

MY CHI-SQUARE IS SIGNIFICANT. IS THAT ANALYSIS OR INTERPRETATION

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Dear Reader,

The tedious part of your work has been completed. You reviewed the literature, talked with experts in the field and have identified your problem.

Then you wrote the objectives of the research, the questions to be asked, and/or hypothesis to be tested. Your methodology section followed—research design, sample, setting, data collection instruments, pilot study and research study details, including a timetable for data collection.

You pre-tested your instruments, trained your data collectors, and collected your data. Finally you organized the data laid it out and spent time mulling over the data, looking for pattern, and trends. Now you will analyze your data to see what your descriptive data and for statistical tests have to tell you. However, analysis alone is not enough; you must explain and find meaning in the data—this involves interpretation. In this letter, analysis and interpretation will be our areas for discussion.

"The word analysis means the categorizing, ordering, manipulating and summarizing of data to obtain answers to research question. The purpose of analysis is to reduce data to intelligible and interpretable form so that relations of research problems can be studied and tested."¹

Before we begin to explore these topics, we need to discuss the help that the statistician can give at this point in the process. Early on, in designing the research problem, the statistician plays a very important role. He helps in an almost preventive way, making sure there will be sufficient numbers in each category for investigation so that valid conclusions can be drawn.² He helps earlier in advising on the survey design, the sample design and the analysis of data;

he also advises on how to set up the tabulations.³

"What does the statistician expect of the researcher?"

The researcher should assume the basic responsibility for the preparation of the tables and should understand the data collected. Paul Hendrick, WHO Statistician, New Delhi, believes that the researcher should know the basic measures, such as the mean and standard deviations of the variables, and the use of percentage distributions.⁴ If possible, he notes, the researcher can undertake some basic analyses such as assessing the significance of the difference between means, the difference between proportions, Chi-Square tests, and even the degree of correlation between items.⁵

The statistician will help you by checking your calculations, assist you in analyzing your results, including analysis of variance and co-variance, so that the most can be gained from the results. He/she will be responsible for the accuracy of all statistical calculations and the validity of the statistical conclusions drawn from the data supplied by the research worker. You, as the researcher, must understand fully the meaning of the various analyses undertaken by the statistician. If you do not use the statistician from the beginning, you may find yourself with a research study which cannot be completed. Let us illustrate this point with an example.

One colleague of one of the authors was conducting a research study in psychology. He had completed all steps through the data collection phase of the study. He had studied perceptions toward mental illness of a particular sample of psychiatric nurses who were no longer at the university where he conducted the study. He approached the statistician expecting the expert's

help to complete the statistical analysis. Only then did he learn that he did not have a large enough sample size to compute the appropriate statistical calculations. The psychiatric nurses who participated in the study were no longer available for interview and naturally, no other group could be used. An entire study became a fruitless effort because of the researcher's failure to use the help readily available early on in the planning. When you analyze your data, you take the information and put it into a form so that the research problems asked (or hypotheses to be tested) can be studied.

In one study we conducted, we wanted to know whether or not a course given to nurses on research methods would significantly alter their attitudes toward research. So we hypothesized that by receiving this educational experience, group attitudes would be changed. We planned the study, set up a control group, and tested both the experimental and control groups, before and after the course. (The control group was experiencing another course of the same time duration but on another topic).

Now to analyze this data, we had to order it, break it down and manipulate it so we could test the hypotheses. Two of these were:

"Nurses who have participated in a two week formalized workshop in nursing research will score significantly higher on a measure of knowledge than nurses who have not been exposed to such a course."⁶

Also hypothesized was:

"Nurses who have participated in a two week formalized workshop in nursing research will score significantly higher as a measure of research-mindedness than nurses who have not been through such a course."

Please note that we had a general plan for analysis already written in our research proposal. Our task was to carry out those plans with the actual data available to us. We take the hypotheses, tested them with the appropriate statistical tests, and analyzed the results in light of the theory we proposed.

Interpretation means that you study the results

of your analysis, make inferences about the relations and draw conclusions about these relations.

"How do you make these inferences. What specifically do you do?"

As you are computing your correlation or "t" you infer and extract the meaning of the calculations. Also, as you work, you begin to compare what you found to what others found. You compare what you found with what you hypothesized. Remember from where you resigned your hypotheses or, wrote your research questions? How did they come about?

"From a review of the literature. By looking at what the theory said."

That's right. You are looking to see how well your hunches compare with the theory. In our research attitude example, we did a review of literature. We learned from experts in the field that spending a concentrated amount of time in a subject area was basic to learning; further, a course designed to include active participants of the learners was essential for learning to occur.

Then we designed the course with those principles in mind and identified and/or created instruments designed to measure changes in knowledge and attitude toward research.

We analyzed the data using t-tests for the significance of the difference between the means and found significance for knowledge, but not for research-mindedness. This is the analysis.

"Now we have to ask, what does this mean?"

That is correct. We judged on the knowledge of hypothesis, but were wrong on the hypothesis related to research-mindedness.

Our data supported the theoretical literature which addressed the role of active participation in learning, which was the teaching method used in the workshop. So our findings were consistent with other research on learning. The study lent support to those who believe that learning research methods during a concentrated period or time can be effective.

"What do you do about the hypothesis that was not supported by the research?"

Negative findings are much more difficult to analyze than positive results. Positive results support our supposedly logical ideas and thinking, and we believe that our careful observations of phenomenon have led us to test our ideas through research. However, we can never be really sure, for sometimes we get the expected results, but for the wrong reason. For example, suppose we took a sample of deprived, malnourished children and brought them to a lavish, beautiful center with excellent facilities. And at this center they were clothed, nourished properly, and kept clean. And let us suppose we wanted to see whether or not introducing them to selected educational materials would change their level of learning. So we pretest the children's level of knowledge. We have them live in the center one month and then we post-test them for changes in level of learning. We find substantial change, that is, we find that the differences between pre and post-test measures are significant. But is the difference due to the educational materials? The change may be due to their change in level of health and/or their bodily responses to better food and clean government. This "halo" effect must be considered when you analyze your results.

"It's something like getting a false negative on a laboratory test."

Something like that. Now with negative results, we must look back on the whole series of thinking—from our formulation of the theory, our deductions from that theory, the research design, methodology and measurement and analysis. A negative outcome can mean an error at any point or many points along the way. Usually, the more experience we have in a field, and the more we are familiar with a body of knowledge, the better are our predictions.

"That may be why some authorities say that experts in the field should suggest topics students should undertake for their research."

We know that is often said. The other argument is often suggested as well. Some feel that every student should have the opportunity of

selecting his/her own topic for research and see for his/herself what the outcome may be. But back to the issue. If, indeed, your methods, design and analysis are correct, and your instruments have been determined to be valid and reliable, then negative findings, also, lend to the greater body of research.

Incidental Findings

Many unforeseen events occur during the study, particularly during data collection, which may be as important as your findings of hypotheses tested. A discussion of these incidental findings are usually very helpful to a researcher who wishes to explore a similar area and who wishes to use a similar population. For example, one of the authors conducted a study at a large, urban university where she selected a random sample of professors to study effective college teaching. She found that out of 250 professors contacted, only 30 would agree to have their classes videotaped. This was certainly an unusual number of refusals and required some notation and explanation. She found that at the time of the study, the university was in an economic retrenchment period, and numbers of faculty members were being reduced. Many faculties were mistrustful and avoided any form of observation and evaluation. The relationship between the academic atmosphere and the research results required further exploration. Perhaps different results may have been obtained if the study had been conducted at a time of full employment. This result may be fortuitous or spurious.

"How are these incidental findings reported? They are not answering one of the research questions or testing a state hypothesis?"

No, that is true. But, you may want to consider presenting a separate sections entitled "Incidental Findings." Here you would describe the observations as they occurred, or as they appeared in the data. You would then discuss the implications, as best as you could, in the light of your experience and intelligence of the area under study. Or, you may believe that these findings had some bearing on the acceptance or rejection of your hypotheses. Then these observations would be incorporated into your analysis section.

The success of your analysis and interpretation is best predicted by the factors described by C.E.R. Burroughs.⁸ He notes, that one's success depends on:

- (1) The intelligence and diversity of thought one can bring to bear and has brought to bear on the whole process;
- (2) The clarity with which one's hypotheses have been specified and one's techniques of testing them have been carried out;
- (3) The breadth of one's understanding of the whole field of which one's own study;
- (4) The extent to which one's mind is generally well-stocked;
- (5) Serendipity;* and
- (6) Luck.

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*An accidental, but happy discovery.

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