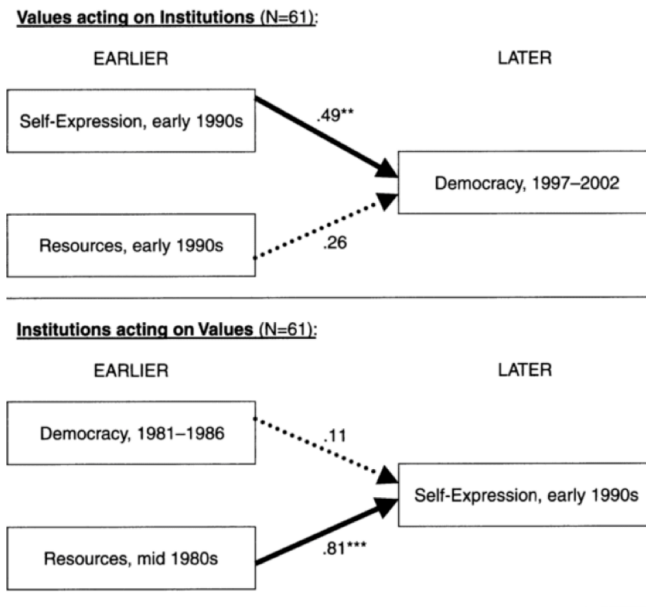


Figure 3

statistics or their causal conclusions. For reasons given in the next section, I have no confidence in their statistical inference methods. But if offered the hypotheses without the surveys and bad statistics, I would have favored theirs anyway, on anecdotal grounds. The successive military coups to sustain liberal democracy in Turkey give evidence that it was never stable – because for a large proportion of Turks Mustafa Kemal’s efforts at producing a liberal mindset did not succeed. The brief democracy in Russia following the collapse of the Soviet Union did not endure because, as the recrudescence of the Orthodox Church suggests, liberal values had never taken widespread hold there. Although he was no democrat, something similar could be said about Pahlavi’s efforts to modernize Iran and its values – it was overwhelmed by the depth and force of tradition. Where liberal values are shaky, as in Turkey, Hungary, Poland, and the United States, we are seeing the emergence of thug regimes in democratic dress.

By and large, the best we can now do in explaining how modernity comes about is history and common sense, and the best we can do in forecasting is much the same. Some things are obvious to anyone paying attention. The population growth in Africa outpaces its economic and educational growth, with predictable unregulated immigration to Europe. The importation of subsidized corn from the United States to Mexico undoes the economies of marginal Mexican farmers, with predictable unregulated immigration to the United States. Because the basic design of missiles and nuclear weapons is widely known, nuclear weapons will proliferate (unless, of course, we all blow ourselves up with those we already have). But detailed political forecasts are chaos. Who could have predicted in 1992 that a well-meaning simpleton, George W. Bush, would be President of the United States ten years later after a murderous attack by hijacked airplanes and that he would use that attack by Saudis as grounds to invade two entirely different countries and spark a third world war involving much of the Levant, North Africa, much of the Arabian peninsula, Russia, the United States and pieces of Europe? Who can predict the effects on the world of an uncouth real estate mogul becoming President of the United States?

3 Considerations of Method

Social scientists spend enormous efforts collecting data and then analyze it in the most casual ways, bending standard tools – linear factor analysis and linear regression – to their data. Inglehart and Welzel do so with

some ingenuity, but consider the reasonable doubts one might have, and arguably should.

Statistical pages using the World Value Survey (Suhr, 2012: <http://support.sas.com/resources/papers/proceedings12/331-2012.pdf>) assure us that factor analysis is not intended for causal inference, but in the same pages, and in Inglehart's work, use it in just that way. (The history given by Suhr (not to be confused with Schurz) and in the sources cited is quite fantastic.) In his 2017 paper Schurz makes the following remarks, which I think are correct but too kind:

"Prima facie, the results of a factor analysis invites for a realistic interpretation of the abducted factors as common causes. In particular, this is the case when one can be sure that no one of the empirically correlated variables can be a cause of the other variables. In practice, however, factor analysis is often applied to variables for which this possibility cannot be excluded. If some of the variables are related as cause and effects, then a causal interpretation of the results of factor analysis is problematic and will lead to mistakes. This may explain why several statisticians prefer to interpret the results of a factor analysis cautiously, as a merely instrumentalistic means of data unification. In spite of this fact, I think that the prima facie intended interpretation of the factors of factor analysis is their interpretation as common causes, for this is how they are designed. The instrumentalistic critique should be regarded as a warning that the realistic interpretation is justified only under the explained constraints."

A sensible view of the intent of the method, agreeing with Schurz, is given by R. J. Rummel, author of a factor analysis text:

"Does factor analysis define factors, then, that can be called causes of the patterns they represent? The answer must be yes. Each of the variables analyzed is mathematically related to the factor patterns. The regularities in the phenomena are described by these patterns, and it is these regularities that indicate a causal nexus. just as the pattern of alignment of steel filings near a magnet can be described by the concept of magnetism, for example, so the concept of magnetism can be turned around and be said to cause the alignment. Likewise, an economic development pattern de-

lineated by factor analysis can be called a cause. In this sense, a gregarious personality factor causes certain attitudes, a turmoil factor causes riots, and an urbanism factor causes liberal voting.” (Understanding Factor Analysis <https://www.hawaii.edu/powerkills/UFA.HTM>)

Leon Thurstone, who first developed factor analysis, titled his book *The Vectors of Mind*, and he gave his factors psychological interpretations, but in the very first pages of the book he says it is about linear reductions of data, not causality. The result was a long history of evasion and equivocation. Any number of papers prove things about statistical consistency and optimalities of estimates of factor loadings given what is in effect a linear model with free parameters, but that is largely irrelevant to whether the method finds true causal relations. Given a causal reading of the claims implicit in the results of a factor analysis, one would expect some evidence of its reliability to the purpose: does the method generate true, or approximately true theories, or guide us towards the truth as evidence increases? Is factor analysis more accurate than common sense or a Ouija board? For causal analysis, one should want at least an asymptotic guarantee or extensive simulation results showing that the method finds what is true. Causal inference is a form of statistical estimation, and we expect statistical estimators to have asymptotic correctness under explicit assumptions, and either analytically derivable finite sample error probabilities or estimates of them from simulations. There are no such demonstrations in the entire literature of factor analysis (Ok, I have surveyed a lot, not all), but there are fairly extensive simulations showing that factor analysis does not capture causal structure in many kinds of cases. In particular, as Schurz observes, if the measured variables, or specific subjective attitudes they are proxies for, influence one another, the estimation of number and effect of latent variables is very inaccurate. (Upon being presented with evidence that this is so, Dag Sobom, one of the authors of a widely used factor analysis program, LISREL, once wrote to me that such structures are impossible. Nature cannot create what Factor Analysis cannot find!) In addition, there is the issue of factor “rotation”. Given a factor model with K unmeasured factors that accounts for some percentage of the covariance of measured variables, any non-singular linear transformation of the K factors will account for the same proportions. The result will be that measured variables are clustered differently under different rotations. Finally, the number of factors obtained is essentially arbitrary and has little connection with the truth. Some of the problems can be

seen with simple graphs. For example, suppose a system in which there is in fact no unmeasured common cause. Rather, as may be plausible in some questionnaire data, each variable is a proxy for another that is unmeasured and the proxies are causally connected, for example:

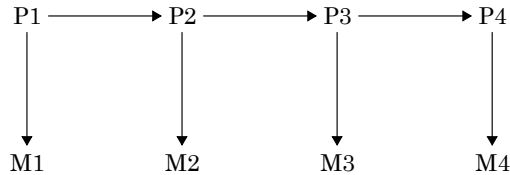


Figure 5

Factor analysis of the M variables will return this structure:

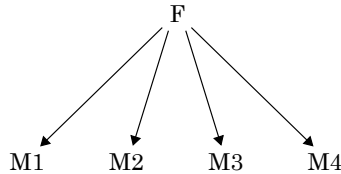


Figure 6

Related results are shown by Shalizi (<http://bactra.org/weblog/523.html>), including examples where up to half the total variance of independent variables is “explained” by a single common factor. Glymour (1997) shows by simulation that when there are direct causal relations between the measured variables, and even when in truth the same measured variable is influenced by two or more latent common factors, the number of true latent common causes is mis-estimated by factor analysis. Inglehart and Welzel extract two latent factors accounting for half the variance in their measures. What happened with the other half? Shur (2012) finds four or five latent factors using essentially the same data. One suspects Inglehart and Welzel found factors they could “interpret” – i.e., that strongly relate to questionnaire answers that the authors describe with their theoretical attitudes – and stopped.

There is in Inglehart and Welzel’s analyses nothing showing that the distributions of the variables are Gaussian or linearly related, or, in view of the fact that their factors leave half the variance unexplained, that the unidentified causes of the rest of the measured variance do not confound their regression predictors and their outcome variables. The

partial correlations from their regressions are what they are, but their indication of causal relations, and the statistical significances the authors claim, depends on these features.

More fundamentally, one wonders what can be meant by the statistical significance political scientists attach to estimates of correlation, partial correlation, etc. There is no plausible frequentist interpretation of the standard errors that statistical software algorithms attach to these estimates, no infinite population sampled from, and indeed, as in the case of Inglehart and Welzel's work, the sample of nations nearly exhausts the current population of nations. There is an infinite collection of times that could have been sampled, but that is not the relevant dimension. Their N is the number of nations, not the number of waves of the Survey. They could have given a Bayesian analysis, which would have made a certain amount of sense, but they did not.

4 *Trying to Do Better*

Here is a first thought for anyone thinking of doing a factor analysis: *how well can the associations among the measured variables be explained without positing any latent common causes; are there constraints among the correlations that a factor model cannot explain?* That's an easy check: just apply any of several asymptotically correct search algorithms that assume there are no latent variables. If the result is a graph in which some pairs of variables with non-vanishing correlations nonetheless have vanishing partial correlations controlling for other measured variables, don't look for unmeasured common causes. Factor models don't produce vanishing partial correlations unless the unconditional correlations are zero. So, in figures 5 and 6, search for an unmeasured common cause would not be warranted (although there is one, P1, just not the sort factor analysis would find). If, on the contrary, the result is a complete, or nearly complete, graph of connections, proceed to look for common causes. For example, the data from Otis Dudley Duncan's famous and influential study of job mobility in the United States results in an almost complete graph. Maybe he should have considered whether unmeasured common causes are at work. The question is how to do the considering.

One case where factor analysis does give correct results is when the measured variables fall into disjoint clusters, all members of the same cluster have a single unrecorded common cause, and no measured variable influences any other measured variable. Further, if one could identify these "pure" clusters, the correlation of the latent factors among

each other could be estimated, and using those correlations the causal relations among the latent variables could be estimated by any of a number of search algorithms – there would be no need for choosing among “rotations”. But as Schurz notes, most data sets in the social sciences are not like that. No matter how the rotations are fiddled, the variables do not partition so nicely.

Inglehardt and Welzel’s procedure provokes a thought. To compare the several waves of the World Values Survey, they *throw out* most of the measured variables. Users of factor analysis, such as Inglehart and Welzel, are often not at all interested in explaining the covariances of their measured variables. They are interested in the causal relations among the unmeasured variables of which the measured variables are effects or manifestations: the covariances of measured variables are chiefly a tool to that end. Of course there might not be any variables that form pure clusters, but if there are, could pure clusters of measured variables be found by throwing out some of the measured variables? Which ones, how? Those questions began to be answered more than a decade ago, and they are answered better in more recent work.

Early in the 20th century, Spearman observed that linear models with a single unmeasured common cause of at least four measured variables entail a set of constraints on the measured correlations.

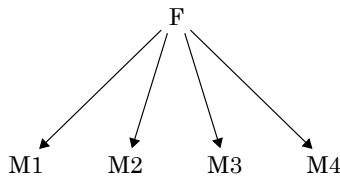


Figure 7

The constraint is that for any permutation of the four measured variables, the product of the correlations of any two disjoint pairs of variables is equal to the product of the correlations of the remaining possible pairs, for example $\rho(M1,M2)\rho(M3,M4) = \rho(M1,M3)\rho(M2,M4)$. There are three such vanishing “tetrad” differences, any two of which are algebraically independent. They are rank constraints on the matrix of covariances of the measured variables. Although Spearman did not know it, these relations hold as well for various non-linear systems, for example if each measured variable has the same non-zero monomials in a polynomial functional form of F .

The various sets of tetrad constraints distinguish causal structures.

For example,

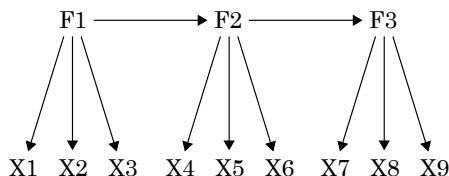


Figure 8

The three measured effects of any latent factor form a vanishing tetrad trio with any one effect of any other factor, but any two from one factor and two from another (or one from each of two others) only imply a single vanishing tetrad constraints. By examining the tetrads, one can distinguish the clusters. Upon estimating the correlations among the factors, it can be discovered that F1 and F3 are not independent, but are independent conditional on F2. If one or more of the variables, say X4, is the effect of two factors, or is influenced by another measured variable, they can be removed from consideration. So the question is how to do the removal systematically and efficiently, that is to say, algorithmically. Ricardo Silva and his collaborators (2005) devised a provably correct method over a decade ago. A faster method was discovered by Kummerfeld and Ramsey more recently (Causal Clustering for 1-Factor Measurement Models) <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5066593/>. Figures 9 and 10 illustrate the application of the method.

The method does not require that the latent factors be linearly related to one another. The results in Kummerfeld and Ramsey are quite general and apply, for example, when there are sets of six measured variables sharing two latent factors. There are many further developments but I leave them to the sample in the references. (Kummerfeld, et al., 2014; Yang, et al., 2017; Zhang, et al., 2017; Sullivant, et al., 2010; Spirtes, 2013).

FindOneFactorCluster(FOFC)

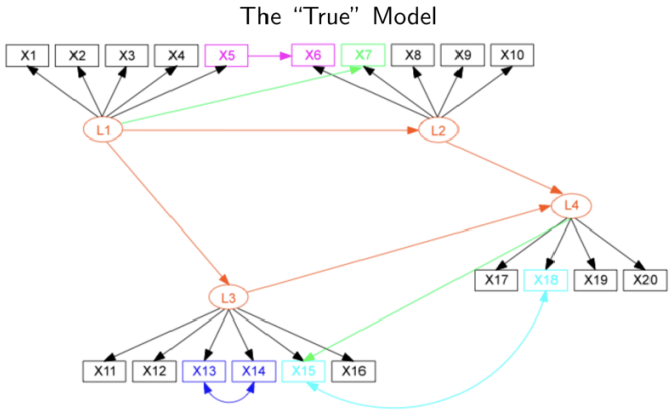


Figure 9

FindOneFactorCluster(FOFC)

Output

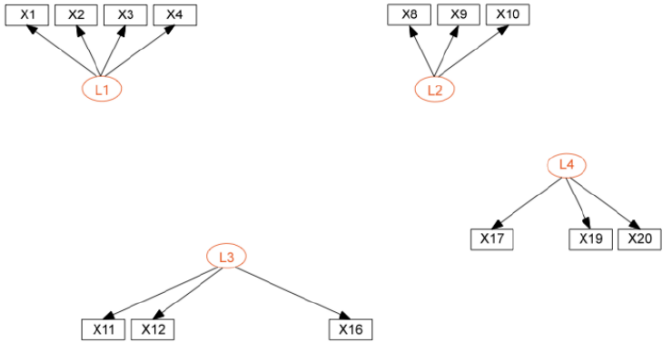


Figure 10

5 Conclusion

Empirical social research can, and sometimes does, document what the news makes obvious. The rich are getting richer; thuggish kleptocrats govern many nations; masses of people are moving; women are treated badly in much of the world; the majority of humans are superstitious; Muslim nations are at war with one another and themselves; Africa, north, south, east, west, middle, is a multi-formed disaster sprinkled with bright spots; the human population is growing too rapidly for its globally limited and locally maldistributed resources; the United States and Russia are in another Grand Game in the Middle East. I look and hope for deeper examinations that will produce rationally convincing accounts of the forces at work, other than the obvious luck and greed and lust and ignorance and superstition, and with them, rational forecasts more subtle than *more of the same is coming, and worse*. Sound guides as to how improve things (by my lights), or at least prevent worse, would be welcome.

The science is bad in part because of the methodologies it uses, adapted from the early 20th century. The methodologies are used because they are taught to every graduate student in social science, and because the users and their teachers often do not think clearly about their real goals in inquiry and whether the methods really further realizing those goals. That requires careful thinking about causality and inference, and a willingness to temper claims to what can be supported by data using reliable methods. Meanwhile, work seldom seen is making advances on the central problem of the great philosophical tradition, methods for *reliable* creative abduction. The subject abounds in open research problems, which I won't try to delineate.

Schurz is right that factor analysis, created at a time when C.S. Pierce was merely providing a slogan, is, with regression, an enduring attempt at an algorithmic system of creative abduction. Some such a system was the aim of Aristotle, Descartes, Leibniz, Bacon, Mill and others, but philosophers in the 20th century almost universally declared the very idea impossible, even silly. The Logical Empiricists thought, wrongly, that an algorithm for discovery must end in a certainty, and the revolution in gravitational theory convinced them, rightly, that there could be no such thing in science, and hence no mechanical guide to inquiry. Einstein's insistence that science is a "free creation" did not help, and that from a man who claimed to be a determinist. Hempel certainly claimed the impossibility of algorithmic creative abduction, as did John Rawls, and many less famous writers. Hempel's grounds were exactly those

that Thurstone's factor analysis and other statistical methods had long refuted, the introduction of novel unobserved variables. Rawls seems to have taken it simply as common knowledge, like the sky is blue. Norwood Hansen went back and forth – his detailed engagement with the history of planetary theory give him, I think, the thought that there was something systematic going on in that subject, something more than just aperçu and flashes of brilliance. “Abduction” has lived on as a slogan without substance, much like “inference to the best explanation.”

Although I think he picked the wrong methodology and neglected issues of truth-findingness, Schurz does philosophy of science a boon by pointing out that there is a method widely in use in the social sciences that attempts to give substance to creative abduction. I suggest that philosophers of science who are interested in reliable creative abduction – which I tend to think is the *only* serious topic in philosophy of science (Schurz may think I overstate) – read the literature – the statistical, mathematical and computational literature – grab a computer, and get to work.

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