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Statistical Consulting in a University: Dealing With People and Other Challenges

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Statistical consulting is examined in terms of the stages of the first consultation, roles that a consultant can assume, and challenges associated with statistical consulting in a university. Some of the challenges that are discussed are (a) dealing with the human side of consulting, (b) consulting on an extremely wide range of research problems, (c) coping with clients having diverse statistical backgrounds, (d) dispelling inappropriate expectations about what statisticians can and cannot do, and (e) contending with a university reward system that penalizes those who engage in statistical consulting as opposed to those who pursue their own research.

KEY WORDS: Consulting roles; Human side of consulting; Interpersonal skills; Stages of the consulting process.

1. INTRODUCTION

Statistical consulting is defined as the collaboration of a statistician with another professional for the purpose of devising solutions to research problems. Statistical consultants practice their craft in a variety of settings, such as government, industry, medical centers, and universities. Although the settings differ, they are similar in terms of the stages of the first statistical consultation and the roles that consultants are expected to play [see, e.g., Froberg, Holloway, and Bland (1984); Hunter (1981); Moses and Louis (1983); and Stegman (1985)]. This article reviews these similarities, discusses several important interpersonal skills, and examines some challenges that face statistical consultants in a university.

2. STAGES OF THE CONSULTING PROCESS

The first statistical consultation with a client usually has five stages: (1) establishing rapport, (2) identifying the research problem, (3) setting goals, (4) agreeing on a division of responsibility, and (5) reviewing what has occurred [for alternative descriptions, see McCulloch, Boroto, Meeter, Poland, and Zahn (1985); Platt (1982); and Zahn and Isenberg (1983)].

2.1 Establishing Rapport

The first stage of a consultation usually begins with an exchange of pleasantries and small talk. Its purpose is to establish rapport with the client. First-time clients are often apprehensive because they do not know what to expect and

may feel defensive about their statistics background. It is important to allay a client's apprehension by exhibiting an accepting, caring attitude—an attitude that encourages the open exchange of information. The first stage of a consultation ends when the consultant says, "Well tell me about your project" or the client says, "The reason I'm here is. . . ."

2.2 Identifying the Research Problem

The second stage of a consultation is concerned with identifying the research problem. During the early part of this stage, the client does most of the talking. The consultant asks questions when necessary to clarify points. The following information needs to be communicated. What questions does the client want to answer, why are these questions important, and what has the client accomplished thus far?

Early in the second stage it is important to determine if the person to whom the consultant is talking is the real client and if others are involved in the research. There is a small group of researchers who, because they are busy or intimidated by statisticians, attempt to consult through an intermediary. Without fail, such clients receive inferior advice and waste the consultant's time. The consultant should insist on seeing the real client or clients.

It is also important to understand the significance of the client's research. How does it fit into the knowledge base of a discipline? Are there well-established research traditions in the discipline that should be followed? In the second stage of a consulting session the consultant should obtain an accurate and relatively complete understanding of those aspects of the research that have implications for its design and analysis. Incorrect assumptions about how data have been collected, for example, should not be allowed to vitiate the analysis and interpretation of an experiment. A consultant should follow up points with "Let's see if I've got this right" or "Are there any other things I should know about?" It is best not to trust the details to memory; take notes during the session. For complex projects, I like to send the client a written summary of my understanding of the project and the agreed-upon course of action. For less complex projects, a verbal summary may suffice. In either case, written notes are invaluable.

The second state of a consultation can be thought of as the discovery stage. In addition to learning about the research problem, the consultant also learns about the client's expectations, research environment, time and money constraints, and statistical sophistication. This information is especially useful since it will influence the kinds of recommendations that can be made in the third stage.

2.3 Setting Goals

There is usually a natural and often imperceptible transition to the third stage of the consultation. This transition

occurs when the client's conversation no longer contains relevant new information about the research project and the consultant's questions indicate a good understanding of the project. The third stage is concerned with setting goals: determining the questions that are to be answered and the actions that are to be taken. By this time the client's research problem will have been couched in terms of statistical hypotheses. If the consultant has been sufficiently articulate and the client has been sufficiently attentive, the consultant will be rewarded with words such as "Yes, that is what I want to know" and "I see, this test will tell me if the two variables are independent." If the consultant has been fortunate enough to see the client before data have been collected, this is the time to talk about sampling strategies, randomization, threats to internal and external validity, informed consent, and ethical issues, if any, posed by the research. If the data have already been collected, the consultant will want to determine the conditions under which the data were collected and whether the client controls the use of the data.

If a client's research project is complex or involves an unfamiliar area, the consultant may choose to bring this third stage to a close with a request for a few days in which to think about the project. In the case of a complex project, visiting the site where the data will be collected or seeing a dry run can be helpful. If the research involves an unfamiliar area, ask the client for reprints of related research and the names of colleagues with whom the project can be discussed. It is important to understand the client's research project and avoid giving snap answers. It is only a matter of time before clients and attorneys discover statistical malpractice. The specter of a malpractice suit should be sufficient motivation for providing the client with a written summary of an agreed-upon course of action and a request for clarification if the client's understanding is different from the consultant's.

2.4 Agreeing on a Division of Responsibility

Once agreement has been reached on the research questions to be answered and the actions to be taken, the consultant steers the session to the fourth stage. This stage is concerned with the division of responsibility between the consultant and the client. Who will do what and when? Most consulting centers have a policy statement describing their services and fee structure. The client should be given a copy of this information prior to a consultation, if possible. But policy statements usually deal only with general issues. The client and consultant need to discuss openly their expectations about what each will do, when it will be done, and how much it will cost, and, of course, reach an agreement. For example, is the consultant expected to write a preliminary draft of the results? What about joint authorship? These kinds of details need to be spelled out.

2.5 Summing-up Stage

The last stage of a consultation I call the summing-up stage. This is the time to review what has occurred. As this stage draws to a close, the consultant has one more opportunity to ask, "Is there anything else I should know about the project?"

3. CONSULTING ROLES

Clients come to a first consultation with varied expectations about what statistical consultants do. The most common roles that consultants are expected to assume are those of helper, leader, data-blesser, collaborator, and teacher. These roles and others have been described by numerous writers, including Barnett (1976), Boen and Zahn (1982), Bross (1974), Hunter (1981), Hyams (1971), Marquardt (1979), Snee (1982), and Stegman (1985). My own, perhaps idiosyncratic, assessment of these roles is as follows.

3.1 Helper Role

The helper role is characterized by a low level of personal involvement on the part of the consultant in the substantive aspects of the client's research project. In this role, the consultant acts as a technician and responds to the client's questions and directions. Typically, the client needs one or more specific items of information—would it be better to run a t test or a Mann–Whitney U test?—or the client needs to have a particular analysis performed. The consultant's job is to supply the information or run the analysis.

The helper role in which the consultant dispenses information or crunches numbers is a common and often appropriate role. Unfortunately, it is not a very satisfying role from the consultant's perspective. One reason why the role is not very satisfying is that often the consultant does not know and, worse yet, does not expect to know the outcome of the session. Did the client use the Mann–Whitney U test? What did the reviewers say about the statistical analysis? One of the rewards of consulting comes from solving a client's problem. Feedback about the outcome of a consultation is less likely to occur in a helper role than in the collaborator and teacher roles, which are described later. Another reason why consultants are not attracted to the helper role is that it can lead to bad consulting. For example, inappropriate analyses can be expected when clients ask the wrong questions or omit important details concerning the data.

3.2 Leader Role

Some clients want a statistical consultant to play a leader role—to assume responsibility for making sense out of the client's data. The leader role requires a consultant who is willing to become intellectually involved in the client's project and a client who prefers a passive role. Consultants should be wary of the leader role—there are pitfalls. The first danger signal occurs when the client has difficulty articulating his or her research questions. Such clients usually prefer to dwell on the quantity of data that has been collected. As one client put it, "With so much data, surely there must be something here." Consultants who accept the challenge of discovering what that something is all too often rediscover the truism that data that have been collected without clear questions in mind rarely answer interesting questions.

Consultants who assume the leader role may find themselves working in an area of science in which they have little or no expertise. The result is often bad science. As Hunter (1981, p. 72) observed, "Since the client will typically know much more about the data than the statistician, a better, more insightful, analysis will be possible if the client is actively involved." There are other pitfalls to the leader role. For example, one of my colleagues spent several months designing an experiment and analyzing the data for a very passive client. The design and analysis, which were quite ingenious, cast doubt on a then widely held theory. I remember my colleague's frustration when she discovered that her contribution was to be rewarded with a footnote citation instead of joint authorship. Disappointment is often one of the consequences of failing to spell out the details of a consulting relationship.

3.3 Data-Blesser Role

The role of data-blesser is one that no statistician likes, but most find impossible to avoid. A typical scenario goes something like this. The client appears at your door just before lunch with the final draft of a manuscript and asks, "Do Tables 3 and 4 look okay?" You examine the tables, make several suggestions, and then make a hasty exit for what remains of your lunch hour. A year later you receive a reprint of the research and there, to your dismay, is a footnote expressing appreciation for your contributions to the statistical analysis of the data. Your frustration grows as you read the paper and discover that the client has run 50 t tests and reported that 3 are significant at the .05 level. How can the statistician avoid this scenario? Thirty years of consulting have convinced me that, in spite of one's best efforts, a consultant will fall into this trap from time to time. A strongly worded policy statement requiring written approval of all credit lines will minimize but not eliminate this problem.

3.4 Collaborator Role

Few statistical consultants would stay in the profession if they were limited to the roles of helper, leader, and data-blesser. The role that makes the consultant's work personally satisfying is that of collaborator. In this role the client and consultant pool their talents and expertise so that the resulting research is better than that which would have occurred in the absence of the collaboration. In the ideal case the consultant is involved in the research from its inception and continues the involvement through the report-writing stage. In addition to the tangible reward of joint authorship, the consultant is rewarded with the opportunity to learn about another area of science and the satisfaction of seeing a project through to its competition.

3.5 Teaching Role

The last role that I want to mention is that of teacher. Good consulting rarely takes place in the absence of teaching—the two are inseparable. Both the consultant and the client assume the teaching role at various times during a consultation. For example, the client learns about design and statistical issues and how to approach similar problems in the future; the consultant learns about another area of science.

Teaching takes place quite naturally as the consultant and client attempt to identify, formulate, clarify, and, perhaps, reformulate the research question. As these efforts progress, the client learns about the kinds of things that consultants consider important: identification of the independent and dependent variables and possible confounding variables, random assignment, estimation of sample size and power, and so on. In the give and take of determining the questions that are to be answered and the actions that are to be taken, the client learns how subtle changes in a research design affect the kinds of conclusions that can be drawn. Such give-and-take exchanges help to dispel the notion that statistical wizardry can somehow compensate for the absence of sound logic in the design of a project. An important by-product of good consulting is a client who is better prepared to design future research projects.

4. DEALING WITH THE HUMAN SIDE OF CONSULTING AND OTHER CHALLENGES

It is generally agreed that successful consulting requires both statistical skills and interpersonal skills (Stinnett 1988). Unfortunately, most graduate programs in statistics give little attention to the latter area, the human side of consulting (Boen and Zahn 1982; Zahn and Isenberg 1983). I want to turn now to several interpersonal skills that are rarely taught in graduate programs in statistics: negotiating for a desired consulting role and guiding the course of a consultation.

4.1 Negotiating for a Desired Consulting Role

Clients enter a consulting relationship expecting consultants to play a particular role. Consultants can either accept the role that is thrust upon them or try through negotiation to obtain a different role. Negotiation is a back-and-forth kind of exchange for reaching an agreement when two parties have some interests that are shared and others that are opposed. First-time clients and even seasoned researchers are often unaware of the different roles that are possible in a consulting relationship. In such cases, a bit of education may lead immediately to a mutually beneficial role. In other cases, one or more of the negotiating principles recommended by behavioral scientists can be helpful in attaining a desired role.

The most important negotiating principle is to try to understand the underlying concerns that motivate a client's behavior and then deal with the concerns rather than the behavior. For example, a client who begins a consultation with a series of questions and is reluctant to discuss the research hypotheses may be motivated by a desire to be in control, a fear of exposing gaps in their statistical knowledge, or a desire to minimize the cost of the consultation. If the client is motivated by a desire to control, the consultant is likely to play the helper role. If, however, the client is concerned about costs, it may be possible to trade consulting time for joint authorship and become a collaborator.

Behavioral scientists have identified five other important negotiating principles.

1. A consultant should avoid attacking a client's position; instead, let the client know that his or her position is understood—understanding does not imply agreement. If a client thinks that his or her position has been understood, he or she is more likely to be receptive to the consultant's position.

2. Clients have multiple interests; develop a climate for agreement by first focusing on shared interests and then turn to interests that are opposed.

3. Clients are more likely to accept the role suggested by a consultant if it seems the right thing to do—right in terms of being fair, reasonable, or honorable.

4. Clients are more likely to accept a suggestion if there is a precedent for the suggestion. A precedent is both an objective standard and a persuasive argument. The use of a precedent conveys a desire to be fair.

5. When there is a disparity between the client and consultant in power or prestige and the difference favors the client, the consultant should try to negotiate on the basis of principle.

The last negotiating principle was used by my colleague mentioned earlier who felt that she deserved more than a footnote citation for her design and analysis. The client was a well-known psychologist, and it was important to preserve a long-standing relationship with his laboratory. My colleague negotiated on the basis of principle by citing the official position of the American Psychological Association. Principle 7f in the *Ethical Principles of Psychologists* (American Psychological Association 1990) states, "Major contributions of a professional character made by several persons to a common project are recognized by joint authorship, with the individual who made the principal contribution listed first." The *Publication Manual of the American Psychological Association* (American Psychological Association 1983, p. 20) goes on to say that "Substantial professional contributions may include formulating the problem or hypothesis, structuring the experimental design, organizing and conducting the statistical analysis, interpreting the results, or writing a major portion of the paper. Those who so contribute are listed in the by-line." When the psychologist realized that my colleague's work clearly qualified as a major contribution and that an ethical principle was involved, he graciously agreed to joint authorship.

When a client resists a role that would be mutually beneficial, most likely there is a problem in perception or communication. If perceptions are inaccurate, begin by trying to see the issues through the client's eyes. Sharing perceptions is an effective way to pinpoint the problem. If misunderstandings exist, reframe the issues to correct the misunderstanding. And consultants should recognize that clients do not have a monopoly on perception and communication problems.

4.2 Influencing the Direction of a Consultation

Over the years, behavioral scientists have learned a lot about the consulting process. They know, for example, that nonverbal cues are especially important in setting the tone of a consulting session. I am referring here to simple things such as the importance of eye contact—maintaining eye contact is usually interpreted as acceptance or approval; avoiding eye contact, as rejection. In a few hours, a consultant can learn to use a variety of simple interaction techniques for guiding the course of a consultation. These techniques, which were described 40 years ago by Robinson (1950), are concerned with the effects of a consultant's verbal and nonverbal responses on a client's subsequent responses. Robinson discovered, for example, that some responses have little effect on the client's next response or the general direction of the consultation. These responses are *silence*; *acceptance remarks* such as saying yes, uh-huh, and nodding one's head affirmatively; and *restatement*, which consists of repeating or paraphrasing what the client has just said. For example, if the client said, "We ran each subject on two consecutive days; the order of the treatment conditions was randomized," the consultant could respond, "You ran each subject on consecutive days and randomized the order of the treatment conditions." This restatement lets the client know that the consultant understands, but the response does not direct or constrain the client's subsequent responses.

If a consultant wants to direct or constrain the client's subsequent responses, *clarification, approval*, and *general leads* can be used. Consider the following two exchanges. The client begins by saying, "In the previous study, blood sugar level didn't seem to make a difference, so we didn't attempt to control it in this study." The consultant responds, "You feel that blood sugar level isn't a relevant variable." The client says, "Uh-huh, but I told Dr. Haynes that we should try to control the blood pressure of the experimental and control groups. What do you think?" The consultant responds, "That seems like a good idea. Are there any other variables that should be controlled?" In the first exchange, the consultant clarified something that the client said—that it was not necessary to control blood sugar level. Notice that no new ideas were introduced. In the second exchange illustrating, respectively, approval and a general lead, the consultant interjected his or her ideas into the consultation. The effect of approval and general leads is to reduce the client's range of potential responses. In this example, the client is further disposed to (a) control blood pressure and (b) consider the possibility of controlling other variables. General leads encourage the client to think more deeply about a topic. They are general enough, however, that they do not arouse the client's resistance.

The use of *interpretation* and *urging* directs the client's thinking along a particular line. In both cases the consultant introduces new elements into the conversation. The following interpretation remark states something that can be inferred from the client's statement and introduces a new element that the client is expected to accept. The client begins, "We had considered controlling age, but it didn't seem practical—ummm—it would have reduced our sample by a third." The consultant responds, "You think that it is important to control age, but the reduced sample size would result in an unacceptably low power." An urging remark attempts to narrow the client's range of responses even more by suggesting that a particular course of action be followed. For example, the consultant could have responded to the statement about controlling age as follows: "I think that you

should control age; let's see if we can use an analysis of covariance here."

The strongest direction in a consultation results from the use of *information gathering, rejection,* and *the introduction of new and apparently unrelated material.* The following exchange illustrates information gathering. The client asks, "If we use analysis of covariance—ummm—don't we have to assume that the within-group regression lines are linear and parallel? I'm not sure that this make sense here." The consultant responds, "Let's go over this again (*pause*) are you thinking about using age as the covariate?" Alternatively, the consultant could have responded, "You don't need to worry about that. Linearity won't be a problem (*pause*) and we can use the Johnson–Neyman procedure if the regression lines aren't parallel." This rejection remark, unlike the information gathering remarks, attempts to change the direction of the client's thinking.

The introduction of new and apparently unrelated material, like the use of rejection, has the effect of changing the direction of a client's thinking. Clients usually interpret the introduction of such new material as rejection, although this may not be what the consultant intends. For example, the consultant could have responded to the client's question about using analysis of covariance and the necessary assumptions as follows: "Didn't you say that the experimental group had 31 subjects and the control group, 35?" The client's feeling of rejection is apparent in the answer: "Well I (*pause*) I think—ummm—that we lost four subjects in the experimental group."

As these examples illustrate, a consultant has a range of responses that can be used to guide the course of a consultation. Behavioral scientists also have investigated procedures for dealing with a variety of interaction problems that occur during a consultation, such as overcoming a client's resistance to suggestions, dealing with an aggressive or abusive client, and learning how to be nonjudgmental when a client fails to meet the consultant's standards. Fortunately, these procedures can be taught to consultants; see Kirk (1982).

4.3 Consulting on a Wide Range of Research Problems

In the discussion that follows, I want to focus on some challenges that face statistical consultants in a university. What are some of these challenges? To begin with, clients in a university seek consultations on an extraordinary range of research problems. Within a two-hour period I have helped a graduate student design a questionnaire to measure religious attitudes and performed an analysis for a senior researcher to determine whether the water in 26 wells has the same chemical profile.

How can a consultant be prepared to deal with this diversity? It turns out that the picture is not quite as bleak as I have painted it. The majority of research problems can be handled using five or six basic statistical procedures. For example, Van Belle (1982) identified six topics that accounted for two-thirds of the statistical procedures mentioned by consultants and clients. His list is similar to the list of the most used procedures in industry, prepared by a committee of the American Statistical Association (1980). These reports are reassuring, particularly to the novice con-

sultant. But what about the occasional really tough problem? When I encounter such a problem, I never hesitate to tell a client that I need some time to think and that I will get back to him or her in a few days. No one expects statistical consultants to be omniscient.

Statistical consultants who have been out of graduate school for a few years face a different kind of diversity— a statistical knowledge base that is increasing exponentially. There is no easy way for consultants to stay current in the field. I have tried to conscientiously follow a reading program and participate in continuing education short courses at professional meetings. Unfortunately, pressures at work often interfere with my best intentions. Professional associations could assist us by videotaping courses and making them available for home rental.

4.4 Working With Clients Having Varied Statistical Backgrounds

Working with clients having varied statistical backgrounds presents another challenge. In this imperfect world, some clients will have minimal statistical backgrounds along with math and computer phobias. How should a consultant proceed when the most appropriate statistical analysis for a client's research project requires knowledge that the client does not possess? One response is for the consultant to perform the most appropriate analysis and expect the client to somehow obtain the background necessary to understand the analysis. This response inevitably leads to frustration for both the client and the consultant.

An alternative response is for the consultant to assume the role of collaborator and take responsibility for those aspects of the analysis that are beyond the client's capabilities. If this arrangement is acceptable to both parties, it solves the analysis dilemma. Unfortunately, such an arrangement is not always mutually acceptable, and sometimes the arrangement is inappropriate, as when the research project is a graduate student's thesis or dissertation.

What about those situations in which the client's statistical knowledge is limited and the collaborator role is unacceptable or inappropriate? In such situations I feel that the use of a statistical analysis that is congruent with the client's statistical sophistication is preferable to the use of a state-of-the-art analysis. The secret to working with a wide range of clients is to work at the client's level of expertise. A client who has had one research methods course, for example, will have trouble understanding and defending the use of analysis of covariance or cannonical correlation. The most naive client, however, can be helped to understand graphs and descriptive statistics. As a general principle, use procedures with which the client is familiar. Avoid the temptation to dazzle clients—use the simplest procedure that will answer the client's question and, preferably, one that is commonly used in the client's research area.

Having said these things, I must admit that there is merit in Stegman's (1985) position that we do not do our clients a favor by providing them with simple answers to complex questions. As Feinstein (1970) observed, clients will not develop the intellectual muscles to walk if they can avoid the necessary effort by being pushed in a statistical wheelchair. Perhaps there is an acceptable middle ground between

Stegman's and Feinstein's positions and that expressed earlier. One compromise is to selectively embrace both positions: make the client walk if the client shows a willingness to acquire more intellectual muscles, otherwise work at the client's level of expertise.

4.5 Cleaning Up the Mess

Another challenge involves the client who contacts the consultant after all of the data have been collected. The worst offenders are graduate students who have relied on the advice of their major professor. Often their data fail to address the questions of interest and may even defy an appropriate statistical analysis. And there is always that large group of fairly prolific researchers who have become comfortable with outmoded or inappropriate research strategies. Their favorite statistics book was published in 1952, and they have not opened the book in the last 10 years. Such clients challenge both the consultant's patience and teaching skills.

4.6 Surviving in Academe

Statistical consultants in a university often have a heavy consulting load and a strenuous teaching schedule. Such demands leave little time for consultants to pursue their own research programs. University administrators have traditionally rewarded research, teaching, and service, in that order. This reward system puts consultants at a disadvantage in achieving tenure and advances in rank and salary. Unfortunately, most universities do not have special criteria for evaluating faculty whose job descriptions contain a significant service component. In the universities with which I am familiar, statistical consultants are expected to publish and obtain grants at the same rate as their nonconsulting colleagues. Obviously, this is not possible, and those consultants who try to compete with their nonconsulting colleagues become candidates for early burnout.

Some statistical consultants succumb to an inflexible university reward system that places a low value on service and give up consulting. When this happens, everyone loses. The alternative is to try to change the reward system. But anyone who has fought the system knows that change does not come easily. I am convinced that statistical consultants must initiate an ongoing, educational campaign to get administrators, department chairpersons, and faculty in other departments to reassess the rewards for research and service. And statistical consultants should encourage faculty in other areas such as speech therapy, social work, and clinical psychology who also have heavy service commitments to join them in this educational effort. There is strength in numbers. For example, Faculty Senates and Promotion and Tenure Committees are more likely to study a problem and make recommendations to the administration if it can be shown that the problem affects several departments.

As part of an ongoing, educational campaign, consultants should periodically forward reports of their consulting activities to their university administration and chairperson. In these reports, it is important to emphasize the consultant's academic contribution to each project (J. R. Boen, personal communication, February 15, 1989). As Boen put it, "Let the administration know that the statistician's contribution goes beyond just cranking out numbers."

Statistical Consulting Centers can play an important role in an ongoing, educational campaign. For example, new clients can be given literature recommending changes in the university's reward system, the advantages of collaborative working relationships, and the conditions under which a consultant should be listed as a joint author or co-grantee.

Consulting statisticians have been reluctant to speak out on the issue of joint authorship. Many consultants fail to request joint authorship when it is clearly deserved. I have found the official statements of the American Psychological Association cited earlier helpful in clarifying the issue. The guidelines concerning authorship are clear; what remains is for consultants to educate their clients.

Statistical consultants who seek academic parity must be prepared to (a) mount an aggressive, ongoing, educational campaign; (b) energetically pursue collaborative relationships; and (c) be assertive with respect to joint authorship. One thing is certain—inequities in the present reward system will not disappear on their own.

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