Title
Models versus theories as a primary carrier of nursing knowledge: A philosophical argument

Journal
Nursing Philosophy, 19(1)

ISSN
1466-7681

Author
Bender, Miriam

Publication Date
2018

DOI
10.1111/nup.12198

Peer reviewed

DOI: 10.1111/nup.12198

ORIGINAL ARTICLE

WILEY

Models versus theories as a primary carrier of nursing knowledge: A philosophical argument

Miriam Bender PhD, RN, Assistant Professor

Sue & Bill Gross School of Nursing, University of California Irvine, Irvine, CA, USA

Correspondence
Miriam Bender, Sue & Bill Gross School of Nursing, University of California Irvine, Irvine, CA, USA.
Email: miriamb@uci.edu

Abstract

Theories and models are not equivalent. I argue that an orientation towards *models* as a primary carrier of nursing knowledge overcomes many ongoing challenges in philosophy of nursing science, including the theory–practice divide and the paradoxical pursuit of predictive theories in a discipline that is defined by process and a commitment to the non-reducibility of the health/care experience. Scientific models describe and explain the dynamics of specific phenomenon. This is distinct from theory, which is traditionally defined as propositions that explain and/or predict the world. The philosophical case has been made against theoretical universalism, showing that a theory can be true in its domain, but that no domain is universal. Subsequently, philosophers focused on scientific models argued that they do the work of defining the boundary conditions—the domain(s)—of a theory. Further analysis has shown the ways models can be constructed and function *independent* of theory, meaning models can comprise distinct, autonomous "carriers of scientific knowledge." Models are viewed as representations of the active dynamics, or mechanisms, of a phenomenon. Mechanisms are entities and activities organized such that they are productive of regular changes. Importantly, mechanisms are by definition not static: change may alter the mechanism and thereby alter or create entirely new phenomena. Orienting away from theory, and towards models, focuses scholarly activity on dynamics and change. This makes models arguably critical to nursing science, enabling the production of actionable knowledge about the dynamics of process and change in health/care. I briefly explore the implications for nursing—and health/care—knowledge and practice.

KEYWORDS

explanation, knowledge, nursing, nursing philosophy, philosophy of science

1 | INTRODUCTION

What is nursing knowledge? This question has been asked, with repeated and varied attempts at answers, since the modern development of nursing as a profession. Much of the debate hinges on the concept of theory in nursing and depends on a definition of nursing as a practice/profession or an academic discipline. The debate has been labelled the theory–practice gap, or the discrepancy between the form and function of knowledge constructed in nursing academia versus the knowledge needs for everyday nursing practice (Morse, 2016; Risjord, 2010). The debate concerns the pursuit of theories in academia that are not considered "useful" to practice (Bluhm, 2014; Thorne, 2011, 2015; Thorne & Sawatzky, 2014).

This tension between the development of nursing theory by nursing scholars and the applied (i.e., useful to practice) mandates of the professional nursing discipline has existed since the entrance of the nursing profession into the academic arena in the 1960s, with concomitant funding to spur academic nursing research (Gortner, 2000). Critically, the nursing academic discipline was established at the time when the "received view" of philosophy of science was dominant, expressing scientific knowledge as theories that define the universal principals, or underlying structures, of the physical world (Bluhm, 2014; Risjord, 2010; Schumacher & Gortner, 1992). As Risjord explains in his book *Nursing Knowledge: Science, Practice, And Philosophy* (2010), "nurse scholars made a philosophical choice" (p. 20) that nursing science should proceed from and feed back into theory; a choice based on the received view, specifically the tenet that "scientific theory was supposed to have a particular logical structure: it was a set of abstract and general laws" (p. 16).

The issue is that theories as defined by the received view entail static, universal statements about the world, while nursing practice engaged with the continuous, messy dynamics of patient/health care (Thorne & Sawatzky, 2014). Over the last decades, nursing scholars have rejected the received view for these reasons and have worked to revise and/or suggest alternative structures for nursing knowledge. But Risjord (2010) makes a convincing case for the continued embeddedness of the received view in nursing meta-theory: even those who reject the received view still rely on many of the main ideas when framing scholarly discussion about theory and scientific knowledge. This includes, for example, a continued belief by some in a theoretical hierarchy, assuming that a greater level of abstraction equates with greater levels of universality (Fawcett & Desanto-Madeya, 2013; Peterson & Bredow, 2017). It also includes assumptions about the function of theory, which at its most powerful should be prediction. For example, Calista Roy's 1985 description of theory is a system of inter-related propositions used to describe, explain, predict, and control part of the empirical world (Roy, 1983). McEwen and Wills, in their book *Theoretical Basis For Nursing*, define theory as involving "a systematic means of collecting data to describe, explain, and predict nursing practice" (2014, p. 25).

Danhke and Dreher, in their book *Philosophy Of Science For Nursing Practice*, describe theory as "the boldest, most powerful statement made in science" (2016, p. 205). They, however, acknowledge that the concept of theory remains ambiguous in philosophy of nursing science, in terms of what exactly a theory is supposed to entail, e.g., the deterministic structure of the world, or something else entirely. They are nevertheless clear in distinguishing "theoretical knowledge" from "practice knowledge" and argue theoretical knowledge should be de-emphasized as a way to overcome the theory–practice gap. Other scholars have used a similar approach to the problem of theory, science, and nursing knowledge, in suggesting that there are "other" forms of knowledge besides theoretical knowledge that should be accounted for as valid. Barbara Carper's four patterns of nursing knowledge are perhaps the most recognized articulation of this approach. For Carper, "theory" corresponds only to the empirical, scientific pattern of knowing, which aims to generate "knowledge that is systematically organized into general laws and theories for the purpose of describing, explaining and predicating phenomena of special concern to the discipline of nursing" (Carper, 1978, p. 14). Carper argues that theory is not an appropriate structure for the other patterns of knowing—aesthetic, personal, and ethical—because they are expressive and/or actualized in practice, and therefore not amenable to formulation. Similarly, Gortner recognizes that nursing knowledge can be theoretic and non-theoretic; both "nomothetic (that is law-like or general) as well as idiosyncratic (specific to the case)" (parentheses in original, Gortner, 1993, p. 479). Thorne & Sawatzky also argue for "moving beyond the trappings of the theoretical world in which it was assumed that the natural progression of science would lead to the dominance of one theory over others" (2014; p. 2). The move to legitimize knowledge sources other than theoretical does the work of articulating the full scope of nursing knowledge, but at the same time reconstitutes the theory–practice gap, separating practice from science knowledge. Risjord's answer to this is a re-conceptualization of theory based on a refined philosophy of science that is systematically stripped of received view trappings. Risjord redefines theory as a "systematic attempt to answer questions arising from experience … and from other theories" (2010, p. 216) and suggests this new understanding of theory will help overcome the theory–practice gap by allowing theories to "do different things for nursing" (2010, p. 217).

While important, I argue that a continued focus on theory, even a redefined one, may continue to result in an orientation towards nursing science that does not fit the needs of nurses nor nurse scientists. My objective is to turn the focus towards scientific models, a burgeoning field in philosophy of science. Theories and models are not equivalent. Scientific models describe and explain the dynamics of a phenomenon of interest. This is distinct from theory, which is traditionally defined as propositions that specify the relationships between concepts, which are expected to explain and/or predict the world. The philosophical case has already been made against theoretical universalism, showing that a theory can be true in its domain, but that no domain is universal. Subsequently, philosophers focused on scientific models argued that they do the work of defining the boundary conditions—the domain(s)—of a theory. Further analysis has highlighted the ways models can be constructed and function *independent* of theory, meaning that models comprise distinct, autonomous "carriers of scientific knowledge." Models are currently conceptualized as representations of the active dynamics, or mechanisms, of a phenomenon. Mechanisms are entities and activities organized such that they are productive of regular changes. Importantly, mechanisms are by definition not static: change may alter the mechanism and thereby alter or create entirely new phenomena.

Orienting away from theory, and towards models, focuses scholarly activity on dynamics and change. This makes models arguably critical to nursing science and practice, enabling the production of actionable knowledge about the dynamics of process and change in health/care. I argue that models provide a way to elucidate these interdependent dynamics and explain phenomena important to nursing in ways theory has not been able to. An orientation towards models as a primary carrier of nursing knowledge overcomes many ongoing challenges in nursing philosophy of science, including the theory–practice divide and the paradoxical pursuit of predictive theories in a discipline that is defined by process and a commitment to the non-reducibility of the health/care experience. In the following sections, I will flesh out the argument in more detail and briefly explore implications for nursing—and health/care—knowledge and practice.

2 | HOW THEORIES LIE

The "received view" of science is a set of assumptions and definitions about the products of scientific inquiry. It articulates a particular idea of science and was once generally accepted as the standard definition of scientific knowledge. Scientific knowledge in the received view is housed in theory (Suppe, 1972). Theories entail the explanatory accounts of physical systems. Furthermore, the goal of a theoretical account of the world is a move towards more universal accounts of the world, with the pinnacle being "one great scientific theory into which all the intelligible phenomena of nature can be fitted, a unique, complete and deductively closed set of precise statements" (Cartwright, 1999, p. 16). The received view has undergone dismantling in philosophy of science. According to Frederick Suppe, its specific time of death was 26 March 1969, when Carl Hempel, one of the main architects of the received view, publically abandoned it in the opening presentation of the Illinois Symposium of the Structure of Scientific Theories (Suppe, 2000). The fatal flaw of the received view of theories is that it provides no rules for the instances when a theory requires positing terms that do not refer directly to something observable. For example, in the familiar theory $E = mc^2$, the energy that E formalizes does not exist observationally, so there is no way to obtain from one side of the equation to the other without more information; i.e., the theory is underspecified and the received view has no clear philosophical rules to better specify it (Bechtel & Abrahamsen, 2005).

Nancy Cartwright has done much philosophical work to detail this fatal flaw, with the professed goal to "undermine the domination of theory" itself in philosophy of science (Cartwright, Shomar, & Suárez, 1995, p. 138). She first argued, in *How Laws Of Physics Lie* (Cartwright, 1983), that laws of physics are meant to explain, but paradoxically, cannot describe the world: they are not literally true. "If the fundamental laws are true, they should give a correct account of what happens when they are applied in specific circumstances. But they do not. If we follow out their consequences, we generally find that the fundamental laws go wrong; they are put right by the judicious corrections of the applied physicist or the research engineer" (Cartwright, 1983, p. 13). This "approximation" of laws in practice means they are literally not true: they do not directly govern objects in reality. And if one needs to endlessly addend and tinker with laws to get them them to play out in reality, the question Cartwright asks is, why bother with laws at all?

Cartwright goes further in her book *The Dappled World: A Case Study Of The Boundaries Of Science* (Cartwright, 1999), in which the lie exposed this time is "the system," i.e., not just theoretical laws themselves, but the entire apparatus that conceives of theories as reducible to more fundamental domains in a hierarchical pyramid, with physical laws the top and psychology theories on the bottom (as visualized by Cartwright, 1999; figure on page 17). Cartwright analyses these so-called, top-of-pyramid laws and shows how they actually are very limited in scope; that many of the phenomenon of the everyday world do not fall "under" the laws. She uses the dramatic example of a dollar bill whirling around in a city square to illustrate the fact that there is not a law of physics that can predict its path. She argues that the impressive success of a small minority of premiere scientific theories in multiple domains does not authorize an assumption that ALL theories are as universal. Instead, Cartwright (1999) shows that what is actually occurring in much theory testing is that we are manipulating our world as much as possible to make the theory manifest as predictive: we are producing worlds to fit a theory, not predicting the world deductively from any theory. She compares the dollar bill with an airplane to illustrate: airplanes exist the way they do in the world because we have constructed them very carefully and diligently to fit the theories we have at hand. But we are still "hunting" for a theory that fits the phenomenon of the whirling dollar bill. To argue that the theories we have "in principle" just need to be "worked out more" to produce the predicted path of the dollar bill is, according to Cartwright, an expression of fundamentalist faith and not a philosophical argument (Cartwright, 1999).

Having shown that top-level theories do not govern even a major portion of the world, let alone all of it, Cartwright argues for a "dappled world," in which the world is governed in different domains by different theories that are not necessarily related to each other in any uniform way (1999). She concludes that we can argue for the truth of some very concrete, context-constrained claims and that this is accomplished only by delineating the circumstances, in what she calls models, in which the claims manifest. This is in direct opposition to (1) the universality of theory assumption, and (2) the hierarchy of theories assumption, in which the goal is to subsume all "lower" theories into one abstract all-encompassing "theory of everything."

3 | THE WORLD CONSISTS OF PHENOMENA, NOT OBJECTS

Cartwright's description of circumstances and conditions that when appropriately defined allow for theories to manifest is a description of a contextually bounded phenomenon, rather than a context-free object: a dollar bill swirling in a city square vs. a dollar bill. This is a major conceptual advance in philosophy of science; the move away from *objects* as the focus of scientific inquiry and towards *phenomena*. As Karen Barad explains in her book *Meeting The Universe Halfway: Quantum Physics And The Entanglement Of Matter And Meaning* (2007), ontological units have traditionally been defined as independent objects with determinate boundaries and properties. More recent conceptualizations understand units of inquiry as phenomena. Barad (2007) explains how this emerged in physics with the long-standing debate about the nature of light: whether it was a wave or a particle. Experiments indicated that light manifests as particle-like under one set of experimental conditions and wave-like under a different set of conditions. Furthermore, these dual results were consistent and reproducible; one experiment repeatedly manifested wave behaviour, while the other repeatedly manifested particle behaviour. Niels Bohr, Nobel prize-winning physicist, set about finding a logically coherent explanation for these findings. As Barad (2007) describes, he called into question prior assumptions that the world is composed of individual objects with determinate boundaries whose properties are independent of context. Bohr believed that quantum physics disproved these assumptions and used the term "phenomenon" to designate the particular instances of wholeness that quantum physics made apparent. He advocated that the word phenomenon "exclusively to refer to the observations obtained under specific circumstances, including an account of the whole experimental arrangement" (Bohr 1963B, in Barad, 2007, p. 81). A phenomenon includes all that is necessary to observe *and* explain a consistent result.

The concept of phenomenon as including more than an independent object did the work of resolving the wave-particle duality paradox. The terms "wave" and "particle" were shown to refer to classical concepts that are in actuality only given determinate meanings by different, indeed mutually exclusive arrangements (i.e., experimental conditions), and therefore refer to different mutually exclusive *phenomena*, not to independent physical objects (Barad, 2007). What Bohr made clear was that there is no "Godlike approach possible to the physical world whereby we may know it as it is 'absolutely in itself;' rather we are able to know only as much of it as can be captured in those situations where unambiguous communication of the result is possible. This is in complete contrast to the classical realist metaphysics where the world is concerned as being the way classical theory says it is, independently of our experimental exploration of it" (Hooker, 1972, in Barad, 2007, p. 87).

4 | MODELS HAVE THE CAPACITY TO REPRESENT PHENOMENA

The question then remains, how can we house the knowledge embedded in "observations obtained under specific circumstances, including an account of the whole experimental arrangement?" Theory does not have the infrastructure to accommodate context and the "whole experimental arrangement." What *can* do this work is models, although this idea is only recently becoming more understood and accepted. In 1945, Rosenblueth and Wiener defined models as surrogates: a similar but simpler construction of a part of the universe under inquiry. Models were necessary because "no substantial part of the universe is so simple that it can be grasped without abstraction" (Rosenblueth & Wiener, 1945, p. 316). Rosenblueth and Wiener (1945) argued that when scientists are inquiring into a phenomenon, but do not yet have a theory to test (i.e., they have no pre-existing knowledge), they construct a model to obtain access to the phenomenon as a way of examining it. Models are material, in that they are constructed systems (say, for example, an animal model for studying neuronal development) that are simpler than the phenomenon of inquiry (say, human brain development) but has some of the same properties (say, neuronal synapses). These models allow for easier experimentation and, critically, provide a window into the unknown.

In the semantic view of theories, which came of age in the 1970–1980s, models were promoted to the same level as theory, meaning that they not only aided discovery, but comprised part of the discovery product—knowledge—as well (Suppe, 1972; 2000). Frederick Suppe claims models are the heart of scientific experimentation, much as Rosenblueth and Wiener did in 1945 and Mary Hesse did in 1953 when she defined models as the formal structures used by scientists to ask and answer questions about a phenomenon as the pathway to theory, i.e., models as the tools of scientific discovery (Hesse, 1953). Suppe, however, makes an important philosophical move by *not* relegating models to tools that can or should be put away when the product is finally completed, i.e., after knowledge encased in theory has been produced (Suppe, 1972; 2000). Suppe defines models as vehicles *of*, as well as for, scientific knowledge. Progenitors of the semantic view proposed models as a way of characterizing theory, as a realization in which the theory is satisfied. The entire argument is complex (see, for example, Giere, 2004; Suppe, 2000), and not relevant to the current argument, but was instrumental in showing that models were an essential "piece" of scientific knowledge, and more than a tool to obtain to scientific knowledge.

Morrison and Morgan's edited book *Models As Mediators* (1999) did the work of elucidating the nature of models as an essential "piece" of scientific knowledge. They confirm the view already described above that models can be constructed without the use of existing theory. They also confirm that models are tools of investigation for exploring processes for which there are no theoretical accounts or rules. They also foreground the important point that models are not situated in the middle of a hierarchical structure between theory and the world: they are partially independent from both, and therefore not fixed into any hierarchical configuration. Models-in-use can and do provide *explanations* of the behaviour of the phenomenon being modelled, even without it being a faithful "reproduction" of that phenomenon. This is important because it shows how learning from models-in-use is a path towards understanding possibilities, which is different than what a theory does, which is predicting certainties (Morrison & Morgan, 1999).

Godfrey-Smith furthers the argument by proposing model-based research as an entirely distinct, and valid, approach to understanding the world, one that is currently being used primarily in biology, psychology, and social sciences (Godfrey-Smith, 2006). Godfrey-Smith defines the modeller's strategy as gaining understanding of a complex system, via an understanding of simpler, hypothetical system that resembles it in relevant aspects. This strategy drives a specific kind of analysis that is different from theory testing. It allows for different models to be constructed that represent different behaviours producing the same outcomes. Godfrey-Smith (2006) uses the example of Levin's evolutionary models: he constructed three different models that all generate the consistent outcome of polymorphism of species in uncertain environments. The analysis involved tracing the similarities and differences of processes across the models. The result was not a confirmation of any particular arrangement over another, but rather an examination of possibilities that emerge based on the processes at play, i.e., a scientific method for predicting the future world that does not involve theoretical assumptions of stasis and universality. It is through this work that Godfrey-Smith argues model-based science is a distinct form of science, functioning as a unique "currency" of explanation (2006).

To summarize briefly, the traditional structure of scientific knowledge is theory. This view has undergone extensive philosophical analyses over the years. Cartwright, as well as others, has convincingly argued that theories do not do the work of knowledgably representing the world and that there is no hierarchy of theories, moving from limited predictive capacity to all-encompassing predictive capacity. What theories offer are rules, and as Cartwright showed, the work is to create circumstances where the rules apply (1983). Furthermore, it is this collection of rules and circumstances and their specific arrangements that comprise the phenomena of the world, which is saying something quite different than discrete, independent objects comprise the world, with theories expressing the rules that apply to these objects no matter where they are or how they are accessed. This is what quantum physics and the wave-particle paradox taught us. In terms of phenomena, there are (many, if not most) phenomena where existing theory just does not apply, for example a dollar bill swirling around a city square. When this is the case, how do we obtain knowledge about these phenomena? The answer is, through models. Models are instruments, tools, investigatory devices, that function to generate understanding of a phenomenon. Over time, it has become recognized that models both constitute *and are constitutive* of knowledge. Models can function independent of theory, yet still provide meaningful and actionable accounts of phenomena of interest.

5 | THE STRUCTURE OF KNOWLEDGE CONSTITUTED IN MODELS

The question remains, what form of knowledge do models constitute, as it is by now apparent it is not theoretical knowledge? Bechtel and Abrahamsen, philosophers of biological science, claim models describe or portray what are taken to be relevant component parts and operations of a phenomenon (Bechtel & Abrahamsen, 2005). Model construction and use is about identifying the "working parts" of a phenomenon. These working parts have been extensively elaborated by Machamer, Darden, and Craver, in their highly influential paper *Thinking about Mechanisms* (2000), which argued that the main activity of neurobiology and molecular biology science is the discovery and description of mechanisms. They define mechanisms as "entities and activities organized such that they are productive of regular changes from start or set-up to finish or terminal conditions" (Machamer, Darden, & Craver, 2000, p. 3). To give a description of a mechanism is to explain how a phenomenon is produced, which is housed in models and constitutes biological knowledge (Bechtel & Abrahamsen, 2005). Mechanisms are comprised of entities and activities (Machamer et al., 2000). Activities produce change and entities are what are engaged in activities. The organization of the entities and activities determines how they produce the phenomenon. Machamer et al. (2000) use the example of chemical transmission at synapses to illustrate. Entities include the cell membrane and ions. The activities include the opening of pores in the cell membrane through a rotation of specific cell membrane proteins, and ions moving through the pores into the cell. The result of this is depolarization. The regularity of mechanisms, such as depolarization, is related to a specific structuring and orientation of entities that are engaged in activities that have a temporal rate, order, and duration. This means, it is not enough to describe the entities and activities to explain a phenomenon; one must also explain the bounding states or conditions that produce the regularity. For depolarization, this includes the initial charge distributions inside and outside the cell, the particular kinds of proteins in the cell membrane, temperature, pH, and presence or absence of specific pharmacological agonists of antagonists (Machamer et al., 2000).

It is important to note that "causal laws" do not drive the regularity of mechanisms. Machamer et al. (2000) explicitly state that biological science is a search for mechanisms, rather than a search for laws. The search is not for static properties, but for functional properties that are defined as the activities by virtue of which entities contribute to the workings of a mechanism. Importantly, functions can change. They are not fixed properties of the entity or activity; they are what happen when the entities and activities are *organized in just such a way* to produce a regular outcome. Change the orientation or rate of a mechanism's activities and entities; then, there is every reason to expect the functionality of each can change and produce different results. *There is no determinacy in mechanisms, therefore the rejection of causal laws* (Machamer et al., 2000).

This is the reason models are *necessarily* different than theory; what counts as mechanism can and does change over time. As entities and activities change, or the conditions in which entities and activities function, so will the products, leading to the discovery of new functions and functionality, or entities and activities, and potentially new phenomena entirely. As a very blunt example, neurons meet at synapses, where morphological changes associated with chemical release result in regular neuronal signalling. However, changes to either entities, such as a receptor, or activities, such as neurotransmitter release, can result in something completely different than typical neuronal signalling, potentially producing the drastically different phenomena of bipolar disease: same parts, different functions, different phenomena.

Models of mechanisms, as opposed to theories, have the capacity to describe how possibly, how plausibly, and how actually (Machamer et al., 2000). Importantly, the possible and plausible explanations can provide elucidation about which entities and activities engage each other and under what conditions. They provide "intelligibility" in showing how phenomena might be produced. Intelligibility, in mechanistic science, is not reducible to a mechanism's regularity. The regularities are a product, not a cause of the explanatory mechanism (Machamer et al., 2000). This means regularity, or objectivity as Bohr defined it, is not an assumed, or defining, trait of mechanistic knowledge.

6 | MODELS AS THE FOUNDATION OF A PHILOSOPHY OF NURSING SCIENCE

This paper started with a description of the current philosophy of nursing science, which has been unable to solve the continued problem of theory; specifically, the continued assumption that scientific knowledge is housed in theories, and the acknowledgement that much nursing practice knowledge does not "fit" into theory. I argue that the introduction of models as a structure of nursing knowledge is one solution that is based on a solid philosophical foundation and has the capacity to generate knowledge that aligns with nursing's commitment to the non-reducibility of the health/care experience, while offering actionable explanations that can be used to shape phenomena in desired ways. Models represent phenomena, which are specific arrangements in the world. This is saying something quite different than the world is comprised of discrete, independent objects, with theories expressing the rules that apply to these objects no matter where they are or how they are accessed. I have argued that theories do not have the appropriate structure to elucidate the complexity of phenomena, but that models do. Models represent the dynamics, or mechanisms, of phenomena. Mechanisms are comprised of entities and activities. Activities produce change and entities are what are engaged in activities. Mechanisms produce regular change depending on the bounding conditions, and this information is included in models: the specific arrangements of the world. Importantly, arrangements can and do change, and they are not fixed properties; they only occur when the entities and activities are organized in just such a way to produce a regular outcome. Change the orientation or rate of a mechanism's activities and/or entities; then, there is every reason to expect the functionality of each can change and produce different results, even different phenomena. *There is no determinacy in mechanisms, therefore the rejection of causal laws*.

Models provide elucidation about which entities and activities engage each other and under what conditions. They provide knowledge about how phenomena might be produced, without assuming that phenomena are produced the same way no matter the conditions. This is arguably *the* critical advantage of models over theory for nursing knowledge; in the fast paced and dynamic world of health care, it can be argued that predicting certainties is a futile undertaking, whereas exploring possibilities through modelling is the correct path for guiding action. Models allow researchers *and practitioners* to both construct workable systems for knowledge generation, as well as draw meaningful conclusion about the systems that can be directly applied to the phenomenon of inquiry. This is important because currently much nursing and health problems worth examining are complex phenomenon that are not static, yet still require explanation and action, for example maintaining optimal health with chronic health conditions. There is no and there will never be one objective theory of heart failure: it exists codependently with other disease states, manifests differently depending on a person's characteristics or the environment, and changes functionally over time as new medicines and treatments are discovered. Models can help to map this diversity and explore potential avenues for intervention, without assuming any single manipulation will produce consistent change.

7 | AN EXAMPLE: MODELS DISGUISED AS MIDDLE-RANGE THEORY

Middle-range theories became popular in the 1990s in nursing. Authors describing middle-range theory typically base their definition on Robert Merton's; "theories of the middle range [are] theories that lie between the minor but necessary working hypotheses that evolve in abundance during day-to-day research and the all-inclusive systematic efforts to develop a unified theory that will explain all the observed uniformities of social behavior, social organizations, and social change" (Merton, 1949/2012, p. 531). Peterson and Bredow further define middle-range theory as: having a narrow scope; concerned with specific phenomena rather than generalities; and are directly applicable to practice (2017). Liehr and Smith uphold Merton's hierarchical nature of middle-range theory, placing it at a level "not too broad nor too narrow, but somewhere in the middle" (Liehr & Smith, 1999, p. 85).

Interestingly, Frederick Suppe collaborated with nurse scientists to promote middle-range theory, which was articulated in their 1995 paper *Collaborative Development Of Middle Range Theories: Toward A Theory Of Unpleasant Symptoms* (1995). They explicitly note that their theory is based on the "adequacy of its empirical foundations and is not simply a matter of its scope or level of abstraction" (Lenz, Suppe, Gift, Pugh, & Milligan, 1995, p. 2). It begins with "extensive practice-based observations" (Lenz et al., 1995, p. 6) to analyse concepts, which are described at the level of their components and the mechanisms by which the components interact to produce the phenomenon of interest. Risjord highlights the fact that the authors specifically *reject* Merton's conception of middle-range theory and articulate a different sort of theory—confusingly, with the same name—that was to replace the entire hierarchical "enterprise" of theorizing (Risjord, 2010). Lenz, Suppe, and colleagues promoted middle-range theory as "the direction for future nursing knowledge development efforts. They are not esoteric; they are understandable and useful. These theories are best developed not in an ivory tower, but by clinically knowledgeable and involved researchers working collaboratively" (Lenz et al., 1995, p. 12). Their theory of unpleasant symptoms includes three categories of variables—physiologic, psychologic and situational—that interact with each other in numerous ways, producing diverse experiences of unpleasant symptoms. The theory aims to show how people with the same physiological alteration can exhibit tremendous variation in the experience of their symptoms (Lenz, Pugh, Milligan, Gift, & Suppe, 1997). The authors note that their middle-range theory "forces us to confront the fact that unidimensional measurement of unpleasant symptoms is unpromising, because these concepts are multidimensional, and the conceptualizations often overlap" (Lenz et al., 1999, p. 22).

Risjord conducts an interesting analysis of the 1995 paper (Lenz et al., 1995) and concludes that Lenz, Suppe, and colleagues "were recommending that nursing science focus on the development of substantive models of phenomena relevant to nursing. In retrospect, calling these models "middle range theories' was a tactical error. It permitted their work to be assimilated into the existing philosophical framework, rather than appreciated as a radical transformation of nursing science" (Risjord, 2010, p. 143). Risjord concludes that the theory of unpleasant symptoms is actually a *model* of unpleasant symptoms. The arguments in this paper align with this conceptualization. Lenz et al. (1997) were explicit in stating their goal was to identify the mechanisms that influence symptom expression, assuming that the same factors can and do interact with each other to produce different outcomes, depending on what interactions occur and the intensity and duration of these interactions. They are also explicit in noting that a person's experience of symptoms can change the state of the factors involved, leading to different interactions and thus altered experiences of symptoms. The authors emphasize the benefits of this conceptualization of symptomology, which allows for clinically relevant action: "the inclusion of multiple influencing factors makes the theory of unpleasant symptoms particularly valuable for individualizing interventions to fit the patient's characteristics and unique patterns of symptoms" (Lenz et al., 1997, p. 23).

This statement is illuminating. It articulates quite specifically the benefit of a *model* that identifies components of a phenomenon of interest and elucidates how they can potentially interact to produce diverse instances of symptomology. This is in contrast to a theory that proposes an explanation of the concepts involved in symptom expression. Lenz and colleagues conclude that the model/theory "provides a structure for beginning to determine the extent of overlap among symptoms and does so at a level … commensurate with nursing diagnoses and interventions" (Lenz et al., 1997, p. 25). This means, the model provides intelligibility in showing how phenomena might be produced; i.e., the model provides a scientific method for predicting a future world that does not involve theoretical assumptions of determinacy or universality, yet still provides meaningful conclusions that can be directly applied to the phenomenon of inquiry. In summary, models provide a window into nursing phenomenon that are both scientific and actionable and conceivably can do much of the work overcoming the theory–practice gap in philosophy of nursing science.

8 | CONCLUSION

In conclusion, I have put forth an argument that models are an appropriate structure for nursing knowledge and conceivably comprise a more robust and actionable structure than theory. Models constitute and are constitutive of scientific knowledge. Models represent the dynamics, or mechanisms, of phenomena, yet are not deterministic or reductive. Models are uniquely capable of describing and explaining the dynamics of process and change in health/care, which arguably are the core phenomena of the nursing discipline. A nursing orientation towards models can produce a dynamic yet rigorous philosophical account of what nursing knowledge is and how it can be obtained. This in turn can drive knowledge production that meaningfully impacts the nursing discipline specifically, and the healthcare field more generally, over time.

ACKNOWLEDGEMENTS

The author would like to acknowledge Martha Feldman, Deborah Lefkowitz, and the University of California Irvine's Practice Theory Reading Group, led by Martha Feldman, Johnson Chair for Civic Governance and Public Management, for their intellectual support and guidance over the years. The author would also like to acknowledge Kyle Stanford, professor of philosophy at UCI, and Bennett Holman, assistant professor at Yonsei University, for extremely helpful conversations. The author would also like to acknowledge all the doctoral students taking UCI NS212 course: Philosophy of Science, for their engagement with the course materials, which inspires me to write.

ORCID

Miriam Bender http://orcid.org/0000-0003-2457-1652

REFERENCES

Barad, K. (2007). *Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning*. Durham, NC: Duke University Press.

Bechtel, W., & Abrahamsen, A. (2005). Explanation: A mechanist alternative. *Studies in History and Philosophy of Biological and Biomedical Sciences*, *36*(2), 421–441.

Bluhm, R. L. (2014). The (dis)unity of nursing science. *Nursing Philosophy*, *15*(4), 250–260. https://doi.org/10.1111/nup.12062

Carper, B. (1978). Fundamental patterns of knowing in nursing. *Advances in Nursing Science*, *1*(1), 13–23.

Cartwright, N. (1983). *How the laws of physics lie*. Oxford: Oxford University Press.

Cartwright, N. (1999). *The dappled world: A study of the boundaries of science*. Cambridge: Cambridge University Press.

Cartwright, N., Shomar, T., & Suárez, M. (1995). The tool box of science: Tools for the building of models with a superconductivity example. *Poznan Studies in thePhilosophy of the Sciences ans the Humanities*, *44*, 137–149.

Dahnke, M. D., & Dreher, H. M. (2016). *Philosophy of science for nursing practice: Concepts and application*. New York, NY: Springer Publishing Company.

Fawcett, J., & Desanto-Madeya, S. (2013). *Contemporary nursing knowledge: Analysis and evaluation of nursing models and theories* (3rd ed.) Philadelphia, PA: F. A. Davis Company.

Giere, R. N. (2004). How models are used to represent reality. *Philosophy of Science*, *7*, 742–752.

Godfrey-Smith, P. (2006). The strategy of model-based science. *Biology and Philosophy*, *21*, 725–740.

Gortner, S. R. (1993). Nursing's syntax revisited: A critique of philosophies said to influence nursing theories. *International Journal of Nursing Studies*, *30*(6), 477–488.

Gortner, S. R. (2000). Knowledge development in nursing: Our historical roots and future opportunities. *Nursing Outlook*, *48*, 60–67. https://doi.org/10.1067/mno.2000.106115

Hesse, M. B. (1953). Models in physics. *The British Journal for the Philosophy of Science*, *4*(15), 198–214.

Lenz, E. R., Pugh, L. C., Milligan, R. A., Gift, A., & Suppe, F. (1997). The middle-range theory of unpleasant symptoms: An update. *Advances in Nursing Science*, *19*(3), 14–27.

Lenz, E. R., Suppe, F., Gift, A. G., Pugh, L. C., & Milligan, R. A. (1995). Collaborative development of middle-range nursing theories: Toward a theory of unpleasant symptoms. *Advances in Nursing Science*, *17*(3), 1–13.

Liehr, P., & Smith, M. J. (1999). Middle range theory: Spinning research and practice to create knowledge for the new millennium. *Advances in Nursing Science*, *21*(4), 81–91.

Machamer, P., Darden, L., & Craver, C. F. (2000). Thinking about mechanisms. *Philosophy of Science*, *67*, 1–25.

McEwen, M., & Wills, E. M. (2014). *Theoretical basis for nursing* (4th ed.) Philadelphia, PA: Wolters Kluwer Health/Lippincott Williams & Wilkins.

Merton, R. (1949, 2012). On sociological theories of the middle range. Chapter 39. In C. Calhoun (Ed.), *Classical sociological theory* (pp. 351–542). Hoboken, NJ: John Wiley & Sons.

Morgan, M. S., & Morrison, M. (Eds.) (1999). *Models as mediators: Perspectives on natural and social science*, vol. *52*. Cambridge, UK: Cambridge University Press.

Morse, J. M. (2016). *Analyzing and constructing the conceptual and theoretical foundations of nursing*. Philadelphia, PA: FADavis.

Peterson, S. J., & Bredow, T. S. (Eds.). (2017). *Middle range theories: Application to nursing research*. Philadelphia, PA: Lippincott Williams & Wilkins.

Risjord, M. (2010). *Nursing knowledge: Science, practice, and philosophy*. London: John Wiley & Sons.

Rosenblueth, A., & Wiener, N. (1945). The role of models in science. *Philosophy of Science*, *12*(4), 316–321.

Roy, C. (1983). Theory development in nursing: Proposal for direction. In N. L. Chaska (Ed.), *The nursing profession: A time to speak* (pp. 453–467). New York, NY: McGraw-Hill.

Schumacher, K. L., & Gortner, S. R. (1992). (Mis)conceptions and reconceptions about traditional science. *Advances in Nursing Science*, *14*(4), 1–11.

Suppe, F. (1972). What's wrong with the received view on the structure of scientific theories? *Philosophy of Science*, *39*(1), 1–19.

Suppe, F. (2000). Understanding scientific theories: An assessment of developments, 1969–1998. *Philosophy of Science*, *67*(2000), S102–S115.

Thorne, S. (2011). Toward methodological emancipation in applied health research. *Qualitative Health Research*, *21*(4), 443–453. https://doi.org/10.1177/1049732310392595

Thorne, S. (2015). Does nursing represent a unique angle of vision? If so, what is it? *Nursing Inquiry*, *22*(4), 283–284. https://doi.org/10.1111/nin.12128

Thorne, S., & Sawatzky, R. (2014). Particularizing the general. *Advances in Nursing Science*, *37*(1), 5–18. https://doi.org/10.1097/ANS.0000000000000011

How to cite this article: Bender M. Models versus theories as a primary carrier of nursing knowledge: A philosophical argument. *Nurs Philos*. 2017;e12198. https://doi.org/10.1111/nup.12198