# INCORRECT INFERENCES COMMONLY DRAWN FROM TRADITIONALLY DESIGNED SURVEYS

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## Introduction

Those of us sitting in on the sessions sponsored by the Social Statistics Section for the past three days have heard many excellent suggestions regarding sampling schemes, cost reduction methods, analytic techniques, measurement problems in panel operations, and some able presentations contributing to our better understanding of certain current social problems. Through all of this, we - or at least I - did not hear specific reference to the problems which serve as content for this paper. Perhaps such omission is justified in meetings such as these because those in attendance at such gatherings are far too sophisticated to commit such errors in their own work. Or perhaps our recent concerns with the more technical aspects of design, collection, and analysis have overshadowed certain of the basics in survey research which we learned so long ago in our apprenticeship training. Whatever the reason for omission of these points in prior discussions, it is the intent of this paper to belabor the obvious in the hope that the future will find no evidence in the survey research literature that such practices exist.

## The Nature of the Critique

It seems indicated at the outset to set the stage for the development of this critique by clarifying some terms used in the title of this paper. For instance, the title refers to "traditionally designed surveys" and the intent here is to include all types of data gathering procedures which seek information from people - no matter how sophisticated the techniques used to gather this information - after those people have been exposed to some related decision making experience. Examples of interest in my work would be surveys conducted to gather information from people who have and have not performed some health related piece of behavior like the taking of a preventive medication, or surveys conducted to gather information about patients suffering from a specific type of disease such as coronary heart disease. In both of these examples, traditionally designed refers to the fact that the behavioral act or the disease state existed in fact before the survey probe was made.

"Incorrect inferences commonly drawn," refers to the tendency of authors of reports based on these types of surveys to infer a causal relationship between two or more of the variables included in their studies. In the latter example just cited - surveys of characteristics of patients with coronary heart disease - several authors have noted the existence of very high levels of anxiety, repressed hostility and other personality dimensions. They then infer that these traits are causally associated with this disease state and fail to point out that it is equally possible for these traits to be the result of the disease. For an excellent review of this type of literature and a cleverly designed study to untangle the time dimension between these variables one is referred to Dr. Michel Ibrahim's (1) "The Role of Certain Psychological Factors in Coronary Disease, Blood Pressure, and Serum Cholesterol" in which he casts considerable doubt on the hypothesis that these personality traits preceed - therefore could be causally associated with - this state of ill health.

The former example cited - surveys conducted after people have been exposed to an experience requiring them to act with regard to a preventive medication - will be used to supply the data upon which this paper is founded. While these two examples seem rather different in terms of problem formulation, research design, data gathering, and analytic techniques, they were chosen to illustrate the generic aspects of the critique being developed in this paper. A great many other examples could be cited from marketing research, opinion polls, etcetera but to cite these would only detract from the main point of interest which is to substantiate the critique that has been made.

## The Data

In 1960, Dade County, Florida (Miami) was selected as the site for the first large-scale field test of a new polio vaccine in the United States, and we were given the opportunity to study the public's reaction to this new preventive measure. The sponsors of that program, however, did not provide this opportunity until two weeks before the public distribution of the vaccine was to begin. This obviously precluded any before-study of the target population and all we could hope to achieve was a chronology of events leading up to the decision to carry out the program in this county of 1,000,000 persons, and the efforts made to secure approval and support of all the official and non-official agencies and organizations necessary to reach nearly 500,000 persons with the vaccine in a period of about twelve weeks. That aspect of our research endeavor was referred to as the community organization phase and contains some extremely interesting data in its own right, but is not particularly germane to the topic under discussion today. While the community organization phase of the research endeavor was being conducted, attention was focused on design of an instrument to gather data regarding the characteristics of the target population, recruiting and training of field staff and all those other details that go into a large-scale survey. We were ready at the end of the vaccine program to initiate our house-by-house interview procedures as soon as the vaccine program was ended. In drafting our questionnaire for use in the field we drew very heavily upon the prior work done with regard to the

introduction of Salk vaccine into this country about 1954 and the rash of studies conducted in relation thereto. This earlier work suggested, among other things, that people's social status as well as their perceptions of risk to and severity of poliomyelitis were major determinants of their acceptance or rejection of such medical innovations. Consequently we built in measuring devices to tap these dimensions and were able to support the association between social status level and likelihood that the vaccine was taken, but unable to find evidence supporting the perceived risk-severity hypothesis. The data from that study have been widely circulated (2) therefore, will not be reintroduced here.

In 1962 a similar program was initiated in another county in Florida (Hillsborough-Tampa) and we were again invited to study the populace's participation patterns (3). This time, however, the request, was received sufficiently in advance of the initiation of the vaccine program as to permit a before-after design which would permit ascertainment of selected characteristics of a sample of the target population both before they were informed that they were going to be asked to take a new vaccine and after they had acted by either taking or not taking one or both doses offered them. In the 1960 study we were not certain whether the inability to obtain a significant association between respondents' perceptions of risk and severity regarding poliomyelitis and behavior with regard to taking or not taking the vaccine resulted from an inadequate tap of these perceptions or the fact that they were being measured after the act had been committed. In the 1962 study, clarification of this point was possible by improving the measuring instrument and by obtaining readings both before and after the behavioral act of taking or not taking the vaccine. These data are used to support the critique conveyed in this paper.

In the Hillsborough study measurements of perceived susceptibility to poliomyelitis and perceived severity of the disease if contracted were made on a modified semantic differential scale developed by Jenkins (4) as part of a larger piece of research he was then developing. With regard to perceived susceptibility the respondent was asked to mark a point on a forty-one point scale anchored at one end with: "The chance you have of getting it (poliomyelitis) is": "Big Chance." and at the other end with "No Chance." There were no intervening labels on this scale but it was marked at quarter inch intervals to guide the respondents' estimate of relative distance between the two extremes. This same type of scale was used in both the before-program and after-program interviews. Table 1 shows the responses obtained in the pre-program interview according to the respondent's then current status relative to having or not having previously taken any Salk Vaccine injections against this disease. Table 2 shows the responses obtained from all respondents at two different points in time. These and subsequent tables are taken from an earlier publication (5).

The data in Table 1 reveal a significant difference in level of perceived susceptibility to poliomyelitis, at the .05 level, whether tested by the non parametric Komozorov test or the traditional parametric two sample t-test. This difference was encouraging in the sense that this scale had not previously been validated, and there was a priori reason to believe that those who had taken the injected polio vaccine should feel somewhat less at risk to this disease. Along the same line of reasoning, the data in Table 2 were reassuring in that a significant decrease in susceptibility following the oral vaccine program was detected. On the basis of these data, plus the fact that respondents' scores on this scale with respect to other diseases properly arrayed these diseases in terms of current incidence rates among young adult populations, it is believed that the scale was adequately measuring perceptions of susceptibility to the disease of interest.

With this assurance that the scale seemed to be measuring levels of perceived susceptibility to poliomyelitis we can look at the data obtained both before and after the vaccine program for groups of respondents who had acted in various ways during the interval. Those data are given in Table 3. If only the after-data, as reflected in the column headed "as of May" in Table 3, were available the situation would be like that pre-

Table 1. Cumulative Percentage Distributions of Level of Perceived Susceptibility to Poliomyelitis in January by Respondents' Previous Vaccine Experience.

| Injected Vaccine Status | Total Persons | Your Chance of Getting Polio | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No Chance | | | | | | | | | Big Chance |
| Non-Takers | 175 | 3 | 3 | 3 | 11 | 15 | 27 | 77 | 82 | 85 | 100 |
| Takers | 198 | 3 | 5 | 7 | 25 | 29 | 38 | 80 | 85 | 91 | 100 |
| Total | 373[a] | 3 | 4 | 5 | 19 | 23 | 33 | 79 | 84 | 88 | 100 |

[a] 7 Respondents refused to answer this question.

Table 2. Cumulative Percentage Distributions of Level of Perceived Susceptibility to Poliomyelitis for All Respondents in January and in May.

| Time Period | Total Persons | Your Chance of Getting Polio | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No Chance | | | | | | | | | Big Chance |
| Prior to Oral Program | 373[a] | 3 | 4 | 5 | 19 | 23 | 33 | 79 | 84 | 88 | 100 |
| After Oral Program | 373[a] | 8 | 14 | 21 | 26 | 49 | 73 | 79 | 84 | 90 | 100 |

[a] 7 Respondents refused to answer this question.

Table 3. Mean Levels of Perceived Susceptibility to Poliomyelitis in January and May By Respondent's Vaccine Acceptance Category.

(The lower the score the greater the perceived risk)

| Vaccine Acceptance Pattern | Total Persons | Mean Levels of Perceived Susceptibility | | |
|---|---|---|---|---|
| | | As of January | As of May | Amount of Change |
| Non-Takers, Any Vaccine | 57 | 15.26 | 16.32 | 1.06 |
| Oral Vaccine Only | 118 | 13.13 | 18.21 | 5.08 |
| Injected Vaccine Only | 41 | 15.70 | 18.44 | 2.74 |
| Both Types of Vaccine | 157 | 16.13 | 21.64 | 5.51 |
| All Oral Vaccine Takers | | | | |
| February Only Dose | 33 | 14.39 | 16.23 | 1.84 |
| April Only Dose | 35 | 14.45 | 21.52 | 7.07 |
| Both Doses | 207 | 14.93 | 20.56 | 5.58 |

vailing in the traditionally designed survey which permits the type of inference being criticized in this paper. Such an inference might state that there is an inverse relationship between level of perceived susceptibility and likelihood of taking preventive action since the data reveal that the behavioral group perceiving themselves as most susceptible to this disease had taken neither the earlier injected vaccine or the new oral vaccine in the recent program, whereas those who had taken both types of vaccine had the lowest level of perceived susceptibility. These differences are statistically significant when tested at the .05 level by means of the two-sample t-test. All too often this is the type of data which is available and the type of inference which is drawn.

If we shift our focus, however, to the data obtained from these same people as of January, before they were aware that a new vaccine was to be offered them, we find that mean levels of perceived susceptibility do not vary significantly, at the .05 level. These data suggest that prior levels of perceived susceptibility were not very useful predictors of the type of vaccine behavior that was to follow. On this basis we would infer that earlier writers were probably in error in emphasizing perceived susceptibility as a major determinant of this type or preventive health behavior.

The bottom half of Table 3 adds some insight into the dynamics underlying people's perceptions and relevant behavioral acts. Notice, for instance, that the mean scores for the three types of behaviors relevant to the taking of the oral vaccine were essentially the same before the program. But notice the difference in shifts in these perceptions dependent upon the type of behavior which had been emitted as indicated by the data in the column headed "Amount of Change." Those who took the first of the two doses offered showed only a slight and not statistically significant decrease in their level of perceived susceptibility to poliomyelitis following that

Table 4. Mean Levels of Perceived Severity of Poliomyelitis in January and May by Respondent's Vaccine Acceptance Category.

(The higher the score the greater the perceived severity)

| Vaccine Acceptance Pattern | Total Persons | Mean Levels of Perceived Severity | | |
|---|---|---|---|---|
| | | As of January | As of May | Amount of Change |
| Non-Takers Any Vaccine | 58 | 25.05 | 19.35 | 5.70 |
| Oral Vaccine Only | 117 | 21.43 | 20.09 | 1.34 |
| Injected Vaccine Only | 39 | 23.58 | 15.79 | 7.79 |
| Both Types of Vaccine | 151 | 22.84 | 18.01 | 4.83 |
| All Oral Vaccine Takers | | | | |
| February Only Dose | 32 | 22.09 | 18.95 | 3.14 |
| April Only Dose | 34 | 24.26 | 19.35 | 4.91 |
| Both Doses | 202 | 21.91 | 19.84 | 3.06 |

act. Compare this change with that observed among people who refused the first dose but took the second dose when offered. That group gives evidence of a significant decrease in their level of perceived susceptibility even though in fact they were no better protected against the disease than those who had taken only the first dose in February. We submit that this type or perceptual shift following a behavioral commitment is best interpreted by dissonance theory as developed by Brehm and Cohen (6, p. 96) when they describe the tendency toward overvaluation of a chosen alternative when the alternatives are of approximate attractiveness in the initial decision making process. From the data in the bottom half of Table 3 it would seem that the group of people who had deterred taking the first dose of the vaccine in February but switched their decision and took the April dose give evidence of this overvaluation of the efficacy of the vaccine. Notice that as a group they expressed feelings of less risk to poliomyelitis following their one dose of the vaccine than did those who had apparently not gone through this conflict in decision and took both the first and second dose.

Neither time nor usefulness to the discussion today permits development of essentially the same points when the focus is shifted to levels of perceived severity of poliomyelitis should it be contracted, but the data are given in Table 4 for completeness of presentation as we turn to the second type of fallacious inference drawn from survey data. It will be recalled that it was stated earlier that one of the types of incorrect inferences resulted from failures to recognize the time dimension underlying the variable chosen for study and the resultant confusion regarding cause and effect relationships. The second deficiency results from failures to recognize interaction effects between and among variables selected for study through the survey process.

We saw in Table 3 that prior levels of perceived susceptibility were not particularly good predictors of the behavior being studied and the same comment holds for the data in Table 4 where levels of perceived severity of the disease are used as a predictive variable. Table 5 presents data regarding the effects of various levels of perceived susceptibility and severity before the vaccine programs on acceptance rates of the oral vaccine when controls are maintained for prior behaviors with regard to another vaccine for the same disease. Using a Chi-square test on the data it is found that these prior perceptions were not significantly, at the .05 level, associated with subsequent vaccine behavior among those who had already taken one type of vaccine against this disease, but were significant, beyond the .05 level, among those who had no prior experience with polio vaccine. The data further suggest that the relationship between levels of perceived susceptibility-severity and subsequent behavior is not linear as suggested by previous writers on the subject. Notice, for instance, that the highest levels of vaccine acceptance do not occur when both perceived susceptibility to the disease and severity of the disease if contracted are high, and this is true regardless of prior experience with a preventive measure for the same disease.

Table 5. Oral Vaccine Acceptance Rates At Various Levels of Perceived Susceptibility-Severity as of January by Previous Vaccine Status.

(Numbers in parentheses indicate the denominator on which the rate is based)

| Injected Vaccine Status | Total | | January Perceptions | | | |
|---|---|---|---|---|---|---|
| | Persons | Oral Rate | Low Susceptibility and | | High Susceptibility | |
| | | | Low Severity | High Severity | Low Severity | High Severity |
| Takers of Injections | 188 | .79 | (30) .77 | (38) .84 | (53) .85 | (67) .73 |
| Non-Takers of Injections | 173 | .67 | (22) .50 | (26) .56 | (56) .86 | (69) .61 |
| | 361 | .73 | .65 | .73 | .85 | .67 |

## Discussion

These data, while restricted to a specific behavioral act primarily of interest to those doing health related research, are illustrative of more general problems commonly trapping survey researchers. The danger of confusing cause and effect through failure to consider the time relationship between variables chosen for study was illustrated by use of data which showed that the so-called dependent variable (the behavioral act) was influencing the so-called independent variable (the perceptual set). Further demonstrated was the fact that the nature of this reversal would not have been apparent without before and after data. Such data not only permit appropriate tests of the predictive power of variables but also inferences about underlying dynamic processes which may prove to be at least as useful in furthering our understanding of human behavior as are predictive variables which cannot be understood or interpreted.

The data also provide evidence supporting the contention that interaction effects between and among the several variables selected for study should be considered. Far too often the author leaves the reader with nothing more than a series of p-values, all "highly significant," and no clues as to what happens when two or more of these are pitted against each other to see how they jointly influence the dependent variable.

While these data do not speak directly to this point, all of the background work which led up to these two surveys and much that has happened since suggests a need for curtailment of the prevailing "coveat emptor" philosophy with regard to social-behavioral science literature in particular and survey research literature in general. Long over due are some self imposed disciplinary standards based on an awareness that poor theory begets weak or inappropriate variables built into survey designs, and these in turn when improperly designed and analyzed complement and speed up the cycle by begetting still more tidbits of inadequate theories of behavior which become grist for still more surveys.

## References


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