A New Foundation for Methodological Triangulation

Mark W. Risjord, Sandra B. Dunbar, Margaret F. Moloney

Purpose: *To show how triangulation with qualitative and quantitative methods can help confirm a theory to a greater degree than can either method alone.*

Construct: *Coherence view of theory structure and confirmation. Evidence helps confirm a theory if the theory is the most coherent way of accounting for the evidence, and one theory is more coherent than another insofar as it leaves fewer unanswered questions (and fewer unquestioned answers).*

Methods: *The method of this theoretical essay is analytic. Analysis of the debate over methodological triangulation reveals presuppositions about theory structure and confirmation. Well-known arguments in the philosophy of science are presented to show that the presuppositions are false. The arguments provide evidence for the construction of an alternative, coherence model of theory structure and confirmation.*

Findings: *Three consequences of the analysis are: (a) qualitative and quantitative methods do not produce theories with different structures; (b) qualitative and quantitative methods help to confirm theory in the same ways; and (c) used together, qualitative and quantitative methods can confirm a theory to a greater degree than the use of either method alone.*

Conclusions and implications: *A coherence of model of theory structure and confirmation supports a version of the blending view of methodological triangulation. Triangulation can provide completeness, abductive inspiration, and confirmation. This version of blending provides principles for resolving issues of methodological dominance and order, and it indicates how different methods can disconfirm theory.*

JOURNAL OF NURSING SCHOLARSHIP, 2002; 34:3, 269-275.

[Key words: triangulation, qualitative research, quantitative research, confirmation]

* * *

In 20 years of debate about methodological triangulation in nursing little progress has been made. The debate about whether triangulation is possible and whether it produces benefits has coalesced into two well-defined positions referred to here as the "building block" and "blending" views. With the theoretical issues unresolved, nurse researchers continue to use triangulation and simply cite sources that agree with their preferred perspective. The result has been a profusion of essays on triangulation—and the emergence of new terms such as "mixed methods" and "the syncretic approach"—but little progress on the underlying issues. Our contention is that this logjam has occurred because parties to the debate share deep, but mistaken, presuppositions. The aim of this essay is to expose those presuppositions, replace them with sound assumptions, and strengthen conceptions of methodological triangulation.

The State of the Debate

Although some early contributors to the literature argued that triangulation was impossible (Moccia, 1988; Phillips, 1988) recent theorists have regarded triangulation as a legitimate research strategy. The disagreement among contemporary theorists is over the purpose and potential benefits of triangulation. Consequently, disagreement continues over the way in which a triangulation strategy must be implemented. Three rationales are frequently given for using methodological triangulation: completeness, abductive inspiration, and confirmation.

Triangulation yields completeness because quantitative methods can further develop findings derived from qualitative research and vice versa. The methods complement each other, providing richness or detail that would be unavailable from one method alone. Authors and researchers who have taken completeness to be a goal of triangulation include Duffy

Mark W. Risjord, PhD, Associate Professor, Department of Philosophy; **Sandra B. Dunbar**, RN, DSN, FAAN, *Alpha Epsilon*, Charles Howard Candler Professor, Nell Hodgson Woodruff School of Nursing; **Margaret F. Moloney**, RN-C, PhD, ANP, *Alpha Epsilon*, Associate Professor, Nell Hodgson Woodruff School of Nursing; all at Emory University, Atlanta, GA. Correspondence to Dr. Risjord, Department of Philosophy, Emory University, Atlanta, GA 30322. E-mail: mrisjor@emory.edu

Accepted for publication April 8, 2002.

(1987), Goodwin and Goodwin (1984), Knafl and colleagues (1988; 1991), Mitchell (1986), Morse (1991), and Shih (1998).

Although the term "abductive inspiration" is our own, this rationale for triangulation has been widely discussed (Duffy, 1987; Goodwin & Goodwin, 1984; Morse, 1991; Risjord, Moloney, & Dunbar, 2001). "Abduction" is the logical process by which a researcher arrives at a new explanation for a phenomenon (Peirce, 1932; Vol. 2, p. 56). Abductive inspiration is the use of one method to generate ideas that are tested by another method. Many nurse researchers use qualitative research when a phenomenon is poorly understood. They orient themselves to the material through methods such as interviews of participants, textual analysis, and participant observation. The results indicate hypotheses to be tested by quantitative methods. Conversely, qualitative investigation can help organize quantitative data that have already been gathered, or can illustrate new ways of approaching the phenomenon.

Many authors, including Duffy (1987), Goodwin and Goodwin (1984), Haase and Meyers (1988), Knafl and colleagues (1988; 1991), Mitchell (1986), and Shih (1998), have suggested that a single hypothesis can be confirmed by both qualitative and quantitative methods. According to these proponents of triangulation, the different methods support each other, strengthening the evidential support for a hypothesis. Triangulation is thus purported to produce a more reliable and highly confirmed result than either method could yield alone.

Only the third rationale for triangulation, confirmation, is controversial. Proponents of the "blending" view contend that methodological triangulation can yield all three benefits: completeness, abductive inspiration, and confirmation. Critics of blending, an approach referred to as the "building block" view, have argued that qualitative and quantitative methods are based on deeply different assumptions about the phenomena studied (Dootson, 1995; Foster, 1997; Morse, 1991; Phillips, 1988). According to the building block theory, different methods and their results must remain independent. Because the methods are different, triangulation cannot yield confirmation. Triangulation is useful, conclude the building block theorists, but only for completeness and abductive inspiration. The fundamental issue in the debate over methodological triangulation, then, is whether the use of different kinds of methods can together confirm the results of a study to a greater degree than can either method alone.

Confirmation and Theory Structure

In its broadest sense, confirmation is any use of evidence as a reason for accepting (or rejecting) a hypothesis, proposition, or theoretical claim. For example, the proposition that a patient has an elevated temperature is "confirmed" by the reading on the thermometer. Likewise, the claim that a terminally ill patient is making sense of her situation by finding narrative continuity in her life is "confirmed" by what the patient says and does. These two examples were chosen to show that both quantitative and qualitative research include evidence as the grounds for accepting a statement. In this sense, both qualitative and quantitative research are confirmed. The difference is the kinds of evidence used and the manner for gathering it. In quantitative research, measurement is a primary tool. Therefore, quantitative researchers value evidence that can be measured and hypotheses that can be confirmed by measurement. Qualitative researchers are interested in phenomena that are not confirmable by measurements, such as meaning, belief, intentions, concepts, or values. Qualitative researchers therefore look to other sources of evidence.

Parties to the triangulation debate agree about the differences between qualitative and quantitative research. In particular, they seem to agree about the character of quantitative theory and the way in which it is confirmed. For example, when contrasting qualitative and quantitative research paradigms, Duffy (1987) wrote: "The procedures employed by the quantitative researcher are usually highly structured and designed to verify or disprove predetermined hypotheses" (p. 131). According to Haase and Meyers (1988), quantitative theories are distinguished by their use of generalizations that have predictive value. The structure they mentioned is a hierarchy of theoretical propositions, generalizations, and correlations. At the highest level are the most general and abstract laws—the laws of mechanics and biology. In the middle levels are generalizations about human physiology and psychology. At the bottom are the most specific generalizations and correlations identified in nursing theory, such as the responses of patients to noisy environments. Ideally, lower-level generalizations can be deduced from more general laws along with limiting conditions. These predictions can be directly tested.

The spatial metaphor of more general principles being "above" less general principles fits neatly with another metaphor for the confirmation of scientific theory: evidence is the foundation of scientific knowledge. Low-level hypotheses rest directly on evidence. Abstract generalizations rest directly on low-level correlations. If a low-level hypothesis is disconfirmed by new evidence, the foundation for that part of the theory is removed and everything that rested on the hypothesis must be taken out of the theory. The conception of quantitative theory as a hierarchy of theoretical propositions or generalizations thus has important consequences for the way in which quantitative theory is confirmed. Chinn and Kramer (1999) wrote:

> [Research to validate a theory] is usually thought of as a deductive approach. The research starts with an abstract relational statement derived from theory. From the theoretic statement, hypotheses or research questions are created for a specific research situation. (p. 125)

From the generalizations that constitute a theory, researchers deduce predictions. If the prediction is found to be true, the hypothesis is confirmed. If the prediction is false,

then the hypothesis must be rejected, along with whatever theoretical statement was used to derive it.

A second aspect of this view of quantitative research is that the propositions of a theory are tested singularly. Chinn and Kramer (1999) expressed this idea explicitly: "A single study is usually based on one or two relational statements from among several that might possibly be extracted from a theory. No one study can test the entirety of a theory" (p. 124). A theory is not tested as a whole. The evidence shows that a specific hypothesis, derived from a specific theoretical proposition, is true or false. The confirmation (or disconfirmation) of a hypothesis therefore confirms (or disconfirms) at most a small number of theoretical statements. On this view of confirmation and theory structure, then, different parts of the theory rest on different parts of the evidential foundation. Metaphorically, removing one brick from the foundation of a wall weakens the wall immediately above that brick. Other parts of the wall remain standing.

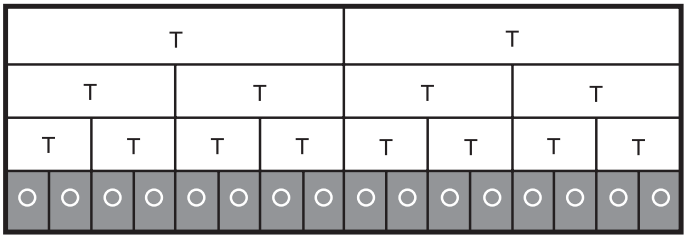

Figure 1. The Wall Metaphor: Theoretical propositions (T), including laws, empirical generalizations, and causal correlations rest on a foundation of observation (O).

Presuppositions of the Triangulation Debate

The foregoing section indicated three presuppositions concerning the structure and confirmation of quantitative theory found in writing about nursing methodology: (a) quantitative theories are structured as deductive hierarchies of propositions; (b) quantitative theories are confirmed by deriving hypotheses from statements of the theory and testing them against evidence; and (c) quantitative methods confirm theoretical statements one by one. These presuppositions are a central part of the building block theorists' argument that triangulation cannot yield confirmation. They argue that a difference exists in the way theory and data are related within qualitative and quantitative paradigms. Morse (1991) said, " [I]n methodological triangulation, the key issue is whether the theory that drives the research ... is developed inductively from the research per se or used deductively as in quantitative inquiry"(p. 121). Deductive research begins with a theory, ideally articulated as a body of laws or universal generalizations [cf. (a) above]. A hypothesis is derived from this theory, and it is tested against observation [cf. (b) above]. By contrast, qualitative inductive research begins with observations alone, without prior theory. One proceeds to distill descriptive claims from the observations. Building-block theorists such as Morse take this difference in method to entail a difference in theory. Quantitative methods are necessary to support explanatory theories that are hierarchically structured. Qualitative interpretations are not tested hypothesis by hypothesis [cf. (c) above]. They are variously said to be "holistic," "dynamic," or "subjective" (Dootson, 1995; Duffy, 1987; Haase & Myers, 1988). Finally, the building-block theorists argue that the standards of evaluation in each paradigm yield nonsense when applied to the other. Interpretations are not appropriately evaluated for statistical significance, and asking whether the analysis of a blood sample coheres with the blood's point of view makes no sense.

The building-block theorists take these differences to mean that failure to keep qualitative and quantitative methods distinct will result in incoherence or outright inconsistency (Dootson, 1995; Foster, 1997; Morse, 1991). In a triangulation study, the qualitative and quantitative components must support theories with different logical structures. Moreover, an individual research method should be expected to withstand scrutiny on its own merits. Therefore, confirmation cannot be an appropriate goal of triangulation. No theory could be supported by both methods. Triangulation can be used only for abductive inspiration or completeness.

Proponents of the blending approach have responded by contending that arguing against confirmation by triangulation ignores ways in which multiple methods can increase the reliability, validity, or accuracy of a study (Duffy, 1987; Haase & Myers, 1988; Knafl & Breitmayer, 1991; Knafl, Pettengill, Bevis, & Kirchoff, 1988; Mitchell, 1986). Blending theorists have two arguments in support of their view. First, qualitative and quantitative methods are complementary. Because qualitative research tends to be focused on a small group of people, applying the results to other populations is difficult, sometimes impossible. Triangulation with a quantitative methodology can increase a researcher's confidence that the conclusions might be transferable to a larger population. The emphasis in quantitative methods on standardization and generalizability means that the questions are often narrow. A survey may not capture what is significant to the patient. Correlation with qualitative data can increase researchers' confidence that a survey has uncovered a meaningful result. Blending theorists conclude that quantitative and qualitative methods are complementary, and therefore they increase researchers' confidence in the whole study.

A second reason for thinking that triangulation enhances confirmation is that it helps to eliminate bias. Both qualitative and quantitative research is subject to bias. Because the biases occur in different ways, the use of both methods enhances researchers' confidence that the biases have been identified. Social desirability bias, for example, occurs in both qualitative and quantitative research. In face-to-face interviews, a researcher may inadvertently express a particular attitude to a participant through tone, posture, or facial expression. At the same time, the researchers are able to identify questions that make people uncomfortable or evasive. The researchers'

presence does not influence the answers in a pencil-and-paper questionnaire, but determining whether the answers were authentic is sometimes difficult. Quantitative and qualitative methods are thus subject to the same bias in complementary ways. When the quantitative and qualitative results diverge, the results of one can be used to refine the methods of the other. If the results converge, then researchers can be more confident that social desirability bias is not present. Blending theorists conclude that, as this example shows, triangulation increases confidence in results to a higher degree than occurs with the use of either method alone.

These two arguments for a blending view do not challenge any of the three presuppositions above. Blending theorists accept that quantitative research is different from qualitative research in just the way that the three assumptions indicate. Although these points are good ones, the arguments do not get to the heart of the matter.

Challenging the Presuppositions

The three presuppositions about quantitative research embedded in discussions of nursing methodology were commonplace in philosophical thought about science during the 19th and early 20th centuries. During the latter half of the 20th century, all three were subjected to powerful criticism. Philosophers including Duhem, Kuhn, Hanson, Toulmin, Putnam, Sellars, and Quine argued that these presuppositions about confirmation and theory structure were simply not true. The echoes of their arguments have been heard in nursing, and readers may find the points below familiar. Nonetheless, as the continuing debate over methodological triangulation shows, the importance of this post-positivist work in the philosophy of science has not been fully appreciated.

The first argument concerns the role of what are sometimes called "auxiliary hypotheses" in confirmation. According to presuppositions (a) and (b), a theory is tested by deriving hypotheses from a theoretical statement. If the evidence shows that the hypothesis is false, then the theoretical statement must be rejected or revised. Suppose, for example, a nurse researcher wants to test the theoretical statement that (P) perimenopausal hot flashes are caused by fluctuating estrogen levels. She derives the hypothesis that (Q) changes in estrogen levels will be correlated with hot flashes. Suppose that the evidence counts strongly against the hypothesis. According to the three assumptions above, the investigator must reject the theoretical statement that perimenopausal hot flashes are caused by fluctuating estrogen levels. One might believe that logic demands this conclusion: when one statement, P, deductively entails another, Q, and Q is false, then P must be false too. Many philosophers of science have pointed out the flaw in this conclusion. All alone, a theoretical statement never entails a testable hypothesis. Many auxiliary hypotheses are necessary. In the above example, the deduction indicates no other causes of hot flashes, no inhibitors or facilitators of hot flashes, that the methods used to diagnose hot flashes and measure estrogen levels were reliable, and so on. A failed prediction shows that one of the statements used in the deduction must be rejected, but nothing in logic indicates which theoretical statement must be rejected. A failed prediction does not necessitate the rejection of the test hypothesis. Some other auxiliary hypothesis may be rejected instead.

This logical point has important ramifications for understanding the structure of theory. A falsified hypothesis does not call into question only the theoretical statements that the researcher had in mind when conducting the test. A test result can have far reaching implications. As Quine (1953) pointed out, virtually any theoretical statement can be insulated from empirical evidence if one is willing to make changes elsewhere in the theory. Conversely, virtually any statement is open to change in the presence of new evidence. A particular failed prediction may therefore result in a wide range of changes to the theory. Therefore, contrary to presumption (c), quantitative methods do not confirm hypotheses one by one. When a prediction fails, researchers need to make a judgment about which theoretical statements should be rejected or modified, and the best resolution may require changing a large part of the theory.

Once one recognizes that theories are not like walls, where pulling one brick from the bottom weakens only the section of wall above it, presumptions (a) and (b) no longer look so plausible. Presumption (b) indicates that deriving hypotheses and testing them against the evidence confirm quantitative theories. Historians and philosophers of science have pointed out that, to the contrary, theories are often maintained even though they are known to show predictions contrary to the evidence. For example, the predictions of Copernicus' heliocentric theory of the solar system were less accurate than was its geocentric competitor. According to the conception of confirmation expressed in presupposition (b), Copernicus' theory should have been rejected on the basis of empirical test. Was it irrational or dogmatic for Galileo to accept it anyway? Not at all: the heliocentric theory was more consistent with the emerging theories of motion. The heliocentric theory of the heavens was thus supported, not by empirical test, but by other theories that were themselves empirically superior to the available alternatives. Many philosophers of science, such as Kuhn (1962), Quine (1953), and Thagard (1999), have concluded that a particular hypothesis can be supported, even when known to lead to false predictions if it is part of a larger theory that is well supported by the evidence. This conclusion undermines presupposition (b) because it shows that, at the very least, other ways are available to confirm a hypothesis besides direct testing by experience.

These two arguments against presuppositions (b) and (c) lead to a notion of theory structure that is contrary to the hierarchical structure expressed in presupposition (a) and shown in **Figure 1**. The first argument showed that theoretical propositions have empirical consequences only as a part of a larger body of theory. The second argument showed how theoretical propositions support each other directly. The

alternative to presupposition (a), then, is to understand theories as interlaced bodies of propositions. Theoretical propositions stand in relationships of mutual support and face confirmation as a whole. The traditional model is well suited to the metaphor of a wall, but the alternative conception is better suited to the metaphor of theory as a spider's web (see **Figure 2**). The edges of the web are the evidence, where the theory is attached to the world. The center of the web contains the most abstract propositions of the theory.

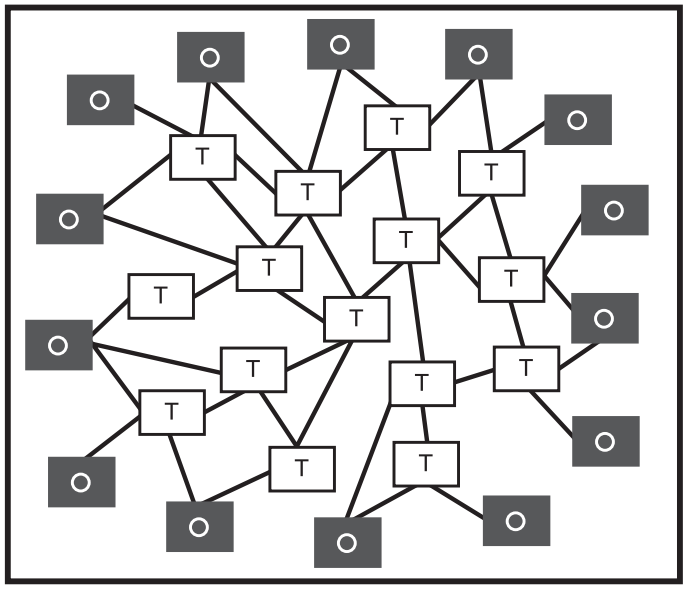

Figure 2. The Web Metaphor: Theoretical propositions (T), including laws, empirical generalizations, and causal correlations in relationships of mutual support to each other and to observation (O).

The new understanding of the structure of theory requires a novel understanding of confirmation. Changes at the edge of the web can be accommodated by a variety of internal adjustments. According to many philosophers, the guiding principle for these changes is coherence (Quine, 1961; Risjord, 2000; Thagard, 1999). When new evidence is acquired, the best changes are those that make the theory more coherent. Theory confirmation is thus a matter of creating a coherent account of the evidence. Evidence confirms a given theory if it is the most coherent of the alternative accounts; a theory is disconfirmed when a more coherent alternative exists. Coherence means, at least, logical consistency and completeness. Changes to a theory must be logically consistent, and a theory is more coherent when it can account for more of the evidence. Coherence also implies some kind of systematicity. A coherent theory should not be fragmented or ad hoc. Our favorite way of grasping this aspect of coherence is the idea that inquiry is aimed at answering questions. Each theoretical proposition can be conceived as either the topic of a question or the answer to a question. The propositions of a theory, including those that constitute the evidence for it, are both questions and answers. A theory is thus more coherent if it leaves fewer questions unanswered and fewer answers unquestioned (Risjord, 2000).

Integrating Qualitative and Quantitative Research

What happens to the triangulation debate if the three presuppositions are rejected and are replaced with a coherence understanding of theory structure and confirmation? The first conclusion would be the lack of structural difference between quantitative and qualitative theory. Qualitative research is supposed to be distinct because it does not derive hypotheses from a body of law-like generalizations. According to the arguments above, this way of contrasting qualitative and quantitative theory depends on a misunderstanding of quantitative theory. Therefore, little difference exists between the two on this score (Risjord, 2000). Similarly, qualitative research is supposed to be "holistic" and "dynamic." A coherence model includes recognition that quantitative theorizing is as holistic and dynamic as is any interpretive or narrative account. Both blending and building-block theorists have erred by accepting the model of quantitative theory expressed by the three presuppositions. In so doing, they have assumed that qualitative and quantitative research constituted formally different sorts of inquiry. Their arguments both for and against blending indicate acceptance of these differences as something to be accommodated. If the arguments above are correct, then nothing in the character of quantitative and qualitative theory keeps them from becoming fully integrated.

The coherence model of theory structure and confirmation thus provides the basis for a new understanding of methodological triangulation. Triangulation, in the traditional definition, occurs when one body of theory is supported by both qualitative and quantitative inquiry. In a coherence understanding of theory structure, the theory contains questions (and their answers) that arise out of qualitative and quantitative research. The theory must be coherent, so the qualitative and quantitative components must be related as question and answer. Answers provided by investigators using qualitative methods must give rise to questions that are interesting from a quantitative point of view, and vice versa. Examples of triangulation in nursing research illustrate and support that view.

Consider first how qualitative research can give rise to questions best answered by quantitative means. One example is from a recently completed pilot study on migraines in perimenopausal women (Moloney & Melby, 2001a, 2001b). Current theory is that hormonally induced migraines occur because of estrogen shifts during this transitional time, but very little work has addressed this problem. Many perimenopausal women are thus unaware that their headaches are migraines, and they do not seek appropriate care. Moloney's pilot study began with a qualitative approach with open-ended interviews and a questionnaire with open-ended questions. She found that although several participants met the screening criteria for migraines, they did not understand that they had migraines. Questions then arose

about the cause of these headaches and whether they were migraines. Moloney asked each participant to keep a daily headache and menstrual diary for 6 months. The diary included primarily quantitative scales and quantifiable questions. The diaries revealed headache patterns that cross-correlated with known migraine triggers such as stress and menses. The quantitative data thus showed that the participants did have migraines, contrary to their self-understanding and diagnostic history. The initial qualitative interviews and questionnaires thus indicated questions that were answered by quantitative means.

The results of quantitative research can similarly indicate topics of questions that must be answered in qualitative ways. Dunbar and colleagues (1999) examined factors associated with patients' recovery process within the first 3 months after they had received an implantable cardioverter defibrillator (ICD). These patients were considered at risk for cardiac arrest from abnormal heart rhythms. Approximately 25% had been successfully resuscitated from sudden cardiac arrest (SCA), and the remainder were considered at high risk for life-threatening arrhythmias. The internal defibrillator, a device that was surgically implanted beneath the skin of the chest wall like a pacemaker, prevented cardiac arrest by monitoring the heart rhythm and delivering a shock when necessary to convert heart rhythms back to normal. A variety of standardized questionnaires were used to evaluate patients' adjustment to this procedure. A standardized instrument for measuring mood revealed, unexpectedly, that patients who had experienced SCA had better mood levels than did those who had not. This quantitative result raised questions that were answered by qualitative means. Why did the patients who had experienced SCA have higher mood levels? Because this study had been designed with collection of quantitative and qualitative data at key time points, the question could be answered. Interviews with patients revealed that the presence of the ICD gave SCA survivors a sense of security, while other patients questioned the need for the device and exhibited varied perceptions of their vulnerability. The patients' feelings of security and ambiguity were made explicit in the interviews and those feelings affected their mood scores (Dunbar et al., 1999).

Neither of the above two examples is easily understood on a building-block model of triangulation, such as Morse's (1991). On a building-block model, Moloney's use of quantitative methods would be understood as providing only a bit of detail to a qualitative study. Similarly, Dunbar's discovery of the effects of security and ambiguity would be a separate inquiry that adds completeness. These examples show that both Moloney and Dunbar used triangulation for confirmation. Moloney's quantitative diaries confirmed the screening criteria and supported the hypothesis that the women misunderstood their headaches. Dunbar's qualitative data about security and ambiguity helped confirm the finding of a systematic difference in mood between SCA survivors and other implant patients. By insisting that the qualitative and quantitative components of research remain independent, a building-block theorist cannot account for research such as Moloney's and Dunbar's. Both researchers have results that could only have been found by triangulation, as our model of triangulation indicates.

Triangulation, therefore, occurs when qualitative researchers raise questions that are most naturally answered by quantitative means, and when quantitative researchers raise questions that are answered in qualitative terms. The result is a single coherent theory insofar as the different parts are related as question and answer. This conception of triangulation has all three of the virtues associated with triangulation: completeness, abductive inspiration, and confirmation. A theory that includes both qualitative and quantitative questions and answers will be more complete than a theory that is restricted to one method alone. Moreover, because the result of one method gives rise to questions asked from another perspective, triangulation leads to abductive inspiration. Finally, triangulation will yield confirmation insofar as the overall theory is the most coherent of the alternatives.

Our view of triangulation is therefore a version of blending theory. It differs from the previous versions because we do not accept the understanding of theory structure, confirmation, and paradigmatic differences that has been presupposed in the debate. Nor are we proposing, as some have (Knafl et al., 1988), that blending must result in a new kind of method that is somehow both qualitative and quantitative. On our view, qualitative research and quantitative research are distinct ways of answering questions and they are appropriately evaluated in different ways. They are blended only in the sense that a single theory can be supported by both qualitative and quantitative research.

Our blending approach to triangulation has two important consequences. First, it indicates grounds for addressing the question: What conclusions should be drawn when the qualitative and quantitative components of a study yield inconsistent results? This is perhaps one of the most pressing issues concerning triangulation. A building-block approach to triangulation gives little guidance because it shows the qualitative and quantitative components as independent. A blending approach shows qualitative and quantitative components as mutually supporting a single theory. Where the qualitative and quantitative components conflict, the whole loses coherence. Hence, conflict between quantitative and qualitative components can lead investigators to disconfirm the theory. In the face of such conflict, some changes in the theory are therefore necessary. Our model shows that the researchers change the theory to maximize coherence. A full account of such change is beyond the scope of this essay. The adjustments might include finding alternative explanations of the data, changing the questions, rejecting presuppositions, making fine adjustments to the instruments, and so on. A virtue of our version of blending is that it can show how resolving conflict between qualitative and quantitative inquiry can ultimately strengthen the theory.

The second important consequence of our blending approach is that it changes the focus of the triangulation debate. Methodological issues that seemed to require global

answers now can be treated with a more local, context-sensitive approach. One issue has been how qualitative and quantitative research should be ordered. When should qualitative research be done first? We suggest that no universal answer to this question is possible. This decision must be made in light of local constraints on the research—what sort of evidence is available at what time, how research methods might influence later data gathering, and so on. Another issue is whether and how one method should dominate the other. Here again, the relative importance of qualitative and quantitative components depends on interests of the researchers and the characteristics of the phenomena they are studying. In each of these cases, our new conception of triangulation changes the focus of the problem from a global, methodological issue to a practical matter appropriately answered by the researchers themselves. Questions about methods are often best answered by considering the specifics of the research situation.

Conclusions

In this paper we have addressed the debate over methodological triangulation in nursing. The two main positions in the debate have crucial but mistaken presuppositions about confirmation and theory structure. These mistaken presuppositions lead investigators to misconceive quantitative research, and thus misunderstand how it is different from qualitative research. Postpositivist science philosophers provide a picture of theory structure more similar to a web than to the traditional metaphor of a wall. Quantitative and qualitative theories are interlaced bodies of questions and answers, and both are judged by their overall coherence, including coherence with the evidence. Quantitative and qualitative research programs become integrated when the results of one method indicate questions that can be answered by the other. This blending theory of triangulation immediately yields the benefits of completeness, abductive inspiration, and confirmation. The concept of inquiry as aimed at answering questions is an alternative that supports the integration of qualitative and quantitative research into a holistic, dynamic model for nursing inquiry.

References

Chinn, P.L., & Kramer, M.K. (1999). **Theory and nursing: Integrated knowledge development** (5th ed.). St. Louis, MO: Mosby.

Dootson, S. (1995). An in-depth study of triangulation. **Journal of Advanced Nursing, 22**(1), 183-187.

Duffy, M.E. (1987). Methodological triangulation: A vehicle for merging quantitative and qualitative research methods. **Image: Journal of Nursing Scholarship, 19**, 130-133.

Dunbar, S.B., Jenkins, L.S., Hawthorne, M.H., Kimble, L.K., Dudley, W.N., & Slemmons, M. (1999). Factors associated with outcomes 3 months after implantable cardioverter defibrillator insertion. **Heart and Lung, 28**, 303-315.

Foster, R.L. (1997). Addressing epistemologic and practical issues in multimethod research: A procedure for conceptual triangulation. **Advances in Nursing Science, 20**(2), 1-12.

Goodwin, L.D., & Goodwin, W.L. (1984). Qualitative vs. quantitative research or qualitative and quantitative research? **Nursing Research, 33**(6), 378-380.

Haase, J.E., & Myers, S.T. (1988). Reconciling paradigm assumptions of qualitative and quantitative research. **Western Journal of Nursing Research, 10**(2), 128-137.

Knafl, K.A., & Breitmayer, B.J. (1991). Triangulation in qualitative research: Issues of conceptual clarity and purpose. In J.M. Morse (Ed.), **Qualitative research: A contemporary dialogue** (pp. 226-239). Newbury Park, CA: Sage.

Knafl, K.A., Pettengill, M.M., Bevis, M.E., & Kirchoff, K.T. (1988). Blending qualitative and quantitative approaches to instrument development and data collection. **Journal of Professional Nursing, 4**, 30-37.

Kuhn, T. (1962). **The structure of scientific revolutions**. Chicago: University of Chicago Press.

Mitchell, E.S. (1986). Multiple triangulation: A methodology for nursing science. **Advances in Nursing Science, 8**(3), 18-26.

Moccia, P. (1988). A critique of compromise: Beyond the methods debate. **Advances in Nursing Science, 10**, 1-9.

Moloney, M., & Melby, M. (2001a). **Trading tampons for pills: The lived experience of perimenopausal women with migraines**. Paper presented at the Society for Menstrual Cycle Research June 7-9, Avon, CT.

Moloney, M., & Melby, M. (2001b). **Use of a daily headache/menses diary in research involving perimenopausal women with migraines**. Paper presented at the Society for Menstrual Cycle Research June 7-9, Avon, CT.

Morse, J.M. (1991). Approaches to qualitative-quantitative methodological triangulation. **Nursing Research, 40**, 120-123.

Peirce, C.S. (1932). **Collected papers of Charles Sanders Peirce**. Cambridge, MA: Harvard University Press.

Phillips, J.R. (1988). Diggers of deeper holes. **Nursing Science Quarterly, 1**(4), 149-151.

Quine, W.V.O. (1961). **Two dogmas of empiricism from a logical point of view** (2nd ed.; pp. 20-46). New York: Harper & Row.

Risjord, M. (2000). **Woodcutters and witchcraft: Rationality and interpretive change in the social sciences**. Albany, NY: SUNY Press.

Risjord, M., Moloney, M., & Dunbar, S. (2001). Methodological triangulation in nursing research. **Philosophy of the Social Sciences, 31**(1), 40-59.

Shih, F.-J. (1998). Triangulation in nursing research: Issues of conceptual clarity and purpose. **Journal of Advanced Nursing, 28**(3), 631-641.

Thagard, P. (1999). **How scientists explain disease**. Princeton, NJ: Princeton University Press.