

# Human Intelligence

Perspectives on Its Theory and Measurement

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## Detterman's Laws of Individual Differences Research

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A system of laws is presented which is intended as a guide for individual differences research in human intelligence. Formulation of these laws was based on previous research efforts in the area. Perhaps most important of these laws is Law IV—it can't be done. These laws were suggested as a starting point for the unification of the two disciplines of scientific psychology.

The preceding papers have addressed the question of what methodology should be used to study individual differences in human intelligence. The authors of these papers have been so thorough that no criticism or preference has been left unexpressed or at least none has been left unimplied. What can a discussant do when everything has already been discussed? Admit that everything worth saying has been said? Never! After considerable thought and consultation, it finally dawned on me that a discussant with nothing to discuss must systematize.

To the casual observer, systemization might seem an impossible task since none of the authors agreed on anything. Nor did they agree with previous writers on the topic, who, it should be pointed out, did not agree with each other. (The one exception might be Carroll's statement that little progress has been made thus far in understanding mental abilities in terms of processes. There seems to be some agreement on this point. However, even here there is substantial disagreement concerning optimism about the future.) General disagreement should not be taken as a serious obstacle to deriving general principles, though. As every good scientist realizes, everything is complicated until it is understood at which time it seems very simple indeed. All that needs to be done is to specify the principles underlying the disagreement and it will be clear that all of those who have addressed methodological issues in individual differences research are actually in substantial agreement.

What I propose to do is to develop a set of laws which will guide those wishing to participate in individual differences research. I am immodestly forced to call these *Detterman's Laws of Individual Differences Research* in

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order to avoid the expense of extended litigation that I have been advised would result if I assigned the names of others more deserving to these laws. Please be assured that I have every confidence of victory in a court test of accuracy of assignment but it is simply another case of unaffordable justice.

Once Deeterman's Laws have been accepted by the community of researchers, they will greatly simplify communication. For instance, a paper concerning methodology might be condensed to a few lines: Law XIV; Law III, Corollary 1; Law XV. Published research papers could be reduced to absurdity in a single line: Jones (1984), Law IV. Manuscripts submitted for publication could be easily dispatched in the same way by any reviewer familiar with the system. In fact, I am optimistic enough to see the day when actual laboratory research becomes unnecessary. Instruction in individual differences research will consist of a seminar in which brash, first-year graduate students attempt to propose research projects to be carried out. Most of these proposals will die a speedy death from the citation of one or the other of Deeterman's Laws. But a few of the proposals will breed real interest among the eager students. These proposals will generate a wave of contagious enthusiasm, sweeping up the students until they are brought crashing back to reality by the gray-haired professor seated at the head of the table. In an impatient, tired voice he says, "Law IV! Law IV! When will you students ever learn to use Law IV?" This is an image that sends chills down my spine. Individual differences research methodology will have ripened to its fullest potential.

Although the laws I am about to set forth form an integrated system, I will present them in three sections. The first deals entirely with statistical methodology, the second with research strategies, and the third with the interpretation of empirical results. For the most part, the laws will be presented without supporting evidence. In most cases, the proof will be immediately evident to the clever student. Other students might wish to substantiate the reasoning for each law to sharpen their methodological sophistication.

#### DEETERMAN'S LAWS OF STATISTICAL INERTIA

There are four basic laws that form the foundation of this portion of the system. From these basic laws, numerous more specific principles are derived. These laws have such an important place in the system that it would probably be wise to commit them to memory (particularly Law IV).

*Law I. Individual differences exist.* This is perhaps the weakest part of the entire system. Some may wish to regard this as an hypothesis, rather than a law, pending definitive evidence.

*Law II. Anything which exists can be measured incorrectly.* If error were eliminated from measurement there would be no uncertainty. If there were no uncertainty, Truth would be obvious, and science as a systematic way of discovering Truth, would be unnecessary. Error, therefore, is the heart of science, the very reason for its existence. Further, those branches of science having the most error require the best science.

*Law III. Incorrect measurements require intelligent application of appropriate statistics to be interpretable.*

*Law IV. It can't be done.* The proof for Law IV may not be obvious to even the best students of individual differences research methodology. That is because several corollaries to Law III have been omitted. You may wish to attempt to discover them for yourself before reading further.

*Law III, Corollary 1. All statistics are the same except for minor differences in form and assumptions.* It can easily be shown that every statistic is related to every other. For example,  $F$ -statistics can be related to  $t$ , the curvilinear correlation coefficient, which can be related to the Pearson product-moment correlation coefficient which can be related to chi-square which can be related to  $F$ . Selection of a statistic to be used is a somewhat arbitrary matter depending on the form of the data and the assumptions the data meet. Selection of the appropriate statistic to satisfy the form of the data is a simple matter and almost always correct. The one exception is the case in which the data meet all of the assumptions of the statistic selected, in which case the form of the data will be inappropriate and another statistic should have been selected. This simplifies matters greatly since the only concern a researcher must have is that his data meet all of the assumptions of the particular statistic selected.

*Law III, Corollary 2. Application of statistics to psychological data requires that some assumptions be ignored, some violated, and still others ravaged completely.* This corollary is supported by a hundred years of research.

*Law III, Corollary 3. There will always be someone to point out Law III, Corollary 2.* The guiding dictum of individual differences methodologists is the New Testament injunction, "Let he who casts the first stone be without sin." Despite other beliefs, methodologists express true ecumenism in the whole-hearted adoption of this principle.

*Law III, Corollary 4. NORTON1952, BOX1953.* The NORTON1952, BOX1953 corollary is an important one because it makes research not concerned with individual differences easy to do. The studies referred to in this law show that the assumptions of analysis of variance are resistant to violation. This law is sometimes known as the "it doesn't matter" law.

Nomothetic researchers ALWAYS use analysis of variance designs. Whenever Law III, Corollary 3 is operative, they simply cite Law III, Corollary 4. Many methodologists regard this law much as the John Birch Society regards the Miranda Decision, as a license for mayhem. In protest, they have refused to practice on the nomothetic side of the street, instead devoting their full attention to individual differences research. *Note:* This law does not apply to individual differences research because it is superseded by later laws.

The four corollaries of Law III should make the validity of Law IV evident. They show that it is quite impossible to perform any statistical test without violating its assumptions. In case it has not been made clear, there are a number of more specific laws derivable from the first three which make Law IV incontestable.

*Law V. Correlations are always wrong.* A euphemistic way of expressing this law is that the computed value of the sample correlation coefficient will always be within  $\pm 2$  of the population parameter.

However the law is stated, its meaning is clear. Whenever a correlation is computed, one of the following conditions will obtain to make it uninterpretable: non-normality, heteroscedasticity, curtailed range, or extreme outliers. If one of these conditions is not present in the data, then some other debilitating condition will be.

There is an occasional brave soul who will claim to have computed a correct correlation coefficient. Laws VI and VII cover this situation. Either may be used or, for full effect, use both.

*Law VI (Special Form). Correlation does not imply causation.* This law will be cited in a condescending tone of voice in such a way as to give the impression that the speaker really doesn't believe the correlation is correct but even if it were it is trivial if it does not imply causation. This law is never stated in its more general form.

*Law VI (General Form). No statistic implies causation.* Implication of causation is a logical process and has nothing at all to do with the statistic employed. I have always wanted to meet the clever nomothetic researcher who developed the Special Form of Law VI. Not only did it place the burden of guilt on individual differences researchers but also diverted attention from other statistical methods by suggesting that all statistics except correlation do imply causation.

*Law VII. Everything is correlated with everything else.* As for Law VI, when the violated assumption of an alleged correct correlation is not immediately obvious, Law VII may be invoked. This law will reduce any correlation (as well as the correlator) to insignificance. A startled expression suggesting that only a ninny would expect to find other than significant correlations is often employed when invoking this law. More complex forms

of this law are frequently used in debates concerning the advantages of orthogonal as compared to obtuse factor rotation.

Although a number of other laws could be stated concerning correlation, Laws V-VII cover every possible situation. Additional laws would be superfluous.

*Law VIII. Never factor analyze anything.* This law can be derived from Law V. Since all correlations are wrong, no factor analysis can be worth doing. However, there are a number of other pieces of evidence which support this law. First, it is impossible to conduct a factor analysis correctly on data which are completely suitable. The reason for this is that there are no data or methods which are completely correct or suitable. Common infractions include too few subjects, inappropriate methods of factor extraction, and inappropriate criteria for factor termination to mention just a few. Second, even if it were possible to extract factors correctly, determining an acceptable rotation has never been accomplished by anyone in the history of Western civilization. Third, it is impossible to name factors and still have friends. Any attempt at naming factors produces instant hostility. I once witnessed an altercation between co-investigators over which factor should be called "Factor I" and which should be called "Factor II." I cannot tell you how the argument ended because I have not yet seen the research in print. I assume they are still arguing. After all, they extracted eight factors, giving them 8! possible namings to discuss.

*Law VIII, Corollary I. No two reviewers will ever agree on the correctness of a factor analysis.* This corollary follows naturally from Law VIII. If you ever have data which have been tainted by the application of factor analysis and wish to publish them as cathartic therapy, there are only two possibilities. You may take your chances and submit to a journal using only single reviewers or you can include all possible reviewers as co-authors.

*Law IX. Analysis of variance is unacceptable.* The underlying reason for this law is that analysis of variance has become identified as the major technique of nomothetic researchers. Some individual differences researchers feel that anyone using this method should be forced to wear a scarlet "A." This seems rather extreme to me, though, since I cannot see how this would contribute to the person's rehabilitation. I think it would be far more constructive to require the hand calculation of several large correlation matrices and hand factor analysis and rotation for particularly hard cases.

There are several more specific reasons for this law. Most of these have been developed to close loopholes enterprising scofflaws have found in the original formulation. One clever technique involves dividing groups on the basis of ability and entering ability as a factor in the analysis of variance design. This approach is sometimes known as the aptitude-treatment interaction approach. It is also employed to discover differences between

normal and mentally retarded subjects. An obvious problem is that the midrange of ability is often omitted and the results are, therefore, not representative of the entire population. Another problem is that task difficulty will vary over ability groups. In the extreme case, floor or ceiling effects result. But even without these extreme effects, artifactual interactions may result simply from differences in task reliability in the ability groups.

Another technique used to attempt to circumvent this law is the use of change scores. There is probably nothing more entertaining in psychological research than to watch a novice attempt to use change scores from a pre- and post-test design to analyze individual differences. I am convulsed by laughter every time I see the expression that results when, after months of studying journal articles and methodological discussions, they realize that Law IV applies. It is particularly good fun when the novice is someone doing a thesis or dissertation. At this point in the development of the system, clever students often suggest the possibility of analysis of covariance. The best way to handle this situation is to have them do a blackboard demonstration of a test of homogeneity of covariance. Do this late in the semester, though, as it may take several months for them to realize that Law IV applies.

*Law X. The less frequently used multivariate techniques (e.g., multivariate analysis of variance or covariance, canonical correlation, discriminant analysis, pattern analysis) must be left to the expert.* These techniques are so filled with potential pitfalls that they should only be attempted by an expert.

*Law X. Corollary 1. There are no experts in the less frequently used multivariate techniques.* And if there are, they wouldn't admit it.

*Law XI. Multiple regression is unnecessary.* It has recently been shown that the application of multiple regression to correlation matrices in which all variables are moderately correlated (as they always are in individual differences research—see Law VIII) is about as good as adding the predictors together and correlating the total with the criterion. In this case, Law V (correlations are always wrong) applies.

In other cases, beta weights will be uninterpretable, cross-validation will be impossible because of small sample size, the matrix will be singular, or the solution will be entirely determined by error variance. I have a personal fondness for multiple correlation because I like the authoritative look of the capital "R" and so it was with a sense of great personal sacrifice for the sake of science that I included this particular law in my system.

*Law XII.* Law XI concludes the present development of Determan's Laws of Statistical Inertia. However, I have reserved Law XII for any statistics invented at some future time. Given the perverse ingenuity of the statistical mind, I probably should make allowance for many more than one future law. Perhaps the numbers over one thousand should be reserved for this purpose.

There is no question that these laws require some practice in application. The experienced researcher should have little difficulty but someone new at

the game may, on rare occasions, be tempted to bring data and statistics into proximity. I have therefore condensed the laws of this section into one law to serve as a general guide for the neophyte.

*Law XIII. The potential usefulness of any statistical technique is directly proportional to the impossibility of its correct application.*

### DETERMAN'S LAWS OF RESEARCH STRATEGY

This set of laws is concerned with the etiquette and procedures for carrying out proper individual differences research. This was, without question, the most difficult set of principles to discover. I liken my efforts to Amy Vanderbilt attempting to discover the protocol governing a fraternity stag film.

*Law XIV. There are no individual differences researchers.* This law is counter-intuitive but true none-the-less. You will not find a single person claiming to be a scientist in the area of individual differences in human intelligence. There are cognitive psychologists interested in individual differences. There are developmental psychologists interested in individual differences. And there are information processing and mental retardation psychologists interested in individual differences. There are not even any graduate programs training students to be researchers in individual differences.

The apparent exceptions to this rule are psychometricians. They unabashedly claim that they are individual differences scientists. The error in this reasoning is readily apparent. They are not scientists at all. They demonstrate a perverse fixation on the elimination of error. By Law II, error is the heart of science. Psychometricians are therefore antiscientific. This is a fundamental point which must be kept in mind at all times.

*Law XV. My area is best.* Always maintain your allegiance to the area in which you were trained. After all, that's where your friends are and that is where the reviewers of your manuscripts are. In the researcher's utopia, friends and reviewers are one and the same. Remember also that you must only use research methodologies native to your basic area of interest. To do otherwise would be an expression of contempt to those to whom you owe your loyalty.

*Law XVI. Always remember that you are bringing religion to the heathen.* Friends will regard your interest in individual differences as peculiar. By maintaining the attitude that you are going to take the superior methods developed in your basic area of interest and solve, at last and once and for all, the problems of individual differences research, you will garner real sympathy for your eccentricities. Many will regard you as casting pearls before swine, but they will respect you for trying to convert the heathen.

*Law XVI, Corollary 1. Never cite other areas.* Citation of other areas will be taken as a sign of approval of that area. Never approve of other areas. Strict adherence to this law will greatly reduce the amount of reading to be done. On rare occasions, a pesky reviewer or editor will require a citation from another area. In these cases, the 97-2-1 rule is considered synonymous with this corollary. The following list must be used in conjunction with this rule:

Psychophysics  
Information Processing  
Cognitive Psychology  
Educational Psychology  
Developmental Psychology  
Mental Retardation  
Psychometrics

The 97-2-1 rule is employed by finding your basic area on the list above. Ninety-seven percent of the citations in any publication should come from this area. Two percent of the citations should come from the area immediately above yours on the list. Citations from areas more than one above you on the list will smack of arrogance. These citations should be accompanied by phrases such as "the very excellent work of" or "the classic study by." The final part of the rule specifies that one percent of the citations in a published paper should come from areas no more than one position below your basic area on the list. These citations should be qualified by phrases such as "the promising work of" or "a line of research with easily correctable deficiencies by." If citations come from areas more than one below you on the list, you will be accused of giving credence to utter nonsense.

The one exception to this rule is the area of psychometrics. Researchers in the area of psychometrics are free to cite, praise, or criticize individual differences research from any area they wish. But since they are antiscientific, all other areas have agreed to ignore them.

The ordering of the above list is completely rational. Psychometricians are antiscientific so they must be placed at the bottom of the list. Mental retardation researchers attempt to bring scientific methods to bear on an antiscientific, psychometric classification system. They are an equal blend of science and antiscience and, therefore, represent the absolute zero point of the scale. Developmental psychologists have a keen desire to do something practical and aspire to be educational psychologists. Educational psychologists have given up the hope of ever doing anything practical and would be content with an abstract understanding of the rules of the mind. They are latent cognitive psychologists. Cognitive psychologists are attracted by the precision of information-processing models, but they don't know enough math to practice in this area. Those in information processing would really like to be psychophysicists but all they know is math.

*Law XVII. Explain psychometric traits in terms of basic processes.* This law describes how religion should be brought to the heathen. What could be more noble than to explain away scientifically an antiscientific classification scheme?

*Law XVIII. Basic processes are processes basic to your area.* For example, if you are in mental retardation, explain psychometric traits in terms of rehearsal, rehearsal strategies, or meta-something. If in information processing, any parameter of the Atkinson and Shiffrin model is a good bet.

*Law XVIII, Corollary 1. Use models at least ten years old.* By adhering to this law, you may be certain that the model used will have wide acceptance in your area of research.

*Law XVIII, Corollary 2. Never blame the model.* If, by some quirk of fate, parameters of the model employed do not account for the psychometric trait in question, never blame the model for this. It would be viewed as ingratitude. Always blame the intractability of psychometric traits. After all the model was developed by nomothetic researchers and they regard individual differences as error. They are therefore more scientific since they have more error to work with than individual differences researchers (see Law II). The fact that no consideration was given to individual differences in developing the model means nothing.

*Law XIX. Never integrate areas.* Attempts to integrate areas are regarded as grave social blunders. For example, it would be inappropriate to attempt a developmental study of the relationship between information processing parameters and psychometric traits.

*Law XX. Collect as few data as possible.* After all, data limit interpretation.

*Law XX, Corollary 1. Those data which afford maximum freedom in interpretation are best.* This should be the ultimate guiding principle in the planning of all individual differences research.

This concludes the portion of the system dealing with research strategy. Strict adherence to these laws will catapult you to instant fame as an individual differences researcher. Attempts to violate them might lead to infamy, though I can't be sure of that since I know of no one who has tried.

#### DETERMAN'S LAWS OF CREATIVE RESEARCH INTERPRETATION

The problem with doing research is that you always have to interpret it. Some scientists believe that it is simply enough to say that X is a function of Y and leave it at that. However, none of these scientists is an individual differences researcher. The trouble is that in individual differences research,

X is so seldom a function of Y or anything else included in the experiment that creative interpretation is essential.

*Law XXI. Lacking reliability and/or validity, theorize.* A good example of the application of this law occurs in the area of infant intelligence. Since none of the extant infant intelligence is either reliable or valid, numerous theories explain why this should be so. Quite frankly, this law is not mine. It was discovered by the originators of personality tests who have since built an entire discipline on it.

*Law XXII. Having obtained reliability and/or validity, theorize elaborately.* Some people are surprised to find that reliable and valid experimental findings require more elaborate theories than those lacking these "virtues." The reason for this is simple. The imposition of reliability and validity creates restrictions on the data. These restrictions require more elaborate theorizing. There are two corollaries which guide the construction of elaborate theories.

*Law XXII, Corollary 1. When changes in experimental conditions produce no changes in performance, refer to the underlying psychological process as a structure or capacity.*

*Law XXII, Corollary 2. When changes in behavior occur without changes in experimental conditions or contrary to predictions, refer to the causative psychological process as a strategy, plan, or metaprocess.* These two corollaries are sufficient to cover the outcome of nearly all of the individual differences research that I know about. They are elegant in their simplicity and universal in scope. There is only one additional law in this portion of the system that needs to be considered.

*Law XXIII. Never define anything more precisely than absolutely necessary.* Sometimes known as the law of minimum definition. The reason for this law is that precise definition limits explanatory power. Where would we be if there were exact definitions of terms like structure, capacity, strategy, trait, process, or cognition? I prefer to contemplate a regression to Watsonian behaviorism than the possibility of exact definition.

It should be pointed out that the invention of new terms is applauded under the authority of Law XXII. When new terms are invented, however, the restriction of Law XXIII should be kept firmly in mind.

These, then, are the 23 laws which constitute *Determan's Laws of Individual Differences Research*. They are sufficient to guide even the most inexperienced researcher on his initial foray into individual differences research. I owe an enormous debt of gratitude to the unrecognized many who have made the formulation of this set of principles possible. They have inspired me by their example and, by their encouragement, have spurred me to codify a system that I hope will stand as testimony to their wisdom. It might even provide the basis for unification of the two disciplines of scientific psychology. But then again, it might not.

After discovery of these principles I found, with some consternation, that there was a slight flaw in the system. Although this flaw probably has little effect on the integrity and cohesiveness of the system. I would be less than honest if I did not mention it. I refer to this flaw as *Determan's Paradox*. Everyone I have shown these laws agrees that they apply to everyone but him. Therefore, by consensus, the laws apply to N-1 individual differences researchers. On the other hand, a tally of those who thought the laws applied to themselves would indicate that they apply to no one. It would appear that the laws simultaneously apply to almost everyone and no one! This paradox is most unsettling. I have every faith that it is an artifact representing a minor oversight that will be easily resolved with some additional work.

## EPILOGUE

If the truth were known, there is only one "law" that I would advocate—Control your conditions and you will see order—but Pavlov said that some time ago. I do not think that there are any magic "laws" which will lead to an explanation of individual differences in human intelligence. In fact, such laws might be counterproductive.

The major strength of research in individual differences is the multiplicity of approaches to the problem. Each approach has the potential of making a unique contribution. And each approach has its unique limitations. Perhaps from the results of these different methodologies, a coherent picture of human intelligence can be pieced together.

It has always seemed to me that the unity in approach demonstrated by nomothetic researchers has been a detriment rather than a strength. Although in many ways it makes life much simpler to have a consensus even when that consensus is incorrect, it can lead ultimately to stagnation.

Perhaps if we learned to tolerate cultural diversity, the research methodologies employed to investigate individual differences in human intelligence would come to be the predominant approaches, or at least the most productive.

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