Multiple triangulation: a methodology for nursing science

The discipline of nursing needs methodological strategies that promote the study of complex and dynamic phenomena like human health behavior. Triangulation is an approach conducive to studying such complex behavior. The purpose of this article is to discuss the four basic types of triangulation and to examine several issues and problems related to the use of a more complex form, multiple triangulation. Solutions are proposed for dealing with each of the problems involved in the research application of triangulation.

Ellen Sullivan Mitchell, CRN, MN, PhC
Doctoral Candidate
University of Washington
School of Nursing
Seattle, Washington

THE DEVELOPMENT of research methods to build a body of nursing knowledge is a challenge facing nursing today. Knowledge of processes and patterns of human health behavior and of people interacting with their physical and sociocultural environment is central to the further development of nursing. Because strategies are not readily available for the study of such complex and dynamic constructs, the scientific advancement of nursing as a discipline is impeded.

Many theoretical perspectives and methodologies derived from disciplines other than nursing such as sociology, psychology, anthropology, and physiology contribute to the theoretical foundation of nursing. However, a single perspective limits the study of many phenomena important to nurse scientists because many of the

The research for this article was supported by a National Research Service Award Nurse Fellowship (NU-05686-02) from the Division of Nursing, Public Health Service, Department of Health and Human Services.

ANS, 1986, 8(3), 18-26
© 1986 Aspen Publishers, Inc.

topics of interest cut across the traditional disciplines. The challenge today is to develop a methodology that integrates several of the existing research methods and theoretical perspectives to reflect the perspective of nursing. In other words, nursing needs to develop its own methodology to answer its own questions.

One approach to the study of complex human health phenomena is the methodology called triangulation. A triangulated study combines different theoretical perspectives, different data sources, different investigators, or different methods within a single study. The purposes of this article are to describe the four basic types of triangulation, to describe a more complex form of triangulation called multiple triangulation, and to discuss several issues involved in the use of multiple triangulation.

Triangulation is a term originally used to describe the navigation and military strategy of taking multiple reference points to locate an unknown position accurately. For example, to identify a specific location a triangle is formed with the unknown point and two known points as the vertices. Using geometry the unknown point can then be located.[1] This idea of triangulation was first applied to research methodology by Campbell and Fiske in 1959.[2] They referred to it as multiple operationism or the multimethod/multitrait method and used it to promote convergent validation. More recently the term triangulation is used to refer to a particular study design that includes multiple methods. Denzin in 1970[3] defined triangulation as the combination of multiple methods in a study of the same object or event to depict more accurately the phenomenon being investigated.

The purpose of multiple methods in a study design is to overcome the deficiencies and biases that stem from any single method. The aim of triangulation is to achieve results in which the variance that is obtained reflects the trait being studied rather than reflecting the method being used to measure the trait. The rationale is that if a hypothesis survives testing by a series of complementary methods, it has a degree of validity unattainable when tested with a single method because the findings are not method-bound.[2]

TYPES OF TRIANGULATION

There are four different types of triangulation: data, investigator, theoretical, and methodological.[3] When two or more different examples of a particular type of triangulation are present within a single study, that study is said to be triangulated. For example, a triangulated study is any study that has several different data sources, or involves multiple investigators, or tests multiple competing hypotheses, or includes two or more kinds of data collection methods, such as both qualitative and quantitative methods. When more than one type of triangulation is represented in a study, this more complex form is called multiple triangulation. It will be discussed in more detail later in this article. The example that will be used to illustrate the four types of triangulation and the combination of these types within a study to represent multiple triangulation will be drawn from an ongoing study about the

antecedents and consequences of food cravings.

Data triangulation

Data triangulation is the inclusion of multiple sources of data within the same study, with each source focused upon the phenomenon of interest. These data sources can differ by person, place, or time. An example is data collected from different groups about the same topic, or at different locations, or during different time periods. Each source of data is chosen to represent dissimilar comparisons to obtain diverse data about a single topic.[3] For example, in the study about food cravings data are being collected from women on different days of the week, during different months of the year, during different menstrual cycle phases, and even during different times of the day. Specifically, daily data in a diary are being obtained about food cravings and eating behavior for at least 90 different consecutive days. Also, data about food intake are being collected during two different menstrual cycle phases as well as throughout the day on eight different days. Retrospective self-report measures also are being obtained as well as the daily concurrent data. This design using data sources from different time periods is an example of data triangulation. The key is that all of the sources of data have a similar focus, ie, they all relate to some aspect of the experience of food cravings. Data triangulation allows one to discover which dimensions of a phenomenon are similar and dissimilar across settings, which change over time, and which differ by group membership.

Data triangulation is the inclusion of multiple sources of data within the same study, with each source focused upon the phenomenon of interest.

Investigator triangulation

Investigator triangulation exists when multiple observers, interviewers, coders, or analysts, each with expertise and with prominent roles in the study, deal with the same raw data. In the food craving study two investigators are collecting data using a semistructured telephone interview while other researchers are collecting closed-ended survey-type retrospective data. When several investigators are involved in a study, this type of triangulation helps to reduce the potential bias possible when only a single investigator is involved. Greater reliability in data collection and analysis is possible when the data can be compared among investigators and checked for potential bias in reporting, coding, or analysis.[3]

Theoretical triangulation

Theoretical triangulation occurs when multiple perspectives and hypotheses are included within the same study. Chamberlin[4] called this the method of multiple working hypotheses. Several alternative explanations of the phenomenon, each theoretically different but related, are considered together and tested within the same body of data. More confidence can be placed in an accepted research hypothesis when it has been tested against rival hypotheses with the same data set. This

tougher test of a theory can be more convincing than a single test because it leaves fewer possible alternative theories.[5] In the model being tested in the food craving study several domains are represented, including the psychological domain testing cognitive and affective state hypotheses, the sociological domain testing attributional and social context hypotheses, and the physiological domain testing nutritional and menstrual cycle hypotheses. Together these different hypotheses, each representing different explanations of food cravings, exemplify theoretical triangulation. This type of triangulation begins at the time the study is designed and a hypothesis is put forth. Early in the development of the study the question that needs to be addressed is what would disprove the hypothesis.[6] Attempts can then be made to include tests of these other hypotheses in the study.

Methodological triangulation

The fourth and most commonly used type of triangulation is called methodological triangulation. Several different methods or procedures of data collection are included within a single study. Examples of different methods or procedures are interviews, questionnaires, direct observation, performance or archival records, and physical evidence.[7] This type of triangulation is most appropriately used when studying complex concepts that contain many dimensions.[8] Examples of such complex concepts of interest to nursing are perceived self-control, attachment, health, coping with chronic illness, and eating behavior. Multiple methods of data collection are required to tap the various dimensions and to generate a rich and comprehensive picture of the phenomenon under study. In the food craving study methodological triangulation is represented by including both qualitative data in the form of the semistructured telephone interview plus the quantitative closed-ended data from each subject in the study.

There are two different forms of methodological triangulation, within-method or across-method. Within-method, the simplest form, involves several examples of the same type of data collection method in a single study. An example is the use of two or three different scales to measure a psychological state. The approach has value as a reliability check on data quality but is limited because reactive measurement effects cannot be identified.[7]

Across-method or between-method triangulation is a form of methodological triangulation with a higher level of complexity than the within-method approach. Dissimilar but complementary methods are used with across-method triangulation to measure the same subjects and the same phenomenon to try to achieve convergent validity. The combination of dissimilar methods also creates the potential for counterbalancing the flaws or weaknesses of one method with the strengths of another. This advantage assumes that the different methods do not share the same weaknesses or potential for bias.[8] An example of across-method triangulation is the inclusion, in a study about the experience of food cravings, of a telephone interview with semistructured questions plus a closed-ended questionnaire containing several measurement scales on attitudes about eating, psychological state, and level of food craving. In other words, both qualitative and quantitative methods

of data collection are combined within a single study. The key point in this type of triangulation is choosing complementary methods to measure the phenomenon in order to increase the validity of the findings in a way not attainable by a single method.[2]

The combination of both within-method and across-method triangulation is a third level of complexity within methodological triangulation. Jick[8] referred to this approach as a holistic design. The purpose of this complex integrated design is to increase both the reliability and the validity of the measurement. By including in the study similar as well as different methods, the potential for achieving greater reliability, for identifying the overlapping or common variance, and for finding the variance unique to each type of method is increased (Fig 1).

One type of method could elicit data that suggest conclusions to which the other type of method might be blind (see A and B in Fig 1). Also, by combining both qualitative and quantitative methods a more complete picture of a phenomenon can arise than if either type was used alone

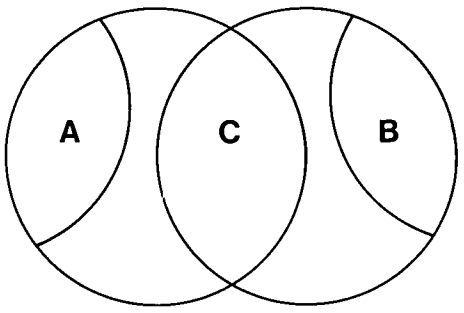

Fig 1. The integrated design. A or B = unique differences, method bound; C = similar differences, not method bound, convergent validity; A + B + C = contextual picture.[8]

By combining both qualitative and quantitative methods a more complete picture of a phenomenon can arise.

(see A + B + C in Fig 1). This integration of methods can provide an expanded understanding of the scope of the phenomenon of interest and increased confidence in the generalizability of the results. Results that are convergent (refer to C in Fig 1) can be formulated into new hypotheses and subsequently tested.[8]

APPLICATION PRINCIPLES

The application of methodological triangulation requires the careful application of at least four principles. The first principle demands a clearly focused research question. This means that the problem, the kinds of data needed about the problem, and the relevance of the problem to the methods chosen must be carefully considered. For example, if the question focuses upon the perceptions of a person with food cravings, a closed-ended measurement scale would not be appropriate. To elicit perceptions the methods chosen might be a combination of different types of semi-structured or open-ended interviews and questionnaires.

The second principle of methodological triangulation requires that the strengths and weaknesses of each chosen method complement each other. Two methods with the same bias will not decrease threats to validity, one of the desired outcomes of this approach. However, two methods with different biases may help counteract the

impact of each other and provide more validity than if either were used alone.[3] For example, retrospective self-report methods probably possess potential respondent bias factors such as stereotypical bias, problems of recall, and social desirability. However, if a retrospective self-report method is combined with a prospective or concurrent method of data collection, some of the methodological biases could be counteracted. To fulfill this second principle, it is important that the different methods not only complement each other in terms of potential bias but that each different method be significantly represented in the study. This is exemplified in a current study about the prevalence of perimenstrual symptoms. In this study subjects report any symptoms on a daily basis for 90 days. At the end of the study these same subjects are asked in a telephone interview to report the occurrence of the same symptoms if they usually occurred either premenstrually or menstrually during the previous three months.

The third principle of methodological triangulation requires that the methods be selected according to their relevance to the nature of the phenomenon being studied. For example, the changing nature of food cravings over time must be considered when selecting the type of data collection methods to study food cravings. If the method used to collect data about food cravings involved data collection for a single time period, the findings would not have much validity because food cravings are a phenomenon that changes day to day.

The fourth and final principle for sound methodological triangulation involves continual evaluation of the chosen methodological approach during the course of the study to monitor whether the first three principles are being followed. The investigator needs to assess continually the appropriateness of the methods chosen, the validity of the data being collected, and the relevance of the data to the nature of the phenomenon. This requires the investigator to be continually in touch with the data and the theory, to be open to change, and to alter the methods if inconsistencies are discovered.[3]

MULTIPLE TRIANGULATION

Multiple triangulation is a complex form of triangulation that combines more than one type of triangulation into a study design.[3] By combining several different types of triangulation, a more comprehensive outcome is achieved allowing new dimensions of the phenomenon being studied to emerge.[8] It is not necessary for all four types of triangulation to be present; to exemplify multiple triangulation only two or more types of triangulation are required.

Problems of implementation

There are several major difficulties involved in using multiple triangulation. Four of these difficulties that must be addressed relate to the unit of analysis, time and money constraints, demands upon the investigator, and data analysis.

Unit of analysis

Multiple triangulation requires a common unit of analysis to guide the design, data collection, and analysis. This common

focus of the data is critical for data from different sources or methods to be combined and must be part of all aspects of the triangulation. For example, in the food craving study the common unit of analysis is the individual woman with food cravings and the experiences related to the various aspects of daily living as they relate to food cravings. Another study might have the family as a unit be the focus of the data.

Time and money constraints

Investigator and data triangulation in particular create difficulty in terms of time and money availability. Many observations are required, over multiple time periods, creating a large volume of data for analysis. This problem may be lessened with more collaborative research by sharing needed human and technological resources.

Investigator demands

The investigator who wants to use multiple triangulation successfully needs a broad theoretical perspective and a broad knowledge base in research methodology, including both qualitative and quantitative methods. Also required are the ability and desire to deal with complicated design, measurement, and analysis issues, and the ability and resourcefulness to deal with limited resources. A certain amount of comfort in working in uncharted waters with limited available guidelines is also needed.

To deal with some of these investigator demands and to prepare nurse scientists to use multiple triangulation, doctoral programs need to offer methodology and statistics courses that represent diverse approaches. Some courses are needed that are not method-bound but are developed to help the nurse scientist student learn to answer the complex questions faced by the discipline.

Analysis of triangulated data

The analysis of data generated by multiple triangulation is a difficult problem that has yet to be solved. The literature provides very few guidelines. Most of the triangulation literature offers ideas about conceptualization and design but not about analysis. There are numerous questions generated by the analysis issue:

- how to combine numerical (quantitative) data and linguistic or textual (qualitative) data;
- how to interpret divergent results between numerical data and linguistic data;
- what to do with overlapping concepts that emerge from the data and are not clearly differentiated from each other;
- whether and how to weight data sources; and
- whether each different method used should be considered equally sensitive and weighted equally.

There are no simple answers to these questions; instead there are more questions than answers. More testing of this methodology is needed plus the sharing of ideas and possible approaches to the analysis problem. The following is one possible approach to the issue of combining qualitative and quantitative data.

A major analysis problem is the combination of numerical or quantitative data with linguistic or qualitative data. This issue occurs at the point when each type of

data has been analyzed separately according to its own accepted principles and rules. For example, qualitative data first would be systematically and carefully analyzed, for content, apart from the quantitative data, according to the accepted principles of sound qualitative data analysis. The same holds for the quantitative data, which first would be analyzed apart from the qualitative data. From these separate and thorough analyses significant variables emerge in terms of the model. At this point multivariate analysis and testing of the model to explain the phenomenon is necessary. The merging of the two different types of significant data is the issue. One of two approaches might be attempted at this point: merging via a statistical approach or a conceptual one.

A statistical approach would include the analysis of those significant variables identified as theoretically important by either the qualitative or quantitative approach by combining them into an appropriate test of a model using multiple regression, a linear structural relations approach (LISREL), cross-classification analysis, multiple analysis of variance (MANOVA), or some other technique. Those variables entered into the equation would come from both the quantitative and the qualitative data. This approach would be appropriate as long as the variables were specifically defined, conceptually different from each other, and not highly intercorrelated. The statistical integration of qualitative and quantitative data would then enable testing and further development of a causal model through the use of an approach such as path analysis, which would determine the strength or direction of the relationships between the variables in the model.

Statistical integration of qualitative and quantitative data enables testing and further development of a causal model.

A second way to integrate triangulated data analytically is through conceptual analysis of all the significant data available about a particular phenomenon. This represents a confirmatory approach or conceptual validation.[9] In this approach, the results from the qualitative analysis would be used to help confirm the data from the quantitative analysis. This conceptual analysis would involve a search for logical patterns of relationship and meanings between the variables measured by either or both qualitative and quantitative methods. The integration of both types of data could lead to a more in-depth conceptual understanding of a particular phenomenon. Hypotheses could then be generated from this conceptual analysis for testing in a subsequent study.

• • •

Multiple triangulation is not appropriate for all types of studies or investigators. It would not be appropriate in a highly controlled experimental design in which a single data source such as a special strain of animal was required and data were measured with precision using a particular technique. Also, an investigator who was trained in one particular research design appropriate for a discipline, who studied

phenomena strictly from the perspective of that discipline, and who worked alone would not be the person to use multiple triangulation. However, for those situations in which more than one view of the same phenomenon is desired to help explain the event, multiple triangulation offers flexibility and an in-depth approach that is not available with more simple designs.

REFERENCES

1. Smith HW: Triangulation: The necessity for multimethod approaches, in Smith HW (ed): *Strategies of Social Research: The Methodological Imagination*. Englewood Cliffs, NJ, Prentice-Hall, 1975, pp 271-292.
2. Campbell DT, Fiske DW: Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychol Bull* 1959;56 (March):81-105.
3. Denzin N: Strategies of multiple triangulation, in Denzin N (ed): *The Research Act*. New York, McGraw-Hill, 1970, pp 297-313.
4. Chamberlin TC: The method of multiple working hypotheses. *Science* 1965;148:754-759.
5. Stinchcombe AL: *Constructing Social Theories*. New York, Harcourt, Brace & World, 1968.
6. Platt JR: Strong inference. *Science* 1964;146:347-352.
7. Webb EJ, Campbell DT, Schwartz RD, et al: *Nonreactive Measures in the Social Sciences*. Boston, Houghton Mifflin, 1981.
8. Jick TD: Mixing qualitative and quantitative methods: Triangulation in action. *Adm Sci Q* 1979;24:602-611.
9. Sieber SD: The integration of fieldwork and survey methods. *Am J Sociol* 1973;78:1335-1359.