I

Introduction

According to its flagship journal, *Psychometrika*, the aim of the Psychometric Society, the society whose members are psychometricians, is the "the development of psychology as a quantitative rational science." Psychometricians can be thought of as applied statisticians whose task is the solution of quantitative problems that arise in the carrying out of social and behavioural science. In its roughly one-hundred years as a discipline, psychometrics has contributed many impressive quantitative tools and ideas that are useful not only within the context of social and behavioural science, but science in general. It has contributed important mathematical discoveries to the theory of the reliability of variates, invented many useful definitions of the important concept of *dimensionality of a set of variates*, contributed to the understanding of how numerical relational systems can be used to represent features of empirical phenomena, and developed many novel techniques of data reduction.

The most distinctive of the inventions of psychometriks is, arguably, the latent variable model. The latent variable model is a statistical model in which are featured two types of random variates: The *manifest* variate, which is said to be *observable*, and a set of which constitutes the "input" into a latent variable analysis; and the *latent* variate, which is said to be, among other things, unobservable and unmeasurable. To date, there have been invented many such latent variable models, prominent examples being the linear factor models (and their siblings, the classical true-score models), the latent class and profile models, a variety of non-linear factor models, including the classical item response models, and the structural equation models.

Within the social and behavioural sciences, latent variable models have become very popular, and are employed both as general data analytic tools, and as frameworks within which to assess the validity of measurement claims (as in, e.g., McDonald, 1999). McDonald (1977, p.165) claims that the "...common factor model is probably the most widely employed device for the statistical analysis of multivariate data." In discussing the history of structural equation modeling, Bentler (1986, p.35) notes that "Unlike many other developments in theoretical psychometrics, this methodology spread from the methodology laboratory into the research laboratory with unusual rapidity." As Bentler (1986) suggests, the rapidity of this proliferation was undoubtedly facilitated by the availability of high-quality computer implementations (notably the LISREL program of Jöreskog and Sorbom). However, this explanation is only somewhat successful. There have been other techniques, also supported by high-quality software (e.g., the optimal scaling programs of the GIFI group), that have failed to approach the wide-spread acceptance enjoyed by various of the family of latent variable models. Moreover, it is not just the wide-spread *use* of latent variable models that is impressive, but the wide-spread acceptance of what might be called "latent variable thinking": The employment of these models goes hand-in-hand with talk of *unobservability*, *causality*, *latent domains*, and *measurement error*, and this has given these models a mystique not possessed by other statistical models.

Despite the fact that their origin, and chief range of application, lies in the social and behavioural sciences, it has become fashionable to claim that latent variable models have now been successfully integrated into mainstream statistical theory (see, e.g., Bartholomew and Knott, 1999). Certainly, understanding of the mathematical and statistical properties of latent variable models has reached an impressive level of sophistication. Yet, while the statistician

may rightly assert that "In a formal sense...there is nothing special about a latent variable model..." (Bartholomew and Knott, 1999, p.1), and note the similarities that exist between latent variable, and other statistical, models, the extent of the integration has been overstated. For latent variable models *are* unusual statistical models, and the mere cataloguing of their statistical characteristics fails miserably to explain their place in scientific inquiry. On the one hand, because a latent variable model involves a statement regarding the regression of a set of variates (the manifest variates) on a second set (the latent variates), it may, indeed, be seen as founded on concepts drawn from general nonlinear multivariate regression (McDonald, 1983). On the other hand, in marked contrast to standard regression models, in a latent variable analysis, observations on the variates that play the role of predictors (the latent variates) do not constitute part of the data to be analyzed. These variates are, it is said, latent, and, hence, unobservable, and, hence, unmeasurable.

On the one hand, one can observe that latent variable models are members, along with, e.g., the component models, of the class of models that are employed in the analysis of the association structures of sets of variates. Each of the models within this class are founded on a definition of the concept of *dimensionality* of a set of variates, and, in various senses, are tools of data reduction. In test theory, for example, concepts of unidimensionality, as defined by latent variable models, are often taken as virtual synonyms for "the items measure in common but one thing" (McDonald, 1981). On the other hand, despite this undeniable similarity of uses, component variates are linear combinations of the manifest variates, while latent variates, which occupy an analogous position in latent variable models, are not. It may well be the case that one and all are comfortable with the concept *latent variate* ("I have never found the idea of a latent variable difficult: it seems such a natural generalization from simple ideas of reliability, true score and measurement error" (Aitkin, 1985, p.127); "My comments reflect the opinion of someone who has had no difficulty in accepting the traditional approach and in regarding latent variables as helpful constructs" (Browne, 1985, p.132)), but whether this ease signals the existence of a transparently useful concept, or a community of scholars in desperate need of rousing from dogmatic slumbers, is a question open to debate.

The controversial nature of, or, perhaps, equivocation over, the concept *latent variate* has caused some discomfort within the psychometrics community, and has led some to suggest that latent variable models could just as well be treated as nothing more than structural models for association (and other) parameters, the concept *latent variate* disposed of outright. While this may be *technically* correct, the practice of latent variable modeling, at least as it is currently understood, depends for its rationale and comprehensibility on far more than that found within the pages of, say, Feller. This is made quite clear when one begins to consider the multitude of remarkable claims made by, and beliefs held by, those who employ and develop latent variable models. The concept *latent variate* has been taken, within particular fields of application, as synonymous with *general intelligence*, *underlying functional unity*, ability terms of various sorts (e.g., Thurstone, Lawley), trait terms of all kinds (e.g., Lord and Novick), *abstractive property*, and *construct*, to name but a few. Regardless of the label chosen to dress up the concept, conceptualization of latent variable models and modeling has always rested upon the themes of latency, unobservability, causality, and measurement error. These are elements in a complex array of interrelated theses which are taken as "explaining" the concept *latent variate* and the role of the latent variable model in science. In the current treatment, this array of theses is called the Central Account (*CA*).

The *CA* makes semantical claims regarding the concept of latent variate, ontological claims regarding its supposed referents, and epistemological claims regarding latent variable models as tools of scientific inquiry. The following are some of its core theses:

i. The latent variable model is a detector of properties/attributes or causal sources of the phenomena represented by the manifest variates.

ii. When a set of manifest variates $\mathbf{X}_j$, j=1..p, (stored in vector $\underline{\mathbf{X}}$) is described, within a population *P* under study, by a given latent variable model, this constitutes evidence that a property/attribute (causal source) of the phenomena represented by the $\mathbf{X}_j$ has been detected. The concept *latent variate to* $\underline{\boldsymbol{X}}$ denotes this detected property/attribute (causal source) and the distribution of the random variate $\boldsymbol{\theta}$ contained in the equations of the latent variable model is comprised of measurements of the objects contained in *P*, with respect this property/attribute (causal source).

Whether that which has been detected is a property/attribute or a causal source is an issue that has organized thinking on latent variable models since they were invented, and preferences for one over the other explains the tastes and practices of both particular epochs of latent variable modeling practice, and particular individuals. The property/attribute characterization is part of what is called, herein, the "Measurement Picture", and the causal source characterication, the "Causality Picture".[1]

Causality Picture

When a set of manifest variates $\mathbf{X}_j$, j=1..p, symbolized as $\underline{\mathbf{X}}$, is described, within a population *P* under study, by a given latent variable model, a cause of the phenomena represented by the $\mathbf{X}_j$ has been detected, the concept *latent variate to* $\underline{\boldsymbol{X}}$ denotes this detected cause, and the distribution of the random variate $\boldsymbol{\theta}$ contained in the equations of the latent variable model is comprised of measurements of the objects contained in *P*, with respect this cause. Early in the history of latent variable modeling, the causal sources believed detected in the use of linear factor analysis were viewed as having biological or genetic ties. Charles Spearman, for example, speculated that *g*, the name he gave to the common factor of a set of intellectual measures, was really "mental energy", while Godfrey Thomson believed that the common factors of intellectual functioning might be "neural bonds".

Measurement Picture

When a set of manifest variates $\mathbf{X}_j$, j=1..p, symbolized as $\underline{\mathbf{X}}$, is described, within a population *P* under study, by a given latent variable model, a property/attribute of the phenomena represented by the $\mathbf{X}_j$ has been detected, the concept *latent variate to* $\underline{\boldsymbol{X}}$ denotes this detected property/attribute, and the distribution of the random variate $\boldsymbol{\theta}$ contained in the equations of the

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1 As is well known, conformity of the distribution of a set of variates $\underline{\mathbf{X}}$ to a latent variable model means only that $\underline{\mathbf{X}}$ is merely "in keeping" with the measurement or causality pictures. That is, on the Central Account, such conformity constitutes *evidence* that either an attribute or cause has been detected. What is of interest in the current work, however, is the logical standing of these interpretations themselves. For compactness, such careful disclaimers, while always accepted as proper, are omitted from discussion.

latent variable model is comprised of measurements of the objects contained in *P*, with respect this property/attribute. There have arisen in the literature on latent variable modeling a number of versions of the measurement picture, including: a) The manifest variates are fallible measures of the latent variate and the latent variate is a "trait", "ability", or "disposition"; b) The latent variate is a signal and the manifest variates are noise corrupted "receivers" of this signal; c) The latent variate is "truth" and the manifest variates, "truth" plus "error"; d) The latent variate is a "fundamental/true/principal variate, or dimension" which "underlies" the empirical domain of interest; e) The latent variate is an "abstractive property", the thing measured in common by an infinite sized set of manifest variates.

iii. When a set of manifest variates, **X**, are described by a given latent variable model, the detected property/attribute (causal source) signified by the concept *latent variate to* ***X*** is unobservable.

The characterization of the (alleged) referent(s) of *latent variate to* ***X*** as unobservable is supported by a dense terminology, herein called "unobservability talk", which includes terms such as *unmeasurable*, *underlying*, and *hypothetical*.

iv. Latent variable models are testable, but not merely in the ordinary sense of statistical testability (i.e., not only in the sense that to test conformity of a set of manifest variates to a given latent variable model is to test a claim about a subset of the parameters of the joint distribution of the manifest variates). To test the conformity of a set of manifest variates to a latent variable model is to test an hypothesis of existence of an unobservable property/attribute (causal source) of the phenomena represented by the manifest variates **X**. Generally speaking, latent variable models are the framework within which the researcher may detect, identify, and study the unobservable properties/attributes (causal sources) that are hypothesized to underlie the phenomena represented by the manifest variates.

v. Because that which is signified by the concept *latent variate to* ***X*** is unobservable, its existence, identity, and empirical properties cannot be "known", but only inferred.

vi. Latent variable models are, on epistemological grounds, special, when compared with other similar statistical models. This follows from the fact that they are detectors of unobservable properties/attributes (causal sources) of the phenomena under study. In contrast to, for example, component models, latent variable models *go beyond* the information contained in the manifest variates. Latent variable models are scientific tools of a qualitatively different sort than other models of similar design.

It is not, in this book, disputed that psychometricians have made impressive advances with respect the understanding of the mathematical and statistical characteristics of latent variable models. Mathematical results do not, however, apply themselves, and it is in the border area of the application of latent variable models to substantive problems that the Central Account rules unchallenged. The Central Account is the life-blood of latent variable modeling. It explains to the latent variable modeller and his readership what his latent variable analyses are *about*, and provides him with a vocabulary in terms of which to describe the findings he believes to have made in his employment of latent variable models. As will be seen, the CA has had a

powerful influence on the development of much extant psychometric methodology, notably the indigenous measurement theory of the social sciences. It is, moreover, solely responsible for the existence of certain practices, for example, the practice of "factor/latent variate interpretation."

It will be argued in this book that the Central Account is a mythology. The CA is not *factually* incorrect, nor is it merely a poor theory, for much of it represents neither empirical, nor theoretical, assertion, but, rather, metaphysical doctrine. The theses of the CA range from blatant mischaracterization to outright nonsense. If this judgment is correct, the existence of the CA is damaging for a number of reasons: i) It has engendered in the social and behavioural scientist profound misunderstandings in regard what he can expect to gain from the employment of latent variable models, and, notably, in regard the epistemological yield of latent variable analyses. If the latent variable model is to be an effectively employed tool of social and behavioural research, the contact it makes with empirical problems must be accurately described. Dressing up mathematical and statistical innovation in mythological robes is not the road to progress; ii) It has provided fertile soil for the growth, within the social and behavioural sciences, of a wide array of misguided, and sometimes incoherent, questions and solutions to problems. An example is the badly misguided attempts of psychometrics to solve the "measurement problem" within psychology; iii) Its existence has fostered the illusion that that certain key issues in the social and behavioural sciences have already been satisfactorily addressed, and, hence, has badly retarded progress in the quest for legitimate solutions; iv) Its existence has helped to engender a twisted view of the nature of scientific investigation and scientific progress. An example is the portrayal by the Central Account of the scientist as involved in a search for *latent* causes, an occupation that, as will be seen, is tantamount to setting off on a quest to find the land of Narnia.

The case that will be set forth in this book is as follows:

i. Latent variable models are not detectors of properties/attributes, nor causal sources, unobservable or otherwise. The theoretician who desires a quantitative tool that can be used, e.g., to detect causal sources or to investigate measurement claims, requires a different type of tool than the latent variable model.

ii. Latent variable and component models are accurately characterized as *replacement variate generators*. Replacement variate generators are sets of quantitative requirements that, if satisfied by the distribution of $\underline{\mathbf{X}}$, provide a blue-print for the construction of random variates which replace (or stand in place of) in a particular, optimal sense, the variates contained in $\underline{\mathbf{X}}$. Hence, when a particular $\underline{\mathbf{X}}$ is described by a particular latent variable model, the concept *latent variate to* $\underline{\boldsymbol{X}}$ does not signify a property/attribute or causal source, unobservable or otherwise. Rather it signifies one or more random variates constructed so as to satisfy certain conditions of replaceability.

iii. Because the referents of the concept *latent variate to* $\underline{\boldsymbol{X}}$ are constructed random variates, the scores that comprise their distributions are not, then, measurements taken with respect to a property/attribute (causal source) of the phenomena represented by the manifest variates.

iv. As with component variates, a random variate that is a latent variate to $\underline{\mathbf{X}}$ is properly characterized in terms of the construction rule by which it is produced, the optimality criteria that it is designed to fulfill, and its statistical properties (univariate and joint moments).

v. The basis for distinguishing between what have traditionally been called *manifest* and *latent* variates is non-trivial, but has nothing to do with unobservability or hypotheticality. The distinction turns on the issue of conceptual signification. The scores that comprise the distribution of a manifest variate are produced by following a rule that can be stated in advance of the latent variable analysis for which the variate is input. In contrast, prior to analysis, no such rule can be provided for the production of scores that comprise the distribution of the random variate $\boldsymbol{\theta}$ to $\underline{\mathbf{X}}$. If $\underline{\mathbf{X}}$ turns out to be describable by a particular replacement variate generator, then, *following analysis*, such a rule, a construction formula, can be provided. However, the scores thus generated are scores on a constructed random variate, and, hence, are certainly not signified by an ordinary language concept. That is, they are not measurements taken with respect a particular property, and lack, as it were, the special sense of meaning that measurements possess.

vi. When some particular $\underline{\mathbf{X}}$ is described by a particular replacement variate generator, the cardinality of the set of replacement variates to $\underline{\mathbf{X}}$ is a function of both properties characteristic of the generator under which the replacement is made and the distribution of $\underline{\mathbf{X}}$.

The fact that, when certain replacement variate generators (notoriously, the linear factor generator) describe a particular $\underline{\mathbf{X}}$, the set of replacement variates has cardinality greater than unity (a property that was the topic of the long-running "indeterminacy debate"):

via. Is uncontroversial and a consequence of the very conditions that $\underline{\mathbf{X}}$ must satisfy in order to be replaceable;

vib. Represents a trade-off between the senses of optimality insisted upon by the generator in question, and other incompatible senses;

vic. Was, for the case of the original latent variate generator, the linear factor generator, an accident in the formulation of the model: Spearman incorrectly believed the factors implied by his model to be "uniquely defined."

vii. The unobservability talk that is a hallmark of the CA, and reflects its strongly platonic metaphysics, is not properly applied in conjunction with the concept *latent variate to* $\underline{\mathbf{X}}$ (a concept which denotes constructed random variates). This talk is simply a powerful reinforcer of illusion. Its propogation has largely rested on an illegitimate identification of a metaphysical (platonic) unobservability and ordinary, perceptual unobservability.

viii. When a researcher tests the conformity of a set of variates to the requirements specified by a particular generator he is not testing an hypothesis about the existence of unobservable entities, but rather an hypothesis that the variates are "replaceable" in the sense of replaceability specified by the generator. Hence, latent variate generators are testable in precisely the sense that are component generators.

ix. Latent variable "models" are neither representers of what is known about the relations between the phenomena represented by the manifest variates and a property/attribute they jointly

measure, nor the phenomena and their cause. Such models are not detectors of any such properties/attributes (causes), let alone *models* in this classical representational sense. They *are* models in a narrow, technical, statistical sense, in that they are restrictions on the distribution of the manifest variates. Such restrictions are sufficient conditions for the replacement of the set of input manifest variates by constructed replacement variates.

x. Latent variable generators are not epistemologically privileged, but instead are on par with component models.

xi. The practice of "interpreting the factor (the latent variate)" rests on the core CA notion that one must make an inference about the identity of an ordinary language concept that is taken as signifying a detected unobservable entity. But this practice is, in fact, nonsensical, because when a generator describes an **X**, nothing has been detected, let alone an unobservable entity. The concept *latent variate to* ***X*** signifies constructed random variates, and constructed random variates are not signified by ordinary language concepts. Moreover, as will be later discussed, the practice of latent variate interpretation presupposes a range of profound misunderstandings about conceptual signification and measurement.

In arguing this case, a number of topics will require consideration. The book is organized into three parts. Part one is an introduction to latent variable models and the Central Account. In particular, Chapter II provides a survey of some of the important ideas inherent to latent variable modeling, a review of the mathematical structure of latent variable models, and a brief discussion of a number of the more commonly encountered latent variable models. Here also is described the standard employment of the latent variable model in scientific work, and the key concept *latent variate to* ***X*** introduced. Chapter III is devoted to a detailed description of the Central Account, and the demonstration that it is foundational to the work of experts in latent variable modeling, and of applied researchers, alike. Because it must be acknowledged that the success of the arguments provided in the book presupposes a successful demonstration of the dependence of psychometricians and researchers on the CA , this is a key chapter. Chapter IV reviews the mathematics of the indeterminacy property of the linear factor model. This property seems to contradict the Central Account, and, since it was first noted by Wilson in 1928, has been the source of consternation within the discipline of psychometrics. Many experts in latent variable modeling have attempted to "eliminate" the problem. These various attempts, which, in their own right, constitute a fascinating case study in the history of psychometrics, are reviewed in Chapter V. It will be argued that, whereas the indeterminacy debate has been portrayed as a debate over whether the non-uniqueness of factor scores constitutes a fatal flaw in the model, what, in fact, has been at issue is the survival of the Central Account. This is clear from the arguments offered by those who have stepped forth to quell concern over what the indeterminacy property seems to imply.

Part two of the book is devoted to arguing that the Central Account is a mythology, a mixture of mischaracterization and pure nonsense. In the course of sustaining this verdict, it will become clear that the CA has flourished in part because of the confusions endemic to the social and behavioural sciences in regard the relationship between conceptual and empirical questions, conceptual signification, and measurement. Chapter VII is an attack on the key CA tenet that latent variable models are tools of detection. Chapter VIII deals with the unobservability property of the Central Account, Chapter IX, the practice of latent variate interpretation, and

Chapter X, the misportrayal of latent variable models as classical representational models. Chapter XII traces the roots of the Central Account to fundamental confusions over the components of science, and, most significantly, confusions over the relation between conceptual and empirical issues. Finally, Chapter XIII features three case studies whose purpose is to illustrate the principles argued (largely in the abstract) throughout Part II within contexts of application different from that of the usual analysis of item sets.

Part three of the book offers an alternative conceptualization of latent variable models and modeling, that latent variable models are replacement variate generators, quantitative recipes for the construction of random variates that optimally replace or stand for a set of input variates. This conceptualization is free of the metaphysics of the Central Account, and, at last, properly reconciles component and latent variable models. Its roots are in the thinking of psychometricians Louis Guttman, Peter Schönemann, and James Steiger. Chapter XV sketches the logic inherent to the replacement variate portrayal. Chapter XVI provides a brief survey of common component and latent variate generators for the purpose of illustrating the logic described in Chapter XV.

The reader who goes in search of an account of the mathematical and statistical properties of latent variable modeling would face no shortage of choices, and yet, if he were to search for a codification of the CA he would be destined to fail. No such codification exists. Nor do the theses of the CA represent the culmination of careful analysis. There exist very few published analyses supporting the claims that they make. Yet, researchers within the social and behavioural sciences seem to be fully at ease with the ideas of which the CA is comprised, e.g., that latent variable models have something to do with unobservability. Variations on the theme that "latent variates arise 'naturally' within the context of statistical modeling" (see, e.g., DeLeeuw, 1996) are often offered up in place of scholarly work on the difficult semantical and ontological issues whose resolution is necessary for a proper understanding of the functioning of latent variable models. And, of course, there is plenty of use within psychometrics of that insipid crutch by which the tacit ontological and epistemological claims of the CA are mislabeled as "assumptions", or "convenient fictions", this manoeuver, once again, taken as somehow removing all concern regarding the status of these claims. The unanalyzed quality of the claims that comprise the Central Account is, however, not the least bit surprising, for the CA is a proto-picture or ürbild.

An ürbild is a world view, or set of suppositions. Through intensive repetition, and, hence, increasing familiarity, the theses that comprise an ürbild, some of which may be heavily figurative, inherently ambiguous, or even incoherent, come to be taken as established fact. At this point, the ürbild is no longer seen as a picture, but, rather, as the truth about that which it describes. This, as will be seen, describes the status of the Central Account within latent variable modeling, and is why the CA is dangerous. For while its theses have come to be seen as self-evident truths about latent variable models and modeling, many are, in fact, nonsense. The influence of the CA on the practice of latent variable modeling is insidious. Many have taken time to disclaim elements of the CA, only to manifest their commitment to it in other ways. This is because the CA is presupposed in the very language with which work in latent variable modeling is discussed. On the other hand, the claim that the CA is just a "convenient fiction" is false, as is evident from the blinders it places on the experts when it comes time to discuss logical issues that arise in the use of latent variable models, and, notably, when the CA itself is challenged.

It should be noted that the discipline of psychometrics has had many opportunities to rethink its characterization of latent variable modeling. Following Spearman's popularization of his factor analytic technique in his *The Abilities of Man*, the mathematician E.B. Wilson, in a series of reviews, expressed his puzzlement over elements of the CA present in the early factor theories. In his 1928 review of *The Abilities*, Wilson likened key elements of Spearman's discussion of factor theory to allegory, and, in his review of Truman Kelley's *Crossroads in the Mind of Man: A Study of Differentiable Mental Abilities*, suggested that Kelley had conflated the technical sense of the concept *factor* as employed in factor analysis, with other ordinary language senses of the term. He also questioned Spearman's and Kelley's belief that the common factor model was a sound mathematical instantiation of their theories of intellectual functioning. Wilson appears to have been both intrigued by these theories of intellectual functioning and uncertain as to what their factor analytic expressions could possibly mean. Whatever were its motives, the discipline of psychometrics showed little interest in engaging in an honest consideration of Wilson's objections.

In his review of *The Abilities*, Wilson showed that when the linear factor model describes a set of variates, an infinity of different sets of factor scores can be constructed, each of which satisfies all of the requirements of the model. This property is called *factor indeterminacy*. In pointing out the indeterminacy inherent to the linear factor model, Wilson provided psychometrics with the only hint it should have needed to enact an early divorce from the CA. For the indeterminacy property suggests that the referent of the concept *latent variate to* $\underline{\boldsymbol{X}}$ is, as with the component variate, a constructed variate, and not an element of a mysterious latent domain. However, in all of the years since Wilson sounded the alarm, only a few, notably Guttman, Camp, Schonemann, and Steiger, have truly been interested in considering this possibility. Rather than serious scholarship, what ensued following Wilson was a seventy year long series of published exchanges that came to be known as "the indeterminacy debate". A poorer name could not, however, have been chosen, for many of the entries of which it is comprised give the impression that debate was less interesting an option to the psychometrics establishment than the systematic suppression, spin-doctoring, and misrepresentation of the facts and implications of the indeterminacy property.

It has often been said that the indeterminacy debate has been about whether the "non-uniqueness" of common factors does or does not reduce the usefulness of the linear factor model. However, a careful reading of the literature quickly debunks this portrayal. The indeterminacy debate has been about nothing less than what is called, in the present work, the Central Account. The work of Wilson, Camp, Guttman, Schonemann, and Steiger represents a threat to the CA because it, among other things, portrays factors as constructions, challenges the legitimacy of the practice of "factor interpretation", and questions the logical status of factor score estimation. In other words, the views of these authors on the topic of factor indeterminacy implicitly undermines much of the CA. For, if the referent of *latent variate to* $\underline{\boldsymbol{X}}$ is a constructed random variate, then it is not a detected causal source, nor a property/attribute, of the phenomena under study. And, if latent variable models are frameworks for the construction of random variates possessing certain optimal properties, then they are not *detectors* of causal sources, nor of properties/attributes. They are, rather, on par with component models. Not surprisingly, then, many theorists, journal editors among them, have stepped forward to face down the threat.

While the work of Wilson, Guttman, Schonemann, and Steiger represents an implied threat to the CA, this work neither identified the CA as the unifying organization prop of latent variable modeling, nor revealed its incoherence. Thus, no direct attack on the CA was

forthcoming. This is the task of the current work. The CA is a mythology. It systematically misrepresents latent variable models and modeling. Its core theses are largely nonsensical, and gain a superficial coherence chiefly from a range of linguistic slights of hand, including the false identification of distinct concepts. At root, however, the CA has flourished for the same reason that so many other ürbilds flourish: It is an enticing picture. As will be seen, even those psychometricians who have reservations about the commitments inherent to the CA have found it relatively easy to run afoul of it.

The writing of this book was, in large part, motivated by the author's puzzlement over the handling of the indeterminacy property by experts in the field of latent variable modeling. The reactions of certain of these experts often seemed to be illogical. They had about them the tone of defensiveness, and yet the something that was the object of the defense never seemed to be acknowledged. Behind all of the debate over often trivial issues lay this something, and it is a something that latent variable modellers are committed to with an almost religious devotion. The emotionality of the arguments put forth far exceeded that which attended the discussion of other statistical issues. Out of the cloud of the often acrimonious exchanges of the indeterminacy debate, and the astonishing language employed to describe the business of latent variable modeling, one can discern a set of beliefs about latent variable models and modeling. These beliefs are rarely brought forth for justification, and this is very often a characteristic mark of an ürbild. I came to call this ürbild the Central Account.

If, in the end, the CA is seen to have been vanquished, it might still be asked what sort of victory has been won. The answer, of course, depends upon the purposes to which a latent variable model are put. There is no question, however, that the glow which attends the use of a latent variable model largely stems from commitment to the Central Account. If, indeed, the CA is shown to be mere mythology, then, at the least, the latent variable modeller's *claims* will require significant tempering. To get an idea as to what will have to be forfeited, one should try to conceptualize latent variable modeling *without* the Central Account: Without reference to *unobservability*; without the portrayal of latent variable models as detectors of unobservable properties/attributes (causes); without attempts to attach ordinary language concept labels to latent variates. Part 3 of the book provides a vision as to what this would look like. There is a very definite "have one's cake and eat it too" character to thinking within the practice of latent variable modeling. Big claims (paired with soft justification) are made that, when challenged, lead to rapid back-pedalling. It is inevitable, then, that some will argue, while admitting that there do exist signs of the CA in the literature, that experts do not take the CA *too* seriously. They will claim that "the CA is a relatively harmless manner of speaking, really just an organziational tool", or, alternatively, a "suggestive model-generating linguistic prop." And, in any case, "ultimately the long term application of latent variable models to data will settle the matter as to what these models are capable of discovering." But such views are badly mistaken, because as long as the Central Account reigns supreme there will never be the opportunity to "see things as they really are." Researchers will continue only to see the mythological forms projected by the Central Account.