The Tripartite Structure of Social Science Analysis*

GUILLERMINA JASSO
New York University

The goal of sociology, and all social science, is to produce reliable knowledge about human behavioral and social phenomena. To reach that goal, we undertake three kinds of activities: theoretical work, empirical work, and, even more basic, we develop frameworks that assemble the fundamental questions together with the fundamental tools that will be used to address them. This article examines the three sets of activities and their interrelations. Both deductive and nondeductive theory are highlighted, as are three kinds of empirical work—testing the predictions of deductive theories, testing the propositions produced by nondeductive theories, and extratheoretical measurement and estimation. Illustrations are drawn from the fields of status, justice, and migration.

INTRODUCTION

The objective of social science is to describe and understand human behavioral and social phenomena. To increase the stock of reliable knowledge, we produce new knowledge, integrate it into the body of old knowledge, and, in light of new knowledge, reinterpret old knowledge. This stock of reliable knowledge is always growing. And, not surprisingly, there is curiosity about the ways that knowledge grows.

In the classic view, the method for increasing reliable knowledge—scientific method—consists of two interrelated though distinct activities, theoretical analysis and empirical analysis: we build deductive theories, deriving an abundance of predictions from a parsimonious set of assumptions; and then we test the deduced predictions. We build sets of theories and compare the theories and test them against each other.[1]

But not all scientific work fits into that simple mold. Besides building deductive theories, we also build nondeductive theories. Besides testing the predictions deduced from deductive theories and the propositions constructed in nondeductive theories, we also carry out a variety of extratheoretical empirical work, including measurement and estimation. And, even more fundamentally, besides doing theoretical and empirical work—indeed, before we do theoretical and empirical work—we develop (albeit sometimes unconsciously) a framework for studying the particular phenomena and processes of interest.

A close look at the work we do to increase the stock of reliable knowledge about human behavioral and social phenomena reveals a tripartite structure. This article describes the *tripartite structure of social science analysis*. The tripartite perspective acknowledges the

[1] For example, the classical idea of a bipartite structure of scientific work underlies Popper's (1963) graceful title, *Conjectures and Refutations*.

critical importance of the research activities that precede theoretical and empirical analy-sis—developing the framework out of which theoretical and empirical analysis emerge. Similarly, it acknowledges the part played by nondeductive theories and links them to deductive theories, and it recognizes the extratheoretical empirical work. Tripartite social science analysis thus represents more faithfully the varied kinds of scientific work we do and their varied interrelationships. It invites to the table, so to speak, activities that in the old world of deductive theory and testing of predictions were slighted, even as they made their own fundamental contributions to the growth of knowledge.

This article has varied intellectual roots, ranging from the general sociological Weltanschauung, which prizes codification, in the spirit of Merton ([1968]1949), and a well-diversified portfolio and highlights types of approaches, types of theories, and types of empirical work, to recent reflections among distinguished sociologists on their own work. For example, the central idea of a framework for social science analysis—as distinct from theoretical work and empirical work—receives cogent discussion from Berger and Zelditch (1993) and new respect from theorists as diverse as Stryker (2001) and Wallerstein (2002). As Stryker (2001:212) observes of nontheories popu-larly called theories: "To label them frameworks is not to devalue them."

To illustrate the tripartite structure of social science analysis, we draw mainly on the study of status and of justice, highlighting one element from each—the S1 status function and the justice evaluation function. These are introduced to illustrate func-tions in frameworks, and subsequently the status function is used to illustrate deriv-ation of predictions in deductive theories and the justice evaluation function to illustrate extratheoretical empirical work.

In describing and discussing the new tripartite perspective, it will be useful to bear in mind a basic principle of social science analysis, namely, the principle that all observed behavioral and social phenomena are the product of the joint operation of several basic forces.[2] Put differently, this principle holds that the world we seek to understand is a *multifactor* world, a view widely accepted in modern social science.[3] Several challenges grow out of this principle. One is to incorporate the multifactor view into empirical tests. Another is to search for the basic forces. As well, the basic principle leads to a sense of the strong interdependence across topical domains and disciplinary boundaries; progress in understanding one topical domain requires pro-gress in understanding other topical domains (Jasso 2001c).

TRIPARTITE SOCIAL SCIENCE ANALYSIS

For most of the 20th century, social science was deeply imbued with the classic bipartite perspective that classified all scientific work into theoretical and empirical work (Jasso 1988b). Moreover, the gold-standard theoretical work was mostly deduct-ive, and the gold-standard empirical work was mostly tests of deduced predictions. As we kept alive that view—a view with strong sociological roots in Merton ([1968]1949) and held as the standard by the pioneering Stanford theory group of Berger, Zelditch, Anderson, and Cohen (Berger, Zelditch, and Anderson 1972; Berger et al. 1972)—we could not help but notice that most social scientific work did not fit neatly into the classic perspective. Often, we made mention of nondeductive theories (Toulmin 1953; Fararo 1989) and inductive empirical work. But there were

[2] This principle can be traced to Newton's views on understanding physical nature.
[3] For example, see Parsons (1968) on Durkheim as a multifactor theorist.

discontinuities. And who was to say whether or how these alien kinds of work played important parts in the growth of knowledge?

The solution to the evident discontinuity lay, equally evidently, in the work around us. It was possible to discern in the research reported year after year in journals and at conferences, across all the social sciences, the outlines of a new and richer perspective—a *tripartite social science analysis*. Tripartite social science analysis classifies the types of work carried out in science into three types, adding to the old *theoretical analysis* and *empirical analysis* a third, the *framework for analysis*, which turns out to play a crucial part in the growth of knowledge. Indeed, in any substantive area or topical field, it is the framework that gives life to both theoretical and empirical inquiry, providing the building blocks for theoretical and empirical analysis. In addition, tripartite social science analysis makes explicit the two main subtypes of theoretical analysis—building *deductive theories* and *nondeductive theories*—and the three main subtypes of empirical analysis—not only *testing the predictions produced by deductive theories* but also *testing the propositions produced by nondeductive theories* and as well engaging in a broad range of *measurement and estimation.*

Tripartite analysis is evident at all scales of work, from particular topics to the Holy Grail of an integrated social science. Whether studying status or power or migration or stratification, or instead seeking the ultimate basic forces governing all human behavioral and social phenomena, the various research activities can be understood better against the backdrop of the triptych produced by tripartite analysis. Indeed, the tripartite schema can serve to consolidate knowledge and to unify a discipline, thus promoting scholarly advance (see Turner 2001).

Figure 1 presents the basic triptych for a topical field, where the field is denoted by "[·]". The center panel of the triptych represents the framework for [·] analysis. The left panel represents theoretical [·] analysis, and the right panel represents empirical [·] analysis.[4]

FRAMEWORK: THE FIRST ELEMENT IN THE TRIPARTITE STRUCTURE OF SOCIAL SCIENCE ANALYSIS

The framework collects the fundamental questions of the field, together with the fundamental tools that will be used to address them. In general, the tools identify

Theoretical [·] Analysis	Framework	Empirical [·] Analysis
Deductive **Postulates** **Predictions** -------------------- *Nondeductive* **Postulates** **Propositions**	**Questions** **Actors** **Quantities** **Functions** **Distributions** **Matrices** **Contexts**	**Measure/** **estimate** **terms/relations** -------------------- **Test deduced** **predictions** -------------------- **Test** **propositions**

Figure 1. Triptych for [·] analysis.

[4] Examples of triptychs for several topical domains are found in Jasso (2001b:44–46).

key features of the substantive process under consideration: *actors, quantities, functions, distributions, matrices*, and *contexts*. Specification of both questions and tools grows over time. New questions may be added to the list of basic questions, new actors identified, useful new matrices specified, and so on. Moreover, different substantive processes have different key features; matrices, for example, may be critical in one process and not even arise in another.

Maintaining a current list of the ingredients in the framework is an important aspect of codification (Merton [1949]1968); it makes it possible to precisely locate the contribution made by new work and to identify neglected areas. For example, when entering a new field of inquiry or reading a new literature, the center panel of the triptych (Figure 1) can serve as a useful checklist, as we ask of every work and every author, "What would you say are the fundamental questions?" "What would you say are the fundamental quantities?" and so on.

Fundamental Questions

Formulating the central questions in a field or subfield is of vital importance to the growth of knowledge. Indeed, although years, or even centuries, may pass before a question is posed correctly, once it is posed the answer is often soon within reach. As Georg Cantor put it in the title of his 1865 dissertation in mathematics from the University of Berlin, "The Art of Asking Questions Is More Important than Solving Problems" (see also Merton 1959).

To illustrate, Table 1 presents lists of central questions in three fields of inquiry—status, justice, and migration. The three lists differ in that one of them—the justice questions—has received focused, explicit attention in the literature, while the two others represent recent compilations that have not yet benefited from sustained scrutiny.[5]

It would be an illuminating exercise to compile lists of fundamental questions for a variety of subfields or topical domains in sociology.

Fundamental Actors

In thinking about the questions, it quickly becomes clear that in any field of social science inquiry there are fundamental actors. Making explicit the fundamental actors is a large step toward specifying the pertinent questions and behaviors. For example, in the study of status, there are two fundamental actors, each conferring and receiving status from the other (Friedkin 1998; Goode 1978; Shils 1968). Similarly, in the study of distributive/retributive justice, there are two fundamental actors, the observer and the rewardee; the observer forms ideas of the just reward for particular rewardees and judges the justice or injustice of the actual rewards received by rewardees (where the observer may be among the rewardees). Across fields of phenomena, one can identify the main actors in each process, thus laying sharp groundwork for the other ingredients in the framework. Table 2 summarizes the fundamental actors in the status, justice, and migration fields.

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[5]In the justice field, Jasso's (1978:1417–18, 1989) early effort to make explicit the core questions yielded a set of three questions that soon was followed by a rival list of three partially overlapping questions proposed by Wegener and Steinmann (1995). Jasso and Wegener (1997) integrated the two lists, producing the present set of four central questions. The importance of a list of core questions for the growth of knowledge in a field was emphasized by Leo Montada in remarks to the biennial meeting of the International Society for Justice Research in Potsdam, 1997. The list of status questions is presented in Jasso (2002:321) and the list of migration questions in Jasso (1999b).

Table 1. Framework for Sociological Analysis: Central Questions in Three Fields

A. Central Questions in Status Analysis
  1. What do individuals and collectivities think is worthy of status, and why?
  2. How do ideas of status shape determination of actual attainments?
  3. What is the magnitude of the status accorded by one person to another? Of the status expected by one person from another?
  4. What are the behavioral and social consequences of according and receiving status and of discrepancies between expected and received status?

B. Central Questions in Justice Analysis
  1. What do individuals and collectivities think is just, and why?
  2. How do ideas of justice shape determination of actual situations?
  3. What is the magnitude of the perceived injustice associated with given departures from perfect justice?
  4. What are the behavioral and social consequences of perceived injustice?

C. Central Questions in Migration Analysis
  1. What are the migrant's characteristics and behavior at entry?
  2. How do the migrant's characteristics and behavior change with time in the destination country?
  3. What are the characteristics and behavior of the children of immigrants?
  4. What are the impacts on the origin and destination countries?

Occasionally, identification of the actors triggers new issues about whether some new kind of actor is fundamental to the process; for example, in the study of justice a third actor, the allocator, is sometimes central. Indeed, thinking explicitly about actors can stimulate new thinking about all aspects of the substantive process (Macy and Willer 2002).

Note that it sometimes can be quite difficult to label the fundamental actors in a topical domain. Consider power. What are we to label the fundamental actors? Are we to call them "Self" and "Other," as in the study of status? Or should we use generic terms like "Focal actor" and "Partner"? Or perhaps invent new terms, such as "Poweror" and "Poweree"?

Table 2. Framework for Sociological Analysis: Fundamental Actors in Three Fields

A. Fundamental Actors in Status Analysis
  1. Self
  2. Other (sometimes called Target)

B. Fundamental Actors in Justice Analysis
  1. Observer
  2. Rewardee

C. Fundamental Actors in Migration Analysis
  1. Migrant
  2. Others at Origin
  3. Others at Destination

Fundamental Quantities

As with the fundamental actors, it quickly becomes clear that there are fundamental quantities arising in a particular field of inquiry. For example, in the study of distributive/retributive justice, there are three fundamental quantities: the actual reward, the just reward, and the justice evaluation. And in the study of migration, the fundamental quantities include personal characteristics such as skills, which change over time and which can be compared between migrant and nonmigrants at origin and between migrant and natives at destination. Table 3 summarizes the fundamental quantities in the status, justice, and migration fields.

Scrutiny of the fundamental quantities can have large payoffs. Consider Blau's (1974) seminal work distinguishing between quantitative and qualitative characteristics in behavioral and social operations. This distinction lies at the heart of Ridgeway's (1991, 1997, 2001) pioneering work on status and plays a fundamental role in the study of justice (Jasso 1980).

Definition and measurement of fundamental quantities, activities integral to development of a framework, provide an important foundation for subsequent theoretical and empirical analysis (Cohen 1980; Coleman 1964).

Fundamental Functions

Each of the central questions is addressed by a function (or family of functions) that combines some of the fundamental quantities. For example, in justice analysis, the first central question is addressed by the just reward function, the third central question by the justice evaluation function, and so on. To illustrate, Table 4 reports the correspondence between each of the four central questions in the study of justice and the four fundamental functions, and Table 5 summarizes the fundamental functions in the status and migration fields as well.

In the theoretical and empirical illustrations that follow, I shall use two of the fundamental functions in Tables 4 and 5, namely, the S1 status function and the justice evaluation function, and thus introduce them now.

The S1 status function—in this article to be called simply the status function, as the S2 and S3 functions will not be used here—specifies the magnitude of

Table 3. Framework for Sociological Analysis: Fundamental Quantities in Three Fields

A. Fundamental Quantities in Status Analysis
   1. Relative Rank in Distribution of Valued Good
   2. Status

B. Fundamental Quantities in Justice Analysis
   1. Actual Reward
   2. Just Reward
   3. Justice Evaluation

C. Fundamental Quantities in Migration Analysis
   1. Migrant's Characteristics and Behavior
   2. Conditions at Origin
   3. Conditions at Destination

Table 4. Fundamental Questions and Fundamental Functions of Justice Analysis

Fundamental Questions	Fundamental Functions
Question 1 What do individuals and collectivities think is just, and why?	**Just Reward Function** $C = C(\mathbf{X}; \varepsilon)$
Question 2 How do ideas of justice shape determination of actual situations?	**Actual Reward Function** $A = A(C, \Omega; \varepsilon)$
Question 3 What is the magnitude of the perceived injustice associated with given departures from perfect justice?	**Justice Evaluation Function** $J = \theta \ln\left(\dfrac{A}{C}\right)$
Question 4 What are the behavioral and social consequences of perceived injustice?	**Justice Consequences Function** $\Xi = \Xi[\mathbf{T}(J), \Gamma; \varepsilon]$

Notes: In the equations, C denotes the just reward and the just reward function, A the actual reward and the actual reward function, and J the justice evaluation; Ξ denotes the justice consequences and the justice consequences function; $\mathbf{X}$ is a vector of rewardee characteristics, Γ and Ω are vectors of other factors, $\mathbf{T}$ denotes a transformation, and ε denotes a stochastic disturbance.

status as a function of relative rank on valued personal quantitative characteristics:

$$S = \ln\left(\frac{1}{1-r}\right),\tag{1}$$

where S denotes status and r denotes the relative rank within a group or population. The status function, which was proposed by Sørensen (1979), embeds

Table 5. Framework for Sociological Analysis: Fundamental Functions in Three Fields

A. Fundamental Functions in Status Analysis
 1. Relative Rank in Distribution of Valued Good
 2. Status Functions (S1, S2, and S3)
 3. Status Consequences Function

B. Fundamental Functions in Justice Analysis
 1. Just Reward Function
 2. Actual Reward Function
 3. Justice Evaluation Function
 4. Justice Consequences Function

C. Fundamental Functions in Migration Analysis
 1. Migrant Selection Function
 2. Migrant Incorporation Function
 3. Child Incorporation Function
 4. Impact Function

the convexity property described by Goode (1978), whereby status rises steeply with rank.

The justice evaluation function specifies the justice evaluation as a function of the logarithm of the ratio of the actual reward to the just reward:

$$J = \theta \, \ln\left(\frac{A}{C}\right), \tag{2}$$

where J denotes the justice evaluation (the assessment by an observer that a rewardee is rewarded justly or unjustly), A denotes the rewardee's actual reward, C denotes the observer's idea of the just reward for the rewardee, and θ denotes the signature constant. The sign of θ is called the framing coefficient, because it embodies the observer's framing of the reward as a good or as a bad (negative for a bad, positive for a good), and the absolute value of θ is called the expressiveness coefficient, because it transforms the observer's experience of justice into the expression thereof. The justice evaluation function, proposed by Jasso (1978), possesses the property emphasized by Wagner and Berger (1985) that deficiency is felt more keenly than comparable excess.

There are many features embedded in the status function and the justice evaluation function. Here only a few are summarized. Status is represented by nonnegative numbers, and the justice evaluation is represented by the full real-number line. Status depends on only one variable (what we may call the actual reward) and the justice evaluation on two (actual reward and just reward). Status notices only ranks; the justice evaluation notices both ranks and amounts. While both status and the justice evaluation increase with the actual reward, status increases at an increasing rate (Goode's convexity property) and the justice evaluation at a decreasing rate. Finally, in the case of cardinal things, the log-ratio specification of the justice evaluation function has been shown to be the only specification that satisfies both scale-invariance and additivity, two conditions thought desirable on substantive grounds in a justice evaluation function.[6]

The fundamental functions become critical building blocks both for theoretical work, where they often appear as assumptions, and for empirical work, where they appear as relations to be estimated. In the illustrations that follow we shall see the status function and the justice evaluation function operating in both these ways. Moreover, the fundamental functions give rise to further functions. For example, the justice evaluation function is aggregated into the justice indexes, which measure the total amount of injustice in a society; in turn, the justice indexes lead to decompositions, which link them to components of overall injustice attributable to poverty and to inequality (Jasso 1999a).

Fundamental Matrices

Each of the fundamental quantities can be arrayed in a matrix defined by the fundamental actors. For example, in status analysis, the Self-Other status matrix provides the magnitudes of status accorded by each actor to each target (Jasso 2001d:101). In the usual representation, the rows of the matrix correspond to Self and the columns to Other. Thus, the magnitudes of status accorded by one actor to all

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[6] For further detail on the status function, see Goode (1978), Sørensen (1979), and Jasso (2001d), and on the justice evaluation function, see Jasso (1978, 1990, 1999a). Contrast between the two functions is provided in Jasso (2002).

targets occupy one row, and the magnitudes of status accorded to a target by all actors occupy one column. Of course, if the group or population is characterized by perfect consensus, the matrix collapses to a vector.

Similarly, in justice analysis, there are three fundamental matrices: the just reward matrix, the actual reward matrix (which in the absence of perception error collapses to a vector), and the justice evaluation matrix. Table 6 provides visual representation of the three fundamental justice matrices.

Fundamental Distributions

Each fundamental quantity also gives rise to one or more distributions. For example, the justice evaluation gives rise to three distributions: the observer-specific justice

Table 6. Observer-by-Rewardee Matrices of the Just Reward, the Actual Reward, and the Justice Evaluation

1. Just Reward Matrix

$$C = \begin{bmatrix} c_{11} & c_{12} & c_{13} & \cdots & c_{1R} \\ c_{21} & c_{22} & c_{23} & \cdots & c_{2R} \\ c_{31} & c_{32} & c_{33} & \cdots & c_{3R} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ c_{N1} & c_{N2} & c_{N3} & \cdots & c_{NR} \end{bmatrix}$$

2. Actual Reward Matrix

$$A = \begin{bmatrix} a_{11} & a_{12} & a_{13} & \cdots & a_{1R} \\ a_{21} & a_{22} & a_{23} & \cdots & a_{2R} \\ a_{31} & a_{32} & a_{33} & \cdots & a_{3R} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ a_{N1} & a_{N2} & a_{N3} & \cdots & a_{NR} \end{bmatrix}$$

If there are no perception errors, the actual reward matrix collapses to a vector:

$$\boldsymbol{a}_{.r} = [a_{.1} \; a_{.2} \; a_{.3} \; \cdots \; a_{.R}]$$

C. Justice Evaluation Matrix

$$J = \begin{bmatrix} j_{11} & j_{12} & j_{13} & \cdots & j_{1R} \\ j_{21} & j_{22} & j_{23} & \cdots & j_{2R} \\ j_{31} & j_{32} & j_{33} & \cdots & j_{3R} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ j_{N1} & j_{N2} & j_{N3} & \cdots & j_{NR} \end{bmatrix}$$

Notes: Observers are indexed by $i = 1, \ldots, N$; rewardees are indexed by $r = 1, \ldots, R$. Thus, c_{ir}, a_{ir}, j_{ir} represent the observer-specific/rewardee-specific just reward, actual reward, and justice evaluation, respectively.

evaluation distribution, the rewardee-specific justice evaluation distribution, and the reflexive justice evaluation distribution (Jasso 1999a:136–37, 140–41).

In the large-population context, it is useful to examine the distributional forms. For example, in the case of status, the relative rank on the valued good gives rise to a rectangular distribution, and S1 status assumes a distribution whose form depends on the number of valued goods and their intercorrelations. If status is generated by either one valued good or several perfectly positively correlated valued goods, the status function is a positive exponential; if status is generated by two independently distributed valued goods, the status distribution assumes an Erlang form; and so on (Jasso 2001d:122). These distributional forms differ importantly in dispersion—there is less status inequality, for example, in a society that values two negatively correlated goods than in a society that values one good or two positively correlated goods.

In the case of justice, there is rich variety in the distributional forms. If ordinal goods are valued, they each give rise to a rectangular distribution, as in the status case. In the case of cardinal goods, the actual reward distribution and the just reward distribution can assume a variety of shapes, usually modeled by variates specified on the positive support, such as the lognormal and Pareto. And the justice evaluation distribution, reflecting the operation of both actual reward and just reward in the production of the justice evaluation, can assume a large variety of shapes as well. For example, even the simplest cases, in which the justice evaluation is modeled with a constant just reward (Jasso 1980) or with actual and just rewards drawn from variates belonging to the same family (Jasso 1999a, 2001a), yield forms that include the negative exponential, the positive exponential, the Erlang, the normal, the logistic, the quasi-logistic, the Laplace, and the asymmetrical Laplace.[7]

Fundamental Contexts

Finally, all of the foregoing elements may exhibit variation across different contexts. In justice analysis, the contexts are formalized by the mnemonic *brots*—where each letter stands for a context that may differentially shape the operation of the sense of justice: *b* for the benefit or burden under consideration, *r* for the type or identity of the rewardee, *o* for the observer, *t* for the time period, and *s* for the society.

Growth Over Time

Frameworks grow over time. To illustrate this growth, consider the justice evaluation function. Originally proposed for cardinal goods (Jasso 1978), the justice evaluation function was extended to ordinal goods in 1980 and to bads of all kinds in 1990. The just reward (one of the two arguments in the justice evaluation function), whose roots in the comparative study of reference groups highlight persons, was reformulated as an amount of a reward (Jasso 1978) whose sources include not only persons (of all kinds—real, fictitious, envisioned) but also parameters of distributions, such as the average, the minimum, or the 90th percentile (Jasso 1980, 1983). The signature constant began life as a scaling constant (Jasso 1978) but was transformed into an expressiveness coefficient in 1980 and, when the justice evaluation function was extended to bads, became a quantity with two constituent factors, the expressiveness coefficient and the framing coefficient (Jasso 1990). Decomposition of the justice index JI1 was not developed until Jasso (1999a). Moreover, the four central questions,

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[7]Summary description of these variate forms is found in Johnson and Kotz (1970a, 1970b).

around which the framework is organized, date only to Jasso and Wegener (1997), which integrated Jasso's (1978, 1989) and Wegener and Steinmann's (1995) overlapping lists of three central questions.

Summary

A large fraction of social science research consists of work developing a framework for the study of some field of phenomena. The framework collects, and provides, the fundamental building blocks that can then be used in theoretical and empirical analysis. For example, as will be seen in the following sections, the justice evaluation function developed in the framework becomes the starting postulate in several justice theories and as well leads immediately to pertinent empirical research. Explicit recognition of the critical value of developing a framework is useful, as it promotes scientific communication in the early stages of research and makes less appealing the temptation to premature theoretical or empirical work.

To convey the centrality of the framework, we let it occupy the central panel in the triptych representing tripartite social science analysis (Figure 1).

THEORETICAL ANALYSIS: THE SECOND ELEMENT IN THE TRIPARTITE STRUCTURE OF SOCIAL SCIENCE ANALYSIS

A *theory* begins with an *assumption*, and that assumption must come from somewhere. In the new perspective of tripartite analysis, the assumption comes from the framework. The rich set of elements in the framework constitute building blocks, some of which can be used as the starting assumptions for fruitful theories.

As shown in Figure 1, in the theoretical panel of the triptych representing tripartite social science analysis, we distinguish between two main kinds of theories, deductive theories and nondeductive theories. Among the latter, this article highlights one prominent form, the hierarchical theory identified by Toulmin (1953). Both deductive and hierarchical theories have a two-part structure, the first part containing an assumption or a set of assumptions—also called *postulates*. In both, the assumption set should be as short as possible, and the second part should be as large as possible and, indeed, always growing, which is why visual representations of theories typically do not have a border at the bottom (Jasso 1988b, 2001b:49).[8]

Deductive Theory

Although a theory begins with an assumption, it does not end there. In the most useful kind of theory—deductive theory—the starting assumption, perhaps in combination with other assumptions, is used as the starting point from which to systematically deduce new *implications*. These implications—also called *predictions*—show the reach of the process described by the starting assumption. They have the property that they are observable, testable implications; as well, they are ceteris paribus implications, given the multifactor world in which we live. It is useful to explicitly label the sentences in a proposed theory according to whether they play the part of assumption or are instead implications and, if they are implications, to provide some idea of how they were derived.

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[8] For further detail beyond the brief discussions provided in this article, as well as graphical representation of deductive, hierarchical, and hybrid theories, see Jasso (2001b:47–50).

There are two sets of criteria for judging a deductive theory, the first theoretical and the second empirical. Theoretical criteria focus on the structure of the theory. A good theory has a minimum of assumptions and a maximum of predictions. The predictions span many topical domains, and they express what the theory requires and what the theory forbids. Moreover, in a good theory, the predictions constitute a mix of intuitive and nonintuitive predictions, and at least some of them are novel predictions. Indeed, novel predictions are the hallmark of deductive theory. Novel predictions are discoveries about the reach of the process. Empirical criteria for evaluating deductive theories focus, of course, on tests of the predictions.[9] It may happen that early in the life of a theory, the assumption set grows. It may come to be seen that the single starting assumption is not sufficient by itself to yield many predictions but that the introduction of one or two additional assumptions produces unexpected synergies and an explosion of new predictions. Often, work with a particular set of assumptions leads to codification of special *methods* for deriving predictions. These special methods may focus on special representations of the assumptions or special kinds of tools.

Note that mathematics is the power tool for derivation of predictions, for obtaining what Popper (1963:221) called the "marvellous deductive unfolding" of the theory. The criterion of fruitfulness, exemplified by novel predictions and by predictions that take the theory far afield from its original domain, is met more easily by the long deductive chains that mathematics enables. Purely verbal arguments tend to tether the deduced consequences to overt phenomena in the assumptions, constraining fruitfulness and destroying the possibility of novel predictions. For example, the popular technique of instantiation by its very nature cannot produce novel predictions, for novel predictions are novel precisely because nothing superficially evident in the assumptions could lead to them.[10]

To illustrate development of a deductive theory, consider one of the theories based on the justice evaluation function, a theory now called justice-comparison theory.[11] The theory began with the notion that the reflexive version of the recently-proposed justice evaluation function (Equation 2) could serve as a useful first postulate, which would potentially yield implications for a host of behavioral and social phenomena.

The justice evaluation function, however, at that time was expressed only with respect to cardinal goods, such goods as income and wealth. In order to extend the scope of the new theory to cover ordinal goods, a second postulate was proposed. This second postulate is a simple *measurement rule*—cardinal goods (and, later, bads) are measured in their own units and ordinal goods as relative ranks in specially selected comparison groups (Jasso 1980).

There was an unexpected, immediate payoff to introduction of the second postulate. Besides enabling application to ordinal goods, it triggered examination of the effects of valuing cardinal versus ordinal goods, and, hence, the effects of living in different kinds of societies, such as materialistic societies (societies that value material wealth) and nonmaterialistic societies (societies that value birth or beauty or some other ordinal good). This new development would lead to interesting new predictions, such as

(1) The most advantaged person in a materialistic society experiences far greater overreward than the most advantaged person in a nonmaterialistic society;

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[9]On the critical importance of novel predictions, see Popper (1963, esp 117, 241–48).

[10]Because a fruitful theory is easier to test (Danto 1967), as will be discussed, using mathematics as a theoretical tool also confers empirical advantages.

[11]Jasso (2001b) provides an overview of this and four other theories based on building blocks in the framework for justice analysis, and Jasso (2001a) provides fuller exposition of justice-comparison theory.

(2) Societies that welcome immigration must be materialistic societies; and

(3) In nonmaterialistic societies, the severity of the conflict between two warring subgroups is a decreasing function of the proportion in the disadvantaged group, but in materialistic societies, the effect on conflict severity of the proportion in the disadvantaged group depends on the shape of the income distribution.

But two assumptions were not enough. In the early days of justice-comparison theory, representations of societies were based on distributions of justice evaluations in which the distribution of the actual reward was varied but the just reward held constant. While it was important to assess the effects of differing actual reward distributions, it was not realistic to hold the just reward constant. Though there were some useful special cases that could be represented by a constant just reward, a more flexible approach was needed. That desired more flexible approach emerged with the introduction of a third postulate, the *identity representation of the just reward*, which represents the just reward by the product of the mean actual reward and a person-specific idiosyncrasy parameter (Jasso 1986).

As with introduction of the second postulate, there were immediate synergies. The identity representation, combined with the logarithmic-ratio form, leads to a situation in which the unknown portion of the justice evaluation function leaves unaffected the operation of the other effects and may even vanish. As well, because the mean actual reward can be expressed as the ratio of the total reward to the population size, the new third postulate opened the door to examination of the effects of affluence and population size, leading to such predictions as

(1) A thing changes value as it and/or its owner moves from group to group;

(2) Inheritance tempers grief;

(3) In historical periods when husbands predecease their wives, fathers are mourned more than mothers, but in historical periods when wives predecease their husbands, mothers are mourned more than fathers; and

(4) Parents of two or more nontwin children will spend more of their toy budget at an annual gift-giving occasion rather than at the children's birthdays.

Two more postulates were soon added—the *Social Welfare Postulate* and the *Social Cohesiveness Postulate*—representing the effects of the mean and inequality of the distribution of justice evaluations. These led to such predictions as

(1) In materialistic societies, the public benefit of religious institutions is an increasing function of income inequality; and

(2) In a marriage, changes that increase marital cohesiveness increase the well-being of one spouse and decrease the well-being of the other spouse.

These five postulates remain at the core of justice-comparison theory (a handy table presenting the postulates and their mathematical expression is provided in Jasso 2001b:58). The predictions to which they lead span many topical domains and also include novel predictions, such as

(1) Posttraumatic stress is greater among veterans of wars fought away from home than among veterans of wars fought on home soil;

(2) A thief's gain from theft is greater when stealing from a fellow group member than when stealing from an outsider; and

(3) Blind persons are less susceptible to eating disorders.

As work with justice theory accumulated, it became clear that the procedures used to derive predictions could be classified into four main methods, known as the *micromodel, macromodel, matrixmodel,* and *mesomodel* strategies. The micromodel begins with the justice evaluation formula at the individual level, and tools from calculus are used to obtain the effects of the constituent factors. The macromodel begins with the distribution of justice evaluations, and tools based on probability distributions are used to derive results. The micromodel and macromodel strategies have been substantially well developed and fruitful. The matrixmodel strategy, which begins with the entire matrix of justice quantities and uses tools from linear algebra, is still undergoing development, as is the mesomodel strategy, which begins with an entire small group and assesses the relations among subsets of members, such as between adjacent pairs and between the bottom and top members. Interestingly, all four derivation strategies yield predictions for both the individual and social levels of analysis. Moreover, it now turns out that all four techniques are useful for deriving predictions in status theory (Jasso 2002) and indeed may show themselves useful for deriving predictions in a wide variety of other sociobehavioral theories.

Hierarchical Theory

Hierarchical theory, a form of nondeductive theory described in Toulmin (1953), also plays a useful part in theoretical analysis. Hierarchical theory differs from deductive theory in that, while both kinds of theories begin with an assumption, in a hierarchical theory there is no deduction; instead, propositions are constructed by linking a term from the assumption with an observable term.

The term from the assumption may be a term appearing in the assumption itself, or it may be a term generated from the assumption. For example, a hierarchical theory in which the justice evaluation function is an assumption might be used to construct propositions linking observables to the justice evaluation or to the proportion over-rewarded or to the average underreward among the underrewarded.

In hierarchical versions of status theory and justice theory, some examples of constructed propositions include

(1) Healthiness is an increasing function of status;

(2) Healthiness is a decreasing function of the justice evaluation; and

(3) The propensity to revolution is an increasing function of negative reflexive justice evaluations and positive nonreflexive justice evaluations.[12]

It is useful to contrast the propositions constructed in hierarchical theories with the predictions deduced from deductive theories. In the deductive case, we know exactly the pathways by which the assumptions lead to the predictions; for example, in status theory we can show exactly how the status function leads to the prediction that the lower-ranking members of subgroups will favor discrimination and the higher-ranking members will oppose it, and in justice theory we can show exactly how the justice evaluation function leads to the implication that inheritance tempers grief. In

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[12] For further discussion and examples of hierarchical theory, see Fararo (1989) and Jasso (2001b).

the hierarchical case, on the other hand, the pathways are invisible, if they are there at all. It is not too wide of the mark to think of the constructed propositions as potential predictions waiting for someone to lay bare the pathways (or show precisely that they do not follow from the assumptions). Obviously, the logical status of predictions and propositions differs markedly, as does the knowledge gained from their empirical tests (a point to which we return in the next section).

Hybrid Deductive-Hierarchical Theory

Note that the same assumption may be the starting assumption of both a deductive and a hierarchical theory. In that case, the theory is said to be a "hybrid" theory with a set of deduced predictions and a set of constructed propositions emanating from it. The deductive part is handled exactly like any deductive theory and the hierarchical part like any hierarchical theory.

Illustration: Deriving Predictions in Deductive Theory

To illustrate theoretical derivation, we turn to status theory, using the S1 status function as the starting assumption. The illustration in this section is drawn from a larger project whose aim is to derive predictions for workplace phenomena from both status theory and justice theory. The full workplace project will examine hiring, firing, promotion, and productivity, as well as relationships among workers in the same or different units in work organizations. In this illustration, we focus on one very special situation—the case in which an *appointment* is to be made to a special position such as executive officer or an endowed chair. For convenience, we will refer to that position as a *top position*, though it need not be the very top position in a unit. In the piece of the derivation presented here, we focus on the members of the unit in which the appointment is to be made. In general, the new appointee may come from within the unit or may be brought in from the outside; we will refer to these two types of appointments as *insider* and *outsider* appointments.

Status theory enables characterization of the group members' status both before and after the appointment is made and enables comparison of the change in S in the insider- and outsider-appointment cases. Thus, status theory can yield predictions about group members' status in the two cases and about their preferences—given that humans typically can imagine their lives under different scenarios. Moreover, if members of the unit are also the decision-makers, as they often are in the case of making an appointment to an endowed chair, and if status enhancement plays a part in their vote, then status theory also yields predictions for the appointment itself. Of course, status is not the only factor at work. The predictions are ceteris paribus predictions, and their interpretation and test require cognizance of the other factors.

To prepare for theoretical derivation, we rewrite the status function (Equation 1), replacing the relative rank r by $i/(N+1)$, where i denotes the absolute rank and N the group size:

$$S = \ln\left(\frac{N+1}{N+1-i}\right). \tag{3}$$

Earlier, the four main methods currently in use to derive predictions from status theory and justice theory were briefly mentioned. The micromodel method is ideally

suited to this application. We begin by writing the formula for the individual's status at two time points, next obtain the formula for the change in S from Time 1 to Time 2, and then investigate the effects of the constituent factors of S—that is, of the change in own rank and group size.

Whenever there is a change in the individual's rank i on the valued good or in the group size N, there will be a change in the individual's status. Thus, the micromodel method permits assessment of the effects of those changes on the individual's status. Note that in general there are many actions and events that can alter the factors in the S formula. For example, theft can affect wealth rank; murder affects group size; natural disasters can affect both.

To begin, then, the basic equation in the micromodel approach is an equation that compares the individual at two points in time:

$$CS = S_2 - S_1, \tag{4}$$

where S denotes status, as before, and CS denotes change in S. If CS is zero, then whatever transpired between the two time periods has had no effect on the individual; if, however, CS is negative, then the individual has become worse off, and, if positive, better off.[13]

Equation (3) is the basic expression that will be incorporated into the change equation in Equation (4), producing

$$CS = \ln\left[\frac{(N_2 + 1)(N_1 + 1 - i_1)}{(N_1 + 1)(N_2 + 1 - i_2)}\right]. \tag{5}$$

The first step in the protocol for the micromodel strategy, after selecting a field of application, is to identify the kinds of actors involved and the kinds of situations and to provide the pertinent special notation. The protocol for the micromodel method includes a special table for collecting the work at each step. Accordingly, as shown in Table 7, Panel C, in this illustration we identify one kind of actor, member of the workplace unit, and two situations, insider and outsider appointments to the new top position. Also as shown, special notation is introduced. The two situations are called A1 and A2 (where the "A" stands for "appointment").

The next step in the micromodel method, shown in Panel D of Table 7, is to write the formula for CS for the members of the workplace unit in both the insider- and outsider-appointment situations. Given that N can change only by 1, we let N without a subscript denote its Time 1 value, rewriting the outsider-case formula to reflect addition of one member.

The formulas shown in Table 7, Panel D, are expressed in terms of group size N and the individual's rank i at Time 1 and Time 2 (denoted by subscripts). It is useful to obtain even more precise formulas than those. Consider the insider-appointment case. If a group member's rank remains constant—either because the new appointee ranks higher both before and after the new appointment is made or because the new appointee ranks lower both before and after—then, as can be seen by removing the subscripts from the rank i in both numerator and denominator, the formula reduces to an expression with identical numerator and denominator and the value of CS will

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[13] Note that the change equation refers exclusively to one individual at two points in time. The individual may become better off or worse off relative to her or his own situation at Time 1.

Table 7. Using the Micromodel Strategy to Derive Predictions from Status Theory for Hiring Phenomena

A. Write Basic Status Function Formula.

$$S = \ln \frac{1}{1-r} = \ln \frac{N+1}{N+1-i},$$

where S denotes status, i denotes the individual's absolute rank on the valued good (say, salary), N denotes the population size, and r denotes relative rank.

B. Express Change in S from Time 1 to Time 2.

$$CS = S_2 - S_1$$

$$CS = \ln\left[\frac{N_2+1}{N_2+1-i_2}\right] - \ln\left[\frac{N_1+1}{N_1+1-i_1}\right]$$

$$CS = \ln\left[\frac{(N_2+1)(N_1+1-i_1)}{(N_1+1)(N_2+1-i_2)}\right]$$

C. Analyze the Top-Appointment Situation.
  1. There is one kind of actor: **Member of the Workplace Unit.**
  2. Define two top-appointment situations:
     (A1) The new top appointee is an insider.
     (A2) The new top appointee is an outsider.
  3. The simplest case has the following features: (1) the group size N remains the same except in A2, where it increases by 1; and (2) the salaries of all members remain constant except that of the top appointee in A1.

D. Write the Formulas for CS in the Two Situations.

Situation A1	Situation A2
Insider Appointee	Outsider Appointee
$\ln\left[\dfrac{N+1-i_1}{N+1-i_2}\right]$	$\ln\left[\dfrac{(N+2)(N+1-i_1)}{(N+1)(N+2-i_2)}\right]$

E. Is CS Positive or Negative?

Situation A1	Situation A2
Insider Appointee	Outsider Appointee
negative among workers who rank above A at Time 1 but below A at Time 2	negative among workers who rank below A at Time 2
zero otherwise	positive among workers who rank above A at Time 2

Table 7. Continued

F. In Which Situation Do Group Members Have the Higher *CS*?

$$\ln\left(\frac{N+2}{N+1}\right) > \ln\left(\frac{N+1-i}{N+1-i}\right)$$

Group members who outrank A at Time 2 have higher *CS* in outsider appointment.

$$\ln\left(\frac{N+1-i}{N+1-i}\right) > \ln\left[\frac{(N+2)(N+1-i)}{(N+1)(N+2-i)}\right]$$

Group members who always rank below A have higher *CS* in insider appointment.

$$\ln\left[\frac{(N+2)(N+1-i)}{(N+1)(N+2-i)}\right] > \ln\left(\frac{N+1-i}{N+2-i}\right)$$

Group members who would lose rank from insider appointment have higher *CS* in outsider appointment.

G. Obtain First and Second Partial Derivatives of *CS* with Respect to Each Factor in the *CS* Formulas. (First partial derivatives shown below.)

Derivative	Situation A1 Insider Appointee	Situation A2 Outsider Appointee
1. Case in which $CS < 0$		
CS_i	$-\dfrac{1}{(N+1-i)(N+2-i)} < 0$	$-\dfrac{1}{(N+1-i)(N+2-i)} < 0$
CS_n	$\dfrac{1}{(N+1-i)(N+2-i)} > 0$	$\dfrac{i}{(N+2)(N+1)(N+1-i)(N+2-i)} > 0$
2. Case in which $CS > 0$		
CS_i	—	—
CS_N	—	$-\dfrac{1}{(N+1)(N+2)} < 0$

be zero. If, however, a group member's rank declines—because he or she outranked A at Time 1 but at Time 2 ranks below A—then the formula for CS becomes

$$\ln\left(\frac{N+1-i}{N+2-i}\right). \tag{6}$$

In the case of an outsider appointment, the group members' ranks can remain the same if at Time 2 they rank below the new appointee or can increase by 1 if at Time 2 they rank above the new appointee. In the first case, among workers who rank below A at Time 2, the formula for CS becomes

$$\ln\left[\frac{(N+2)(N+1-i)}{(N+1)(N+2-i)}\right]. \tag{7}$$

In the second case, among workers who rank above A at Time 2, the formula for CS becomes

$$\ln\left(\frac{N+2}{N+1}\right). \tag{8}$$

The CS formulas express the change in status due to the new appointment. Following the protocol for the micromodel method, there are three main sets of questions to be addressed, each illuminating different aspects of behavior in this appointment situation and singly or in combination yielding a variety of predictions. These three main questions are

(1) What is the sign of CS?
(2) In which situation do group members have the higher CS? and
(3) What are the effects on CS of the individual's rank and the group size?

Does an individual group member's status increase or decrease when a new top appointment is made? In the insider case, as shown previously and as summarized in Table 7, Panel E, CS can be negative or zero. That is, status cannot increase from an insider appointment, but it can decrease if a group member loses rank because the new top appointee ranked below at Time 1 and above at Time 2 (Equation (6)).

In the outsider case, algebraic manipulation of Equation (7), which expresses the change in status for a group member who ranks below the new top appointee, indicates that CS is negative in this case. And Equation (8), which expresses the change in status for a group member who ranks above the new top appointee, is obviously positive.

Thus, in the insider case, a group member's status may decline or stay the same, and in the outsider case, a group member's status may decline or may instead increase. In the insider case, most group members will experience no change in status, unless the appointment reaches deep into the ranks. In the outsider case, in contrast, given that the new top position by definition is a very high position, most group members will experience a decline in status.

This first set of results indicates that hiring for a new top position is a delicate matter. Suggestions that a broad search be conducted will be resisted. The group may suggest to a philanthropist who wishes to endow a chair that she or he instead endow a research center, or a visiting lectureship, or student fellowships, etc. There is an

obvious solution: appoint the top-ranking person who does not have a chair, as this
ensures that the status order is preserved intact.

The second set of questions seeks to learn in which situation the group members
have the higher magnitude of CS. Looking at Table 7, Panel E, and at the formulas
obtained previously, we see that a positive CS occurs only in the outsider case, doing
so among workers who rank above the new appointee (Equation (8)). Thus, workers
who would outrank A at Time 2 have higher CS in the outsider case. In contrast,
workers who always rank below A have a higher CS in the insider case. And workers
who would lose rank from an insider appointment have higher CS in the outsider
case; even when they rank below A in the outsider case, so that CS is negative in
both insider and outsider scenarios, algebraic manipulation shows that the loss in
status in larger in the insider case than in the outsider case. These results are
summarized in Table 7, Panel F, which shows the inequalities evaluated, implicitly
or explicitly.

The final set of questions to be addressed involves the effects of each factor on the
change function CS (Panel G, Table 7). Because as we have seen there are different CS
formulas for different scenarios, we analyze each one separately. To begin, the insider
case in which CS is negative—for group members who outrank A at Time 1 but not at
Time 2, given in Equation (6)—leads to first partial derivatives that are negative for
rank i and positive for group size N. Thus, the decline in status in this case is
intensified the higher the rank and is attenuated the larger the group.

In the outsider case in which CS is negative—among workers who rank below A at
Time 2, given in Equation (7)—the first partial derivative with respect to rank i is
negative and with respect to group size is positive. Thus, here again the decline in
status is intensified the higher the rank and is attenuated the larger the group.

Finally, in the outsider case in which CS is positive—among workers who
rank above A at Time 2, given in Equation (8)—there is no effect of rank, and the
effect of group size is negative. Thus, the larger the group the smaller the positive
increase in status. To summarize these results, group size always attenuates the change
in status, and own rank always intensifies the change in status, as shown in Table 8.

The final step in theoretical derivation is to compile a list of predictions. Here an
initial list of the predictions obtained from this derivation is presented:

PREDICTION 1. Making a new top appointment in a workplace group can generate
both gains and losses in status among group members.

Table 8. Worker's Status When New Top Appointment Is Made

	New Top Appointee	
	Insider	Outsider
A. Change in Status as a Result of New Top Appointment		
	loss; none	loss; gain
B. Conditioning Factors		
1. When change in status is a loss		
own rank, before new hire	intensifies	intensifies
group size, before new hire	attenuates	attenuates
2. When change in status is a gain		
group size, before new hire	—	attenuates

PREDICTION 2. The members' change in status differs according to whether the appointee is an insider or an outsider and according to each member's rank before and after the appointment.

PREDICTION 2.1. When the appointee is an insider, there are no gains in status; group members can only lose status or retain the same magnitude of status.

PREDICTION 2.2. When the appointee is an insider, members who rank above the new appointee at Time 1 and below at Time 2 lose status.

PREDICTION 2.3. When the appointee is an outsider, status may increase or decline but cannot remain the same.

PREDICTION 2.4. When the appointee is an outsider, workers who rank below the new appointee lose status, and workers who rank above the new appointee gain status.

PREDICTION 3. When a group member loses status, the higher the rank, the greater the loss in status.

PREDICTION 4. When a group member loses status, the larger the group size, the smaller the loss in status.

PREDICTION 5. When a group member gains status, the larger the group size, the smaller the gain in status.

PREDICTION 6. Group members who outrank A at Time 2 have higher CS in the outsider appointment.

PREDICTION 7. Group members who always rank below A have higher CS in the insider appointment.

PREDICTION 8. Group members who lose status from both insider and outsider appointments lose less status in the outsider appointment.

From this basic set of predictions, it is possible to generate many further predictions. For example, if individuals prefer situations that enhance their status, then a set of predictions for preferences can be derived. This would include predictions such as: "Group members who outrank A at Time 2 prefer an outsider appointment." Similarly, if the group members themselves are the decision-makers, new predictions can be obtained, such as: "In a vote to decide between an insider and an outsider candidate, the group almost always will choose the insider candidate unless the insider candidate is fairly low ranking."

In this illustration, taken from a larger project investigating justice and status effects on behavioral and social processes in the workplace, I have followed the protocol for the micromodel strategy. I have obtained and reported the principal mathematical results in the special case of a new top appointment and have provided a flavor for their substantive interpretation. The reader will no doubt draw many further implications. Avenues of analysis that may prove fruitful include scrutiny of the connections between these implications and further implications for preference formation and decision-making. Of course, all the implications are ceteris paribus implications, and, in a multifactor world, testing them will require thoughtful research design.

EMPIRICAL ANALYSIS: THE THIRD ELEMENT IN THE TRIPARTITE STRUCTURE OF SOCIAL SCIENCE ANALYSIS

In general, there are three kinds of empirical work, as shown in the empirical panel of the triptych representing the tripartite structure of social science analysis (Figure 1). Two of these are testing the predictions deduced in deductive theories and the propositions constructed in hierarchical theories. A third kind of empirical work, and sometimes the only empirical activity—especially in the early stages of development of a particular topical subfield—consists of basic measurement and estimation operations. The quantities identified in the framework are measured, the functions and distributions estimated, and the matrices populated. It is easy to forget how important these extratheoretical activities are to the growth of knowledge. Yet it is these bits of knowledge that provide early impetus for a theory, or, alternatively, early skepticism, or that simply grow alongside partial theories until a large theory comes to unify, to interpret, and to reinterpret them.

In this section, we provide a brief overview of the three kinds of empirical work and a brief illustration of one kind, the measurement and estimation activities.

Testing the Predictions of Deductive Theories

This kind of empirical work begins with a prediction or set of predictions that the empirical analyst will test. Popper (1963:221) was acutely insightful: "The wealth of [a theory's] consequences has to be unfolded deductively; for as a rule, a theory cannot be tested except by testing, one by one, some of its more remote consequences; consequences, that is, which cannot immediately be seen upon inspecting it intuitively."

There are three steps: (1) preparing the prediction for test; (2) designing the specification and estimation; and (3) interpreting the results.[14]

Preparing the prediction for test. Sometimes, theorists publish predictions that are completely ready for testing; other times, however, the prediction is still couched in theoretical language and is not yet fully observable. Whenever the prediction is not yet fully observable, the empirical analyst's first task is a theoretical one, namely, to continue the deductive chain until it reaches an observable point. For example, the prediction presented earlier, "In a marriage, changes that increase marital cohesiveness increase the well-being of one spouse and decrease the well-being of the other spouse," requires further theoretical work before it is fully ready for testing. Terms like *changes, cohesiveness,* and *well-being* must be given observable content; the changes could be joining the labor force, layoff, retirement, and so on. In contrast, the prediction, also presented earlier, "Parents of two or more nontwin children will spend more of their toy budget at an annual gift-giving occasion rather than at the children's birthdays," is ready for test; the only major step left to be taken, and only in some research designs, is to select the appropriate annual gift-giving occasion for the particular social context (e.g., Christmas, the Feast of the Three Kings, Chanukah, New Year's Day).

Designing the specification and estimation. In designing the specification, it is critical to recall the basic principle set forth in the introduction: observed behavioral and social phenomena are the product of the joint operation of several basic forces.

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[14] For a detailed example of testing a theoretical prediction, see Jasso (1988a).

A prediction cannot be tested reliably, nor can the magnitude of an effect be unambiguously assessed, without including in the specification all the other factors thought to play a part in the process under study. Once the specification has been set up, selection of the estimation procedure takes into account both the nature of the specification as well as the usual statistical issues that arise from imperfect data.

Interpreting the results. The multifactor view poses special empirical challenges, for the operation of two factors may lead to opposite effects, and hence isolating the two effects becomes a prime empirical objective. It may appear at first that one prediction is rejected, but in fact it may be that one of the two effects is stronger than the other. For example, suppose that mechanism A predicts that Y is an increasing function of X and that mechanism B predicts that Y is a decreasing function of X. The empirical finding that Y is an increasing function of X does not constitute, in a multifactor world, evidence that mechanism B is not operating but rather is consistent with the operation of both mechanisms such that the effect of mechanism A is stronger or "dominates" mechanism B. And conversely.[15]

Beyond the predictions—assessing the theory. The results of tests of predictions—once there is reasonable confidence in the results—provide information for assessing the empirical status of the theory. If one considers the empirical assessment of a single theory in isolation, then the perennial issues are (1) how many tests? (2) of how many predictions? and (3) with what combination of results? There is widespread agreement that rejecting a prediction is not a sufficient condition for rejecting a theory. Moreover, rejecting a prediction is not a necessary condition for rejecting a theory; even if all of a theory's predictions survive test unrejected, one may still reject the theory—in favor of a better theory, one with "excess corroborated content" (Lakatos 1970). Indeed, the view known as *sophisticated falsificationism* holds that it is not possible to judge the empirical merits of a theory in isolation; falsification requires comparison of the relative merits of two theories (Lakatos 1970:116).[16]

Testing the Propositions Constructed in Hierarchical Theories

As with predictions, there are three steps: (1) preparing the proposition for test; (2) designing the specification and estimation; and (3) interpreting the results. In general, testing the propositions constructed in hierarchical theories is less demanding than testing predictions and, concomitantly, somewhat less informative for assessing the empirical status of a theory.

Preparing the proposition for test. Testing the propositions constructed in hierarchical theories is less demanding in part because the proposition is already at least half-observable, given that it was crafted by linking a term from a postulate to an observable term.

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[15] This is one of the reasons why it is easier to test a theory the more fruitful it is. As Danto (1967:299–300) observed: "Indeed, it is by and large the ability of a theory to permit derivations far afield from its original domain which serves as a criterion for accepting a theory, for in addition to the obvious fruitfulness such a criterion emphasizes, such derivations permit an increasingly broad and diversified basis for testing the theory."

[16] These and other issues that arise in the empirical assessment of a theory or theories have been extensively and cogently analyzed by Popper ([1935] 1959, 1963), Kuhn ([1962] 1970), and Lakatos (1970).

Designing the specification and estimation. Here, the design of the specification and estimation is no less demanding than that associated with predictions. The basic multifactor principle leads to similar specification challenges, and both the nature of the specification and the quality of the data lead to similar estimation challenges.

Interpreting the results. Because in the construction of propositions in hierarchical theories no pathways have been specified, the knowledge gained from empirical tests is less informative in some sense than the results of tests of predictions, though nonetheless important.

Extratheoretical Measurement and Estimation

As already noted, there is a third kind of empirical work, namely, empirical work that does not grow out of a theory. Such extratheoretical empirical work consists mainly of measurement and estimation of the quantities and relations in the framework. In Figure 1, this type of work is represented in the top subpanel of the empirical panel in the social science analysis triptych.

Depending on the topical subfield, this third kind of empirical work may be quite extensive. For example, in justice analysis, extratheoretical research activities are quite numerous and informative. They include measuring the true and disclosed just rewards, measuring the experienced and expressed justice evaluations, estimating the just reward function and the principles of microjustice, estimating the principles of macrojustice, assessing the extent of interindividual disagreement on the principles of justice, ascertaining whether individuals frame particular things as goods or as bads, estimating observer's expressiveness, comparing the just inequality with the actual inequality, assessing just gender gaps and their underlying mechanisms, measuring trends in overall injustice, estimating the poverty and the inequality components of overall injustice, and so on.[17]

Illustration of Extratheoretical Research

To illustrate extratheoretical research briefly, we examine justice indexes and gender gaps in the U.S. sample surveyed by the International Social Justice Project (ISJP) in 1991. The ISJP was the first major international effort to document the views of ordinary citizens regarding social, economic, and political justice. The project involved five Western democracies and eight formerly socialist countries. A subset of the countries (not including the United States) were surveyed again in 1996. Data and results from the ISJP constitute the best currently available cross-national information on several justice questions.[18]

Some of the most important empirical questions pertain to the experience of injustice. How pervasive is the experience of unjust underreward? Does the experience of injustice vary systematically by gender? Is the experience of injustice driven by poverty or by inequality? Here we look at evidence from the ISJP's U.S. sample, which asked

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[17] See Jasso and Wegener (1997:416) for tabular presentation of the quantities and relations identified in the framework. As noted earlier, the framework is always growing, and thus it is not surprising that the set of quantities is already larger than that shown in Jasso and Wegener (1997:416), now including the just reward gaps developed by Jasso and Webster (1997, 1999) and the mean component and the inequality component of the justice index JI1 (Jasso 1999a).

[18] For fuller description of the ISJP, see Alwin and Wegener (1995), the initial set of research reports, collected in Kluegel, Mason, and Wegener (1995), and Jasso (1998).

respondents not only their actual earnings but also about the earnings they thought just for themselves, building on the initial analysis of these data reported in Jasso (1999a).

To measure the individual's justice evaluation, we use the justice evaluation function introduced previously (Equation (2)), calculating the justice evaluation from the information provided on actual and just earnings; this is known as the experienced justice evaluation and omits the signature constant:

$$J = \ln\left(\frac{A}{C}\right). \tag{9}$$

JI1, one of two justice indexes recently proposed (Jasso 1999a), is defined as the arithmetic mean of the experienced justice evaluation. It can assume positive, negative, and zero values. A positive value has the interpretation that the center of gravity of the distribution of justice evaluations lies in the overreward region, and a negative value indicates that the center of gravity lies in the underreward region.

Table 9 reports, in Panel A, basic information—the average actual earnings, average just earnings, and sample size, both for the U.S. sample as a whole and for gender-specific subsamples. Panel B reports JI1 and two decompositions. As shown, JI1 is negative for both men and women, but women experience greater injustice, on average, than do men (approximately 14 percent more injustice: –.207 among men versus –.236 among women).

The first decomposition of JI1 makes it possible to distinguish between two components of overall injustice, injustice due to the mean, and injustice due to inequality. Formally, as shown in the formula in Table 9, overall injustice is the sum of the mean component and the inequality component. Depending on the context, the mean component may be interpreted as a scarcity component or a poverty component. As shown in Table 9, Panel B, the mean component is larger than the inequality component for both men and women; however, the relative magnitudes differ considerably. While among men, almost 75 percent of overall injustice is due to scarcity, among women the comparable figure is 94 percent. Overall injustice among women is driven almost completely by scarcity, with only a small portion (slightly over 5 percent) due to inequality.

The second decomposition of JI1 distinguishes between injustice due to reality—that is, to actual earnings (aggregated into the actual mean and the actual inequality)—and injustice due to ideology—that is, to just earnings (aggregated into the just mean and the just inequality). Formally, overall injustice is equal to the reality component minus the ideology component, as shown in the formula in Table 9. Among both women and men, the ideology component exceeds the reality component, producing the negative JI1. As already known from the magnitudes of JI1, the discrepancy is larger among women than among men.

It is often desirable to decompose an index, such as the justice index or an inequality index, into components attributable to subgroups. A special case of JI1 enables such a decomposition. This special case, denoted JI1*, arises when the just earnings equal the mean earnings, that is, when justice is equality. This special case was examined in Jasso (1980) and, though consistent with some powerful sociological reasonings (Blau 1960, 1964; Blalock 1967), is thought to apply only in special circumstances, such as small homogeneous groups or utopian communities. Nonetheless, its decomposition capability makes it an appealing measure.

Table 9 reports in Panel C the values of JI1*. As shown, they are larger than the corresponding values of JI1, indicating that, on average, ideas of justice depart from

Table 9. Justice Indexes and Gender Gaps: U.S. Sample, ISJP 1991

	Men	Women	All
A. Base Data			
Average actual earnings ($)	36,950	20,084	28,847
Average just earnings ($)	43,137	25,106	34,474
N	438	405	843
B. Justice Index JI1 and Its Decompositions $JI1 = E(J) = E[\ln(A/C)]$			
1. JI1	−.207	−.236	−.221
2. Decomposition into Mean and Inequality Components			
$JI1 = JI1_{Mean} + JI1_{Ineq}$			
Mean component $JI1_{Mean}$	−.155	−.223	−.178
Inequality component $JI1_{Ineq}$	−.052	−.013	−.043
3. Decomposition into Reality and Ideology Components			
$JI1 = JI1_{Reality} - JI1_{Ideology}$			
Reality component	10.178	9.637	9.918
Ideology component	10.385	9.873	10.139
C. Justice Index JI1* and Its Gender Decomposition $JI1^* = E(J^*) = E\{\ln[A/E(A)]\}$			
1. JI1*	−.340	−.271	−.352
2. Decomposition into Within-Gender and Between-Gender Components			
Within-gender component	—	—	−.307
Between-gender component	—	—	−.0453
D. Gender Gaps in Actual and Just Earnings			
Actual gender gap	—	—	.544
Just gender gap	—	—	.582
E. Special Relation Between Mean Component of JI1 and Ratio of Gender Gaps			

$$JI1^F_{Mean} - JI1^M_{Mean} = \ln\left(\frac{\text{Actual Gender Gap}}{\text{Just Gender Gap}}\right) \approx -.0684$$

equality. Indeed, if equality was used as the standard for just earnings, experienced injustice would be greater, substantially so among men (−.207 versus −.340 among men and −.236 versus −.271 among women).

In the decomposition of JI1*, the within-group component is the weighted sum of the group-specific values of JI1*, where the weights represent the fraction of the population in each group. The between-group component is the weighted sum of the log of the ratio of the group mean to the overall mean. JI1* is equal to the sum of the two components. As shown in Table 9, Panel C, the within-gender component is larger by far than the between-gender component, constituting 87 percent of the overall JI1*.

Panel D of Table 9 reports the gender gaps, defined as the ratio of the women's average to the men's average, for both actual earnings and just earnings. As shown, and as evident from the base data in Panel A, the gender gap is greater for actual earnings than for just earnings.

Finally, Table 9 provides numerical approximation to an exact relation between aspects of the justice index and aspects of the gender gap. In brief, the signed

difference between the women's mean component of JI1 and the men's mean component of JI1 is equal to the log of the ratio of the actual gender gap to the just gender gap. This relation vividly shows that the usual way of measuring gender gaps is completely inattentive to within-gender inequality.

Taken together, these estimates provide evidence that in the United States in 1991, women experienced more injustice, on average, than men; that the experience of injustice was driven by scarcity rather than by inequality, markedly so among women; and that although average just earnings exceeded average actual earnings among both women and men, the relative shortfall was greater among women. Moreover, the experience of injustice depends critically on the individual's own ideas of justice, which therefore must be ascertained. If equality were used as the justice standard, as is implicitly the case in inequality measurement, experienced injustice would have been substantially greater than it actually was. Thus, while inequality measures portray factual inequality, the leap to individuals' well-being cannot be made without knowledge of individual-specific ideas of justice.

Here, for purposes of illustration, we have looked at only one country at one point in time. Obviously, it is important to compare the patterns across countries and over time. Moreover, this type of analysis can be usefully carried out with subgroups formed by characteristics other than gender. Finally, note that a special estimation task, not reported here, is to analyze the determinants of actual earnings and just earnings and to compare them.

This illustration vividly shows that extratheoretical empirical work can be extensive and informative. More importantly, the knowledge accumulating from this third kind of empirical work—extratheoretical measurement and estimation—can serve both to stimulate new theories and, eventually, to test them.

CONCLUDING REMARKS

Links Among the Three Elements in the Tripartite Schema

As discussed earlier, the starting assumptions of theories in a particular field are drawn from among the building blocks in the framework for the study of that topic or process; the theories in turn produce both deduced predictions and constructed propositions to be tested. Concomitantly, the building blocks in the framework also lead directly to empirical analysis, including measurement of quantities and estimation of relationships. To visualize these links, Figure 2 reproduces Figure 1 and adds arrows to link the three panels in the triptych representing the tripartite structure of social science analysis. The origins of each arrow are indicated by a circle, and the destinations by an arrowhead. As shown, there are five arrows. Three arrows originate in the framework, two ending in the theoretical panel of the triptych and one ending in the empirical panel; and two arrows originate in the theoretical panel, ending in the empirical panel. The two arrows from the framework to the theoretical panel go to the deductive and nondeductive subpanels, respectively, and the two arrows from the theoretical panel to the empirical panel originate in the deductive and nondeductive subpanels, respectively, and end in the deduced-predictions and constructed-propositions subpanels of the empirical panel. The third arrow originating in the framework ends in the measurement/estimation subpanel of the empirical panel.

Of course, work of all three kinds is carried out simultaneously, and over time there are many other connections across the triptych's panels and subpanels. Theoretical and

Theoretical [·] Analysis	Framework	Empirical [·] Analysis
Deductive Postulates Predictions	Questions Actors Quantities Functions	Measure/ estimate terms/relations
Nondeductive Postulates Propositions	Distributions Matrices Contexts	Test deduced predictions
		Test propositions

Figure 2. Triptych for [·] analysis.

empirical work can bring to light new quantities and functions that belong in the framework, new ways to define and measure the quantities, and new ways to specify the functions; empirical work can yield numerous insights subsequently incorporated into theories. Moreover, work anywhere in the triptych pertaining to one topical domain can stimulate developments anywhere in the triptych of another topical domain.

How does scientific knowledge grow? From the tripartite perspective, knowledge grows via three fundamental kinds of activities—developing a framework, theoretical analysis, and empirical analysis. Each of these in turn encompasses a suite of different kinds of research. In developing a framework, research activities range from sharpening the questions to choosing functional forms to identifying the pertinent contexts. In theoretical analysis, research focuses on building two distinct kinds of theories, deductive and nondeductive, both beginning with a parsimonious set of postulates, deductive theory leading to a large set of testable predictions and nondeductive theory to a large set of testable propositions. In empirical analysis, research tasks range from measuring the terms and estimating the relations found in the framework to testing the predictions of deductive theories and testing the propositions crafted in nondeductive theories.

The Tripartite Schema as GPS

This article has argued that the activities of social science analysis have a tripartite structure and that all three kinds of scientific work contribute to the growth of knowledge. In closing, I would like to suggest that explicit, self-conscious attention to the tripartite structure itself may contribute to an acceleration in the growth of knowledge. Use of the tripartite schema as a kind of global positioning system (GPS) may have large payoffs. First, if we know exactly what kind of task we are engaged in, we will be quicker to think of pertinent special tools, substantive connections, and criteria for judging our work. Second, when entering a new field, we will make sense of it more quickly if we summarize the state of knowledge by reference to the tripartite structure. Third, we can more quickly integrate new arguments, research reports, and other contributions into our knowledge of a field by characterizing them according to the task or subtask they address, pointing to a panel or subpanel of the triptych. Fourth, the tripartite schema makes it easy to identify lacunae in knowledge and projected research. Fifth, new contributions can be assessed more sharply and pertinently if both author and reader know the precise kind of work reported, given that methods and tools may differ greatly

across the tasks and subtasks. Sixth, the tripartite schema enables succinct contrasts of the stage of development of different fields and subfields.

As a brief illustration, consider the universal challenge—for both experienced researchers and young students—of learning about a new field or topical domain. The tripartite schema can be used as a checklist, starting with the framework (Figure 1): What are the fundamental questions? Who are the fundamental actors? What are the fundamental quantities? What are the fundamental functions? And so on. A particular topical domain may be heavy in quantities and sparse in functions or may be rich in actors and poor in questions. Continuing through the theoretical panel of the triptych, we can take an inventory of theories, identify their deductive or nondeductive character, identify their assumptions, list the methods for theoretical derivation, note the extent of mathematization in both the assumptions and the rules for deriving predictions, assess the theories' fruitfulness, and look for novel predictions. Finally, going through the empirical panel of the triptych, we can take an inventory of empirical work, from explicit tests of deduced predictions and explicit comparative assessments of deductive theories to tests of the propositions suggested by nondeductive theories to measurement and estimation of the quantities, functions, and other ingredients in the framework.

It often is also useful to follow a quantity or a function from panel to panel in the triptych. For example, the justice evaluation first appears in the framework, where it receives definition, mathematical representation, and functional specification; next it appears in the theoretical panel, playing a part in the assumptions of some justice theories; finally, it appears in the empirical panel. Moreover, following this thread makes vivid the interplay across different kinds of work—empirical work, for example—providing an impetus to sharper representation in the framework. It hardly need be added that the tripartite perspective can be a useful tool in the history of ideas; the justice evaluation, which eventually would be seen to link two great bodies of thought—concerning ideas about what is just and concerning reactions to injustice—long lay implicit until emerging as a three-category variable (justice, underreward, overreward) in Berger et al. (1972), soon thereafter displaying degree variation (Jasso and Rossi 1977), and finally appropriating the full real-number line (Jasso 1978).

In reviewing a field's progress, a simple but promising device is a spreadsheet that cross-classifies articles and fundamental questions, entering into each cell whether the work pertains to the framework or is theoretical or empirical. Thus, for example, a literature review of all articles published in a given year in the field of migration would have a row for each article and four columns corresponding to the fundamental questions. In each cell one would note the kinds of work reported in the article. An article might have one cell filled with the maximum three entries ("Framework," "Theoretical," and "Empirical") and all other cells blank, or an article might have all the cells filled, each with a different kind of task. Such a spreadsheet informs at a glance about the kinds of questions being addressed and the kinds of work being carried out to address them.

As Popper (1963:245) put it, the challenge is to "make genuine guesses about the structure of the world." The tripartite schema may be useful in locating those guesses—identifying the questions they address and the manner in which they are addressed.

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