

# Population Review

Volume 47, Number 2, 2008

Type: Viewpoint pp. 85-92

## The Interplay of Theory and Measurement

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### Introduction

This Viewpoint concerns all of the sociological sciences that deal with empirical phenomena, including sociology, demography, political science, social anthropology, communication, and socio-environmental science. The reason for the focus on these disciplines rather than on demography alone is that the theoretical base of sociology underpins all of the others. Put differently, each of the others takes its fundamental theory from sociology.

The discussion that follows consists of five parts. The first part details what I think a theory is. The second presents the gist of a well known article that I wrote with two co-authors on status attainment (Sewell, Haller, and Portes 1969). Written some forty years ago, it serves as an example of the mix between theory and measurement, referred to herein as a mini-theory. Having been republished several times over the years, it is still more or less fresh. The third part summarizes the general theory that underlies the mini-theory's concepts. The fourth discusses the general theory in more detail and provides a brief history of the concepts and measurements involved in the mini-theory. The fifth and final part consists of concluding remarks.

### Theory

If memory serves me right, Immanuel Kant once stated a key dictum that easily applies to scientific reasoning: 'No concept without percepts, no percepts without concepts'. This implies a sort of progression in which concepts yield new percepts and percepts yield new concepts, oscillating back and forth in a never ending series of interchanges, some of which bring on shifts of theoretic paradigms. This is precisely how scientific theory advances. As applied to such research, Kant's dictum may be restated: No science without theory, no theory without observation—or even better, no theory without measurement.

Theory itself is purely conceptual. That is, a theory is made up of concepts. It is not made up of observations no matter how relevant they may be for a given theory. More specifically, theory is a set of inter-related concepts. A theory in an empirical science is made up of a set of inter-related concepts purporting to explain the behavior of a domain of observed phenomena. It consists of all the interdependent sets of well reasoned concepts and their conceptual linkages. In the empirical sciences theory is tied to empirical observations. This is true of all such sciences.

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In the physical sciences the tie between a theoretic concept and the observed phenomenon to which it refers is taken for granted. That is, physical scientists have become so adept at measuring the referents to their conceptual variables that concept and measurement are isomorphic.

Not so, unfortunately, in the sociological sciences. In these fields the connection between concept and observation is often widely separated, with so-called 'proxies' and 'indicators' being quite common. Despite this, among sociological scientists much effort has gone into determining the extent to which the operational definition of a conceptual variable is a good measure of it. Techniques for testing the validity of an operational definition are well known. Similarly, considerable effort has gone into determining the extent to which the measurement of an operational form of a conceptual variable can be trusted. Like those of validity, techniques for testing the reliability of the operational form of a conceptual variable are well known.

Even so, though well known, such devices are not often used by sociologists, demographers, political scientists, etc. In part this is due to the widespread dependence on so-called 'secondary data', data sets designed for one set of purposes that are used for another. Many of these data sets (maybe most of them) are designed to serve the purposes of governments. Often their validity is assumed, not tested. And tests of instrument reliability seem rare indeed.

Still, it's easy to see why secondary data are so frequently used. Researchers often aim at generalizing to specifiable universes, such as a nation. The cost of doing this, even in medium-sized nations, is so large that only a government can cover it. But there is also a cost to using them. The measurement devices that can be constructed from them may not be very precise ways to match a project's conceptual variables to the available data. The effect of this is to introduce error into the tests of the theory they pertain to.

### **A Mini-Theory**

As an example of mini-theory, let me turn your attention to the process by which young people are sorted into one level or another of the social status hierarchy of occupations, thus setting the start-point of the specific occupational trajectory that will describe the career of each youth. In this project career start-points are considered to be the youths' occupations by the time the most highly educated of them finish their schooling. Note that this example illustrates several of the points mentioned earlier. It shows the effects of both theory and measurement. It uses secondary data, with both its advantages and disadvantages. It may be generalized to a larger universe. Later, we present test of the mini-theory, one that was planned from the beginning as a test of it.

At the time it was published sociologists were often satisfied if the relationship between their independent and dependent variables was statistically significant at a point greater than zero. As a small theory of behavior among individuals, our example was unusually powerful in that it explained 50 percent of the variance of educational attainment and 34 percent of that of the level of the occupational hierarchy attained by the youths. Even today those levels of explanatory power are rarely found in data on individuals.

All variables were measured by more or less standard techniques. They were assumed to be valid and reliable. The process was measured by path coefficients in a causal pattern. These coefficients were taken as measures of the effect of a prior variable on one that succeeds it. The data were taken on a sample of farm boys who were seniors in high school in Wisconsin. There were two data waves, the first in 1957 and the second in 1964. The data were taken on each sample member at both times. The data for all variables other than the outcomes—levels

educational attainment (LEAtt) and levels of occupational attainment (LOAtt or the socioeconomic level of each youth's job)—were taken while the sample members were still in school.

A theoretic causal chain with five different points along the chain was established—each in the chain such that the variables that preceded it and those that followed it stood in a realistic sequence. Path coefficients ( $p$ ) were used to measure the apparent effect of one variable on another.

The first antecedents of youths' 1964 occupational statuses (the exogenous variables) are two: the socioeconomic status (SES) of each youth's parents, and his mental ability—roughly, IQ. The first of these was measured by a factor-weighted index of SES variables, the second by Henmon-Nelson test scores. In the causal scheme the next variable was academic performance: the normalized rank of the student in his high school class. It was found to be strongly affected by mental ability, the second point in the causal sequence, at  $p = .63$ . But it was not related to the parents' SES. The next endogenous variable was the influence of significant others (SOI), measured by the sum of three variables—teachers' influence, parents' influence, and friends' influence. It was moderately affected by the parents' SES ( $p = .22$ ), and rather strongly by academic performance ( $p = .47$ ).

SOI was found to have rather strong effects on the variables of the third point in the sequence, level of educational aspiration (LEAsp: college plans), at  $p = .59$ ; and, at  $p = .54$ , to level of occupational aspiration (LOAsp, the SES of the job the individual desired in the future). SOI also had a moderately high direct effect,  $p = .33$ , on the youths' level of educational attainment (attendance at college), the fourth point in the causal sequence. LEAsp was found to be influenced, not only by SOI, but also by LEAch,  $p = .44$ . LOAsp had a rather small direct effect on the young persons' LOAtt,  $p = .21$ . The effect of LEAtt, educational attainment, on LOAtt was measured at  $p = .43$ .

Both LEAch and LOAtt may be considered as dependent, or outcome, variables even though LEAch is causally prior to LOAtt.

A multivariate regression analysis showed that the total effects of the all of the variables explained 50 percent of the variance in educational attainment and 34 percent of that in occupational attainment, as was said before.

Even today, with improvements in both measurement and statistical analysis, these figures are astonishingly high for non-aggregated data on individuals.

By coincidence, the mini-theory was also tested on data from 17 year old school boys attending school in a Michigan county. Like the Wisconsin sample, they were questioned first in 1957. They were interviewed by telephone 15 years later. The validity and reliability of the instruments was tested and found to be excellent. The results showed that in fact the mini-theory of status attainment processes just sketched explained 62 percent of the variance in educational attainment and 50 percent of the variance in occupational attainment.

Except for one (significant others' influence) the conceptual variables and their causal sequence were the same in both the larger Wisconsin sample and the much smaller Michigan sample. In the Michigan sample, the antecedents' total effects on educational attainment were found to be much large than in the Wisconsin sample. In it the explained variance amounted to 62%, as against

Wisconsin's 50%. The difference of the antecedents' total effects on occupational attainment was even larger, 50% for Michigan and 34% for Wisconsin.

Obviously, as a test of the mini-theory, the results of the Michigan sample confirm and go beyond those of the Wisconsin sample. But why would the mini-theory appear so much more powerful in the data from Michigan?

One answer is certain. The Michigan project was specifically designed to test the mini-theory. As a result, the conceptual variables were much better measured in it than in the Wisconsin project. This is true for all but one (SOI) of the key variables: educational aspirations and attainments, occupational aspirations and attainments, and the parents' social status. Also, for the Wisconsin sample, there was no way to test the reliability and validity of the instruments used to measure the conceptual variables. Both were rigorously tested in the Michigan sample.

Other factors no doubt had something to do with the differences between the two. Wisconsin's were all farm boys and were seniors in high school. They were from all over the state, rich areas and poorer ones. They were re-interviewed only seven years after first contact. The Michigan boys lived in a rather rich county and at 17 they were mostly 11<sup>th</sup> or 12<sup>th</sup> graders. They were re-interviewed 15 years after the first interview.

### **Concepts in the Mini-Theory**

In the 1960s, the variables that were least understood by those who were not involved in this sort of research were socioeconomic status (SES), significant others' (SOs) and their influence (SOI), the two aspiration variables, educational and occupational. Of course, everybody knew about educational attainment in college. But the prestige hierarchy of occupations by which occupational attainment was measured was poorly understood by most people.

In a way, everybody knows about social class. But in truth such knowledge is really pretty vague. Some people are better off and some are worse off. This may be thought of in terms of occupation: doctors are prestigious, teachers so-so, and store clerks somewhat less. Or it may be in terms of money: those that are richer, those that are poorer. Or it may be in terms of education. Sociologists, on the other hand, see social class as one concept: the socioeconomic status of one's occupation—the occupational standing that defines one's position *viz a viz* others in day to day interaction.

SOI is a little more complicated. In the 1960s this concept had not yet entered into common use. It was not until the 1970s that it became commonplace among educators (perhaps the result of the popularity of the previously-cited 1969 paper). Actually, it had been around since about 1940 as a modification of George Herbert Mead's concept of the generalized other (the opinions of others that control one's behavior and sometimes one's conscience.) The mini-theory saw SOI as having two forms: the examples of models and the expectations others have for one.

Educational and occupational aspiration levels are concepts that are even more unusual, or they were in the 1960s. Let's take occupational aspirations first. Every job a person sees as appropriate for himself stands at a point or level somewhere along the hierarchical ranking of occupations. When a person chooses an occupation, he or she automatically chooses a point on the scale of occupations, whether knowingly or not. And when a youth says, "I don't care what it is. I just want a job," he or she is automatically choosing the lower levels of the scale of occupations. (We know this because it has been tested and confirmed repeatedly.)

The scale of educational aspiration is more obvious. Everyone in this country in the 1960s (and long before) knew that education is graded by years, with certain years as completion or termination points, like high school and college graduation, and on up through advanced education.

The concept of occupational attainment assumes that there is a general understanding in the population of which occupations are higher and which are lower in prestige or social evaluation. In real life, for those who are starting out, the point or level of this structure is the start-point of a career trajectory that ends with retirement or death. A youth's level of educational aspiration is the highest rung on the educational ladder that he expects to attain.

### **The Interplay of Theory and Measurement**

This section consists of two parts. The first is a discussion of the two emphases of sociological theory. The second is on the theory's recent history, beginning around 1930.

#### *Fundamental Theory in Sociology*

Sociology is a field with many subdivisions, one of which is demography. As I said at the outset, its theory is also that of the other empirical sociological sciences. Common to all of them are psychosociology and structural sociology.

Psychosociological theory is the sociological part of the field many call 'social psychology'. But social psychology itself is two different things. One of them is a part of the field of psychology. It is concerned with social influences on the personality and behavior of the individual. Psychosociology, as it was recently named, is the other. It is concerned with the massive and changing matrix of interactions, opinions and beliefs that constitute a culture. Within this matrix are the individual's changing multiple self-identities that emerge through enacting the behaviors of his social roles in exchanges with others. Of course, certain behavioral tendencies are tied up with the individual's genetic heritage. But a great many are determined or at least influenced by the ongoing matrix in which he participates. These include the person's more or less unique attitudes, behavior characteristics, habits, etc.

Within the matrix certain behaviors coalesce, or have long since coalesced, into sets of standardized social definitions of the sexes, age categories, racial characteristics, and so forth. Institutions, such as formal organizations, are among the many durable structures made up of coalesced behaviors. So are systems of stratification, societies' hierarchies of power—political, economic, social and informational. Indeed, the mini-theory sketched earlier is a sub-theory of stratification. It is intended to describe the process through which the educational and initial occupational trajectories come into being. The trajectories mark the career pattern of a person's informational and social power positions. This sub-theory is dependent on the structure of the stratification system into which it fits. As such, it changes constantly, if glacially, as its parent stratification system changes.

Structural theory, then, is the second of the two emphases of sociological theory. It concerns the analysis of the nature of societal structures, the changes they undergo, and the consequences of their states and changes.

#### *History*

Research that led to the mini-theory worked itself out in a complex interplay between theory and measurement. Perhaps the most salient and overarching was the early 20<sup>th</sup> century analyses of C. H. Cooley and G. H. Mead on social behavior—on mind as an information and communication process in which each individual participates in one way or another; on self-identities as products of the combination of genetic tendencies and of the influence of both immediate and more distal social environments; on the unique capacity of humans to ‘take the role’ of the other—to understand ‘where the other is coming from’ (as is said today), and thus to respond meaningfully to the actions of the others with whom the person participates. Beyond this, Mead held that the ‘generalized other’, as he called it, greatly influenced the understandings of all of us about proper behavior. By this he meant that such knowledge is shared by most of the people of a culture and is automatically imbibed by the young as they grow up.

Kurt Lewin’s concept of level of aspiration is a more specific contribution to the theory behind the mini-theory. It comes from the 1920s and 1930s. It holds that each person sets many goals for himself and tries to realize them. In any set of people, there are some that set more difficult or higher goals for themselves and some whose goals are farther down the scale. It is this variation of the levels of goals that Lewin calls ‘levels of aspiration’. He and his colleagues successfully applied the concept and measured its variations in a number of different settings. There appears to be no evidence that they used it in connection with the hierarchies of occupations or with the educational ladder. As we know, in the post-WWII years, educational and occupational aspirations became one of the most important concepts of status attainment research.

The measurement of family or household socioeconomic status (SES) has a long history, one that reached its peak in 1940, with the publication by W. H. Sewell of a superbly constructed and tested scale to measure its variations. The Sewell scale has been translated into several languages and used around the world. Besides that, many other researchers have used it as a model for new SES scales. Nevertheless, SES scales, successful as they have been, have never been shown to fit into the theory of stratification. This theory, as noted above, holds that there are four basic content (or substantive) dimensions of stratification systems: political, economic, social and informational power (or status, if you prefer—they are two sides of the same coin.) Sewell-type SES scales do not seem to match any of these four. Yet a new look at some old data may provide a solution to this conundrum and bring SES scales back into the fold of basic stratification theory. So far as is known there is only one data set in the world that includes measures of all four of the basic dimensions and an SES scale. Fortunately all five of these variables were well measured and have been shown to be valid and reliable. The correlations among the five suggest that SES may be the same as the variance that is shared by the four theoretically established dimensions. That is, far from being an atheoretic outlier, SES may be central to the theory. A crucial test of this conjecture may soon be performed.

Sometime around 1940, the concept of the significant other (SO) emerged. It is attributed to Harry Stack Sullivan, a psychiatrist. In any case, it fits nicely into his theory of behavior and is a response to Mead’s concept of the generalized other (GO). The idea of the GO fit well into the period when Mead was young—the somewhat evenly distributed culture of the 20<sup>th</sup> century’s more or less rural society of American white people in the north of the country. By 1940 this culture was seen as past: that America was and is a much more complex racially, ethnically, economically, regionally diverse society than Mead conceived of it. The SO concept arose to account for the sector-specific beliefs and behaviors governing ordinary interaction among people. These would be learned from SOs, such as mother, close friends, father, and so on. They would reflect the norms common to all of the people in a given sub-cultural sector of American society.

In the status attainment literature, however, it is a pair of specific types of SOs that are of interest. These are models and definers, and even more specifically, the exemplifications of various statuses that models provide, and the expectations of present and future statuses that are communicated (directly or indirectly) to the young person. I shall return to this below after turning now to the educational and occupational hierarchies.

The educational hierarchy is well known. It can be seen as a ladder that starts on the ground and goes upward one rung at a time, through the primary and elementary school years (one to eight in America), on up through (usually) to the 12<sup>th</sup> grade, on into four year-equivalents of college, and on up to doctoral degrees and beyond. The educational exemplifications and expectations of SOs are mirror images of this hierarchy—restricted in the mini-theory to the college years and beyond. That is, they are psychological and behavioral isomorphs of the objective educational hierarchy. Occupational SO exemplifications and expectations behave the same way. They are isomorphs of the occupational status hierarchy, with its jobs that range from the heights were doctors are found to the depths were the least skilled workers abide.

So how do we know what the occupational status hierarchy is? Studies of peoples' evaluations of occupations and the hierarchical ratings thus assigned to them go back at least to the 1920s. But it was a study of the evaluations of 90 occupations that provided the first national rank order of a large set of occupations. The scores each of the interviewees attributed to a given occupation were averaged. The averages formed the rankings. This was a big step forward, but 90 occupations are far from all of those in the nation at that time. This hiatus was filled in 1961 in a research project in which 43 or so of the above scores were paired with their equivalents from the U. S. census, from which the educational and income level were extracted to serve as regressors against the 43. The regression weights were then used to provide a score of each census occupation. This provided a scale for all occupations of the time and was called the Socioeconomic Index for all Occupations (SEI). Since then several other SEI scales have been constructed, some of them for other countries. The scale of SES used in the Wisconsin version of the mini-theory was constructed in the spirit of the SEI but was cruder because its evidence came from its secondary data set. So it was not as good as a standard SES scale would have been. The SEI score of the youth's father's occupation was used for this variable in the Michigan study.

The concepts of level of educational and occupational occupation are forms of attitudes that, like all attitudes, are orientations to action with respect to an object. Such aspiration variables take as their object the hierarchical variable pertinent to them, the educational and occupational hierarchies in this case. A person's level of aspiration for education is a point or limited range of points along the educational ladder. Similarly, one's level of occupational aspiration is a point or limited range of point along the occupational hierarchy.

As already seen, the two aspiration variables are isomorphs of their respective hierarchies. As action oriented attitudinal variables, theory dictates that they should be more highly predictive of the attainment variable of which they are isomorphic than would be the case for any other variable, assuming no interference from other variables and providing that they are measured perfectly. In the Michigan data, where they and the other variables of the mini-theory were measured very well, this hypothesis from theory tends to hold up rather well, with correlations ranging from .70 to .55.

In general, we may say that, other things being equal, a behavior orientation variable will be correlated with the behavior to which it refers to the degree to which the two are isomorphic. In other words, isomorphism is a variable and, other things being equal, the degree of isomorphism

may be measured by the Pearsonian correlation coefficient provided each has been measured perfectly.

How does the above relate to relevant patterns of correlations in the data? The concept of the influence of significant others (SOI) was measured in the Wisconsin sample in a way that is close to being an isomorph of educational attainment and aspiration, variables that are very close to their occupational counterparts. In fact, the correlation between SOI and these four variables is moderately high, ranging from  $r = .41$  to  $.59$ . It will be recalled that the SOI scale was composed of items with educational content. So its correlations with educational aspiration and educational attainment should be the highest of the four. Indeed they are:  $r = .57$  and  $.59$ , respectively. (SOI was not measured in the Michigan data.)

Now, using the more exactly measured variables of the Michigan data, let's look at the measurement of mental ability in relation to the aspiration and attainment variables. It is obvious that mental ability scales, such as IQ measures, are directed toward the quality of performance in the educational and occupational world of our times. So such instruments should be moderately isomorphic to the aspiration and attainment variables of the mini-theory. And this is what the data show. The respective correlations range from  $r = .36$  to  $.44$ .

## **Conclusion**

This Viewpoint is an attempt to illustrate the interplay between theory and measurement. The basic theory presented toward the first of this essay is generally attributed to the field of sociology. As stated, it has two forms, psychosociological theory and social structural theory, the real life instances of the latter having been constructed from real life elements of the former. Though the theory is most closely associated with sociology, it is also the theoretic underpinning of the empirical work in demography, political science, social anthropology, communication, and socio-environmental sciences—the primary areas of knowledge covered in this journal.

To illustrate the interplay of theory and research a mini-theory from the literature was presented, one that was published in 1969, along with data from another that were published a decade later. Toward the end of this essay, data on the mini-theory, gleaned from sociological meetings in 1967, were presented. The basic theory and special concepts of the mini-theory were the subject matter of the rest of the essay. The mini-theory and its underpinning were chosen for several reasons. One is that it has been around for quite awhile, having been reprinted several times. Another is that the mini-theory moved rapidly into the educational community where it appears to have been used for purposes of policy. So, surprisingly, it turned out to have practical value in addition to its contribution to theory. Last, it provides an example of the kind of reasoning the research published in this journal is intended to foster.

## **Reference**

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