SCIENCE AND RELIGION AS LANGUAGES: UNDERSTANDING THE SCIENCE–RELIGION RELATIONSHIP USING METAPHORS, ANALOGIES, AND MODELS

by Amy H. Lee

Abstract. Many scholars often use the terms "metaphors," "analogies," and "models" interchangeably and inadvertently overlook the uniqueness of each word. According to recent cognitive studies, the three terms involve distinct cognitive processes using features from a familiar concept and applying them to an abstract, complicated concept. In the field of science and religion, there have been various objects or ideas used as metaphors, analogies, or models to describe the science–religion relationship. Although these heuristic tools provided some understanding of the complex interaction, they failed to address the broad nature of science and religion as well as the multifarious relationship between the two in a sociocultural context. Unlike the previous candidates, the concept of language, including the notions of linguistic worldview, linguistic identity, dialects, power, and bilingualism, offers a unique and comprehensive window through which science, religion, and the relationship between the two are seen with clarity.

Keywords: analogy; bilingualism; cognitive science; language; mapping; metaphor; model; religion; science

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The definitions of the terms "metaphors," "analogies," and "models" vary not only across disciplines but also across diverse schools of thought in the same field of study. For instance, a model in mathematics refers to a set of equations that describe relationships between variables, but a model in fine arts commonly denotes a miniature version of a larger structure that an artist hopes to build. Similarly, the definition of a metaphor is a topic of debate among scholars in the field of linguistics. Some argue that a metaphor is the same as a simile, only different in form, while others say that a metaphor is entirely different from a simile because the two

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are processed separately. Raymond W. Gibbs even calls this debate the "metaphor war" (Gibbs 2017). Janet Soskice estimates that more than 125 definitions of metaphor have been proposed (Soskice 1985, 15). Given the diverse meanings and uses of the terms, various scholars employ them without any consensus on precise definitions. Although some treat these words as synonyms, others emphasize their dissimilarities.

Unfortunately, the situation in the field of science and religion is not too different. Although the use of the terms "metaphors," "analogies," and "models" is one of the most intriguing similarities between science and religion, they are often used interchangeably. For instance, Alister McGrath (2010, 106) uses the terms "analogies" and "models" both to imply the notion of illuminating certain aspects of one's understanding of a particular subject; Stephen Jay Gould (2001, 102) refers the antagonistic relationship of science and religion as either the warfare model or metaphor. However, there are some scholars such as Ian Barbour who acknowledge the importance of distinguishing between metaphors, analogies, and models.

Considering the blurry boundaries between the three terms, is there any change of meaning by describing a representation of science and religion relationship as metaphors, analogies, or models? It is impossible to answer these questions unless the terms "metaphors," "analogies," and "models" are clearly defined. In this article, I argue that there are critical differences between metaphors, analogies, and models in terms of their nature and function. I begin the discussion by outlining a few attempts in the past to analyze and distinguish metaphors, analogies, and models. Despite being theoretical, these approaches stress that the three operations have contrasting properties. The recent development in cognitive science provides a rich resource for understanding how metaphors, analogies, and models are processed separately in thought. Although these terms underscore the process of finding correspondences between the source and the target domain, they exhibit significant variances in their processing mechanism and function. Applying the cognitive view of the terms into the field of science and religion, I propose that selecting an appropriate source domain to represent the complex science–religion relationship is the actual challenge. Among different source candidates suggested by various scholars, I argue that language is the best candidate for generating creative, nuanced views about science, religion, and their interrelation.

The Past Approaches in Differentiating Metaphors, Analogies, and Models

Many scholars devote their studies to focus on metaphors, analogies, and models. But there is only a handful of scholars examining them separately and investigating how they are related to one another. This section reviews the works of three scholars—namely, Max Black, Ian Barbour, and Daniela

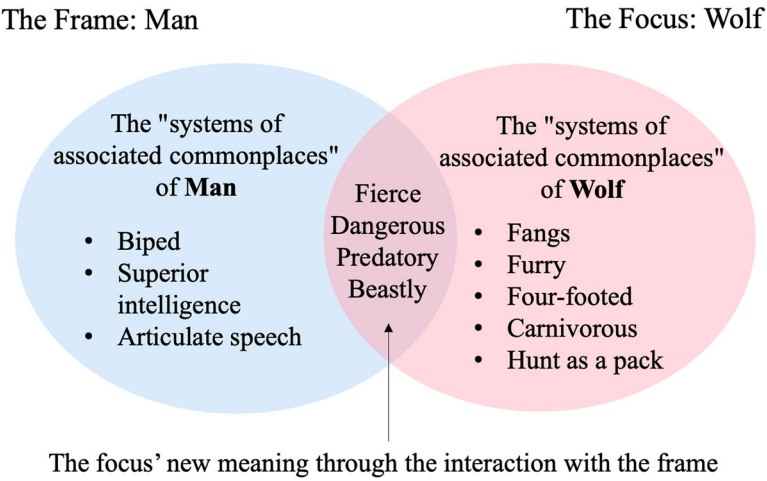


Figure 1. Black's interaction theory of metaphor illustrated with the example, "man is a wolf."

M. Bailer-Jones—to uncover their approaches in understanding the distinct properties of metaphors, analogies, models, and the interconnection between these terms.

In his theory of metaphor, Max Black argues that metaphors and models are different in terms of their degree of complexity and that analogies serve as the foundation to metaphors and models. In "Metaphor" (1955) and *Models and Metaphors* (1962), Black defines a metaphor as a filter or a frame that allows the subsidiary subject to be projected upon the principal subject, thereby acquiring a new, nonexpendable meaning. Rejecting the traditional "substitution" view, which suggests that metaphors can be translated or reduced to literal terms without a loss of the cognitive content (A is B = A is like B), Black explains that a metaphor works by interacting the "systems of associated commonplaces" or domains of A and B (Black 1955, 291; see Figure 1). During the interaction between two subjects, Black contends that the metaphor "selects, emphasizes, suppresses, and organizes features of the principal subject [B] by implying statements about it that normally apply to the subsidiary subject [A]" (Black 1955, 291–92).

In *Models and Metaphors,* Black characterizes a model as similar to a metaphor. He expounds that models, especially ones used in science, are related to metaphors in that they facilitate the understanding of the object of study by interacting with a more familiar subject. Summarizing Black's view of scientific models, Douglas Odegard writes that

> the purpose of using such models is not simply to facilitate visualizing, or to compensate for an inability to handle abstract concepts, or to provide a flowery means of exposition, but, rather, is to introduce something (objects,

> structures, and so on) the properties of which are *better known* to the investigator (as a layman *or* as a scientist) than those of the original object of study, thus enabling him to draw tentative inferences and to form testable hypotheses about the latter. (Odegard 1964, 351)

Although Odegard's comment focuses on scientific theoretical models, Black argues that any mental model aids one's understanding of the less familiar subject through the interaction between two domains.

Although Black maintains that both models and metaphors achieve the same effect in facilitating one's understanding, he distinguishes a model from a metaphor chiefly on the ground that the former has a systematic and sophisticated method of application to the original subject (Black 1962). In the 1977 article "More about Metaphor," Black explains the close relationship between metaphors and models:

> I am now impressed, as I was insufficiently when composing *Metaphor,* by the tight connections between the notions of models and metaphors. Every implication-complex supported by a metaphor's secondary subject, I now think, is a *model* of the ascriptions imputed to the primary subject: every metaphor is the tip of a submerged model. (Black [1977] 1993, 30)

By alluding to a metaphor as the tip of a model, Black asserts that a model structures one's view of reality in ways which one metaphor may not immediately reveal (Black 1962). In other words, a metaphor, which transfers ideas from one context to another, is only a fraction of the complex underlying system of implications called a model (Bailer-Jones 2002, 124).

If Black sees metaphor as a part of the structured system called a model, what about an analogy? Although he does not explicitly define analogy, he often uses it to denote an obvious and salient resemblance or similarity. Rejecting the idea that a metaphor and an analogy are merely different in form, Black insists that analogies that pinpoint similarities and dissimilarities between two domains form the basis of a metaphor. He states, "to suppose that the metaphorical statement is an abstract or précis of a literal point-by-point comparison, in which the primary and secondary subjects are juxtaposed for the sake of noting dissimilarities as well as similarities, is to misconstrue the function of a metaphor" (Black [1977] 1993, 30–31). In summary, Black considers a metaphor to be rooted in analogies, which allude to the one-to-one correspondences, while many metaphors construct a complex system of inferences called a model.

Another scholar who draws distinctions between models, metaphors, and analogies is Ian Barbour. Influenced by Max Black's philosophy, Barbour examines how each term is used in the field of science and religion and identifies them in different categories of thought. In *Myths*, *Models*, *and Paradigms*, Barbour sees models as mental concepts that systematically structure and help interpret the world. After examining the roles of the models in various disciplines, Barbour argues that models in science are

"mental constructs devised to account for observed phenomena in the natural world" (Barbour 1974, 6). He also highlights that "[t]hey are neither literal pictures of reality nor 'useful fictions,' but partial and provisional ways of imagining what is not observable." Moreover, he states that scientific models are symbolic representations of aspects of the world that are not directly accessible to us (Barbour 1974, 7). Religious models are very similar to scientific models in that they are neither accurate pictures of reality nor useful fictions. Barbour argues that religious models used as organizing images order and interpret patterns of human experience, especially those associated with awe, reverence, moral obligation, reorientation, reconciliation, interpersonal relationship, key historical events, order, and creativity (Barbour 1974, 7). For Barbour, scientific and religious models differ in that the former deciphers observations and the latter interprets experiences including attitudes, but both ultimately direct attention to particular patterns of events and restructure the way one sees the world (Barbour 1974, 7).[1]

Barbour also characterizes an analogy as the process of comparison and contrast that is essential for the construction of both metaphors and models. He claims that models "originate in a combination of analogy to the familiar and creative imagination in the invention of the new" and that metaphors "[propose] analogies between the normal context of a word and a new context into which it is introduced" (Barbour 1974, 6, 12). Although he does not explicitly define the term "analogy," Barbour is using "analogy" to convey the idea of pointing out the similarities and differences between the two juxtaposed objects or contexts.[2]

Finally, Barbour proposes that metaphors are dynamic actions triggering open-ended transfers of ideas. Drawing on Black's theory of metaphor, Barbour describes that a metaphor undergoes a highly selective transfer of some of the familiar associations of a word that produces and presents ideas that are and should not be interpreted literally (Barbour 1974, 12). Barbour explains that a metaphor employs both *positive* analogy focusing on similarities and *negative* analogy concentrating on the differences and invites the reader to the discovery of an unspecifiable number of potential interpretations (Barbour 1974, 14). In other words, a metaphor has no limit as to how far the comparison might be extended and is, therefore, irreducible to a set of literal statements (Barbour 1974, 14, 42). Moreover, Barbour sets apart metaphors from scientific models, articulating that metaphors are used momentarily, whereas models are systematically developed and represent the enduring, but often static, structural components of the physical world (Barbour 1974, 27). He also insists that metaphors, unlike scientific models, evoke many types of personal experiences, including emotional and valuational responses (Barbour 1974, 44). However, this point is not valid when compared with religious models because they express attitudes and assume subjective overtones.

Overall, Barbour understands models as systematically developed and prevailing mental constructs, analogies as the mental processes of compare and contrast, and metaphors as the active explorations of analogies between two frames of reference. Moreover, he argues that analogies help metaphors and models to create and communicate new meaning. Although Barbour underscores that models, analogies, and metaphors are closely related, he presents them differently by alluding to how they are developed and used.

So far, both Black and Barbour underline that metaphors and models are rooted in analogies, which compare features of two things. In addition, they advocate that models are systematic and structured. However, the philosopher Daniela M. Bailer-Jones does not share Black and Barbour's views. Unlike the two previous scholars who center their argument around analogical thinking that serves as the basis of metaphors and models, Bailer-Jones focuses on the purpose of each term in the field of science (Bailer-Jones 2002).

A model, according to Bailer-Jones, is "an interpretative description of a phenomenon that facilitates access to that phenomenon" (Bailer-Jones 2002, 108). In this definition, the phenomenon is always empirical (both objects and processes), and the access can be perceptual or intellectual. By "facilitating access," Bailer-Jones means focusing on specific aspects of a phenomenon while deliberately disregarding others. Consequently, she contends that the interpretative descriptions set forth by a model are partial (Bailer-Jones 2002, 109). But the essential feature stressed by this definition is the purpose of a model: to describe an empirical phenomenon.

Bailer-Jones defines a metaphor as "a linguistic expression in which at least one part of the expression is transferred from one domain of application (source domain), where it is common, to another (target domain) in which it is unusual, or was probably unusual at an earlier time when it might have been new" (Bailer-Jones 2002, 114). According to this definition, the primary purpose of a metaphor is to express certain aspects of the target domain using suitable vocabularies presented by the source domain. For Bailer-Jones, a model can be a metaphor if the transfer from one field to another assists the purpose of the model—that is, to interpret an empirical phenomenon (Bailer-Jones 2002, 124). She also notes that a metaphor is usually concerned with negative analogies or differences while a model analyzes negative analogies to understand its limits of applicability and efficiency (Bailer-Jones 2002, 120).

An analogy, for Bailer-Jones, serves the purpose of pointing to the similarities in two different domains (Bailer-Jones 2002, 110, 112). By establishing the relationship between two things, it can facilitate the interpretation of insightful metaphors. Furthermore, it can support the explanatory function of models by finding similarities between an unfamiliar or new phenomenon and a more readily grasped concept (Bailer-Jones 2002, 113). Consequently, Bailer-Jones claims the following:

> Analogy deals with resemblances of attributes, relations, or processes in different domains, exploited in models and highlighted by metaphors. Note that neither metaphors nor models *are* analogies—they are descriptions. (Bailer-Jones 2002, 124)

Here, Bailer-Jones is stressing that models and metaphors rely on analogies to carry out their descriptive role. At the same time, she is cautioning that the importance of analogy does not mean that analogies precede or equate to metaphors or models. The analogy relationship offers familiarity, but the understanding of a metaphor cannot be reduced to the use of analogy; there are models that have their roots in an analogy, such as Thomson's plum pudding model of an atom, but there are also others that do not have their origin in an analogy at all (Bailer-Jones 2002, 118, 113). As such, Bailer-Jones calls for a further investigation on the relationship between analogy and the interpretative descriptions such as models and metaphors.

In summary, Black, Barbour, and Bailer-Jones characterized the terms "metaphors," "analogies," and "models" based on their property, function, and use. For Black, a metaphor is the product of the interaction between two domains, but a model is a complex system of inferences built on metaphors, and the interactions between two domains are supported by analogies. Similar to Black, Barbour agrees that models and metaphors differ in terms of complexity and systematicity, but Barbour also adds that metaphors are used momentarily, whereas models are more enduring. Unlike Black and Barbour, Bailer-Jones questions whether analogies serve as the base category of metaphors and models. Noting how some models are not analogical, she argues that models and metaphors cannot be reduced to analogies. Having examined the approaches of Black, Barbour, and Bailer-Jones, a question still lingers: if metaphors, analogies, and models are indeed unique, then does each activate different cognitive processing? If these cognitive processes involving metaphors, analogies, and models are not the same, how are they different, and how are they related?

Metaphors, Analogies, and Models in Cognitive Science

Recent developments in cognitive science provide valuable prospects to understand metaphors, analogies, and models. Because cognitive science draws on several disciplines, including psychology, philosophy, linguistics, sociology, and anthropology, it provides a valuable resource for investigating how these terms are represented and processed in our minds. In recent years, cognitive science has been producing a large amount of research data to examine how metaphors, analogies, and models work in human cognition. These findings are also helpful in discerning the difference between the three terms.

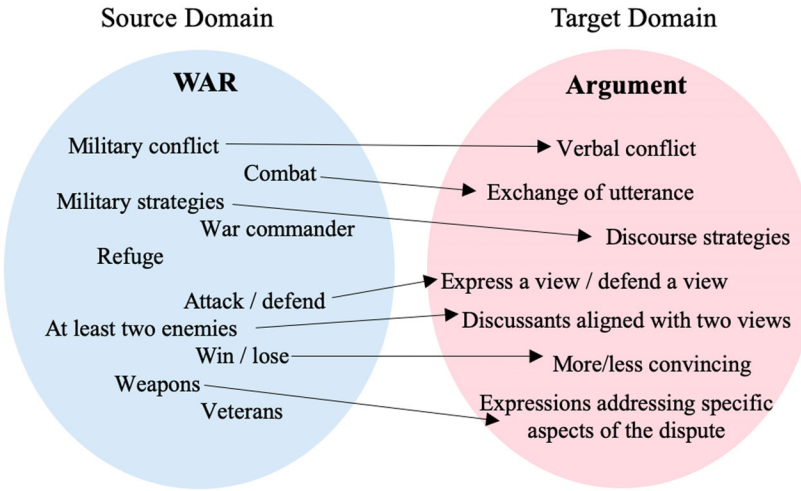


Figure 2. The cross-domain mapping of "argument is war" under CMT.

In cognitive science, or specifically in cognitive linguistics, a metaphor is defined as "understanding one domain of experience (that is typically more abstract) in terms of another (that is typically more concrete)" (Dancygier 2016, 13). The concrete domain, which is highly structured, easily understood, and perceptible, is often called the *source* (or vehicle), and the domain that people seek to understand is the *target* (also called the topic or tenor).[3] This view, first outlined by George Lakoff and Mark Johnson in *Metaphors We Live By* (1980), has been known as Conceptual Metaphor Theory (CMT).

In examining the metaphors in thought, there have been two conflicting views about how metaphors are processed. Some scholars argue that a metaphor is processed by a *comparison* between the two juxtaposed objects or ideas. Alternatively, others propose that a metaphor is dealt with by a method called *categorization*.

There are three significant variants in the *comparison* school. First is the *cross-domain mapping* proposed by Lakoff and Johnson. During the cross-domain mapping, the familiar concepts of the source domain find correspondences in the less familiar, abstract target domain. Consider the metaphor "argument is war" (see Figure 2). *War*, the source domain, quickly summons the notions of combat, attack or defend, winning or losing, and weapons, which are then mapped onto the domain of *argument.*

Following Lakoff and Johnson, Gilles Fauconnier and Mark Turner also adopt the general mapping principle. However, they adjust the CMT, proposing that metaphor is a conceptual integration or blend produced by comparing two or more distinct sources (Fauconnier and Turner 1996).

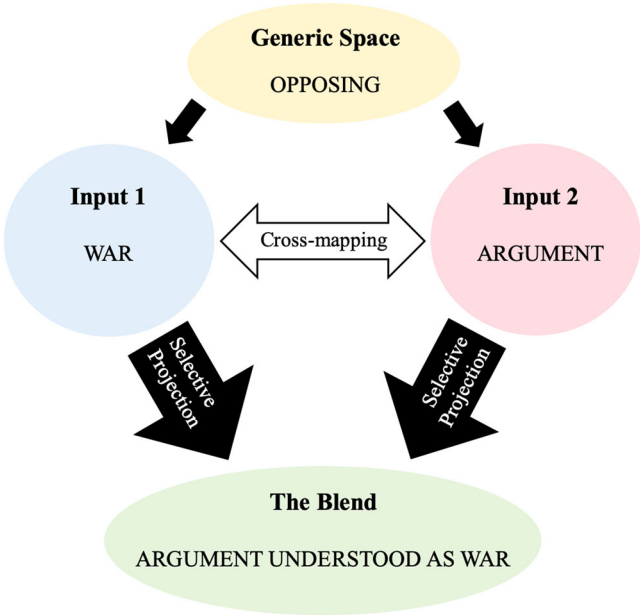


Figure 3. "Argument is war" under CBT.

Similar to CMT, Conceptual Integration/Blending Theory (CBT) contends that a metaphor blend is a pervasive phenomenon in human thought in everyday language, but unlike CMT that involves the two domains of source and the target, CBT uses four "spaces" in the mapping process (see Figure 3). The blending process works by constructing a partial cross-mapping between two *input spaces* and selectively projecting inferences from those inputs into a novel *blended mental space* (Fauconnier and Turner 2002). The more general domain, called *generic space,* connects the two input spaces. According to Joseph E. Grady, CBT advances from CMT in a few ways. It provides a way of describing examples in which the metaphorical image cannot be a straightforward projection of source onto target, offers a direct explanation of how multiple metaphorical patterns are combined within a single complex conceptualization, can allow the blended space to provide some feedback to any of its inputs, and places emphasis on the dynamic, online processing (Grady 2007, 200–01).

Another variant of the mapping mechanism is structure mapping, presented in the works of Dedre Gentner, Brian Bowdle, Lindsey Smith, and Arthur Markman (Gentner 1983; Gentner and Markman 1997; Gentner and Bowdle 2008; Gentner and Smith 2012). Structure mapping occurs in three stages (see Figure 4). In the initial mapping stage, the target and the

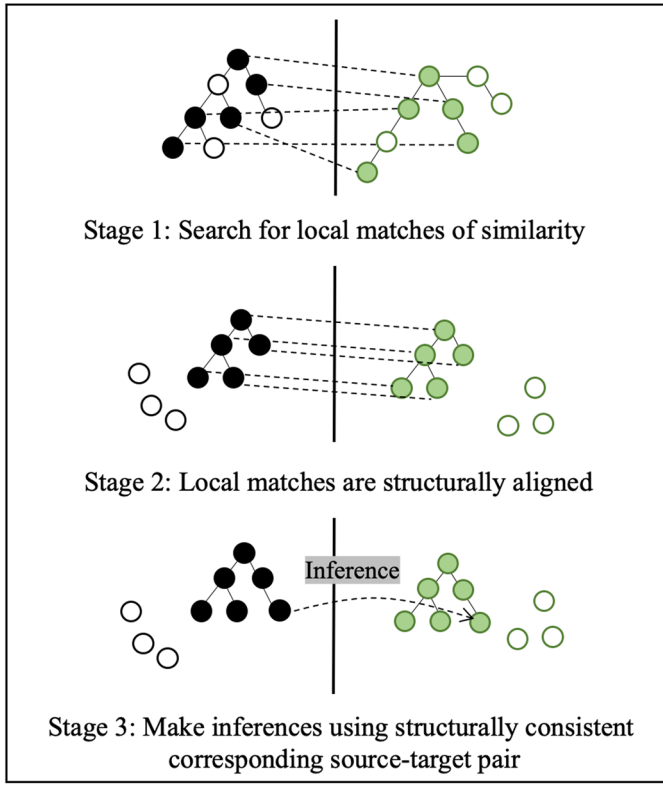


Figure 4. The stages of structure mapping (adapted from Gentner and Bowdle 2008, figure 6.1).

source are compared and searched for similarities. There is no directionality at this stage. In the second stage, the local matches coalesce and form structurally aligned concepts, which yield both literal and metaphorical interpretations. In the final step, many inferences are directionally projected from base to target as natural outcomes of comparison, and they reflect relational, and not just feature-specific, aspects of the metaphor comprehension process (Wolff and Gentner 2011; Gibbs 2017, 107).

In contrast to the *comparison* view, scholars like Sam Glucksberg argue that metaphors are processed by a different method called *categorization*. This process, according to Glucksberg, involves finding the nearest available category that subsumes both A and B in the "A is B" metaphor. For example, lemons and kiwis are both fruits; lemons and flowers are both plants; lemons and birds are both alive. These categories observe the similarities between the two objects. However, in the case of metaphors, some very different ideas or objects, such as lawyers and sharks, are

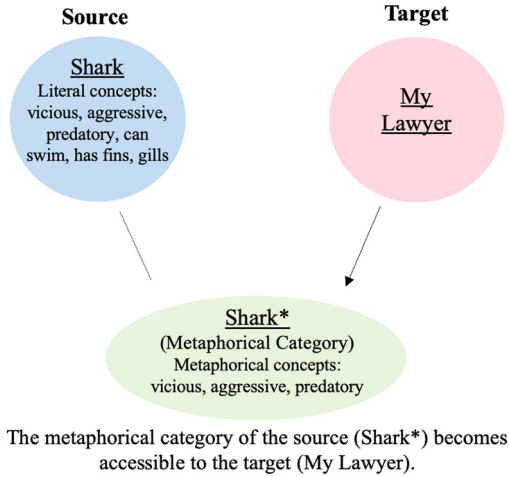


Figure 5. The categorization view using the example "my lawyer is a shark" (adapted from Gentner and Bowdle 2008, figure 6.1, 6.3; Glucksberg 2011, figure 4.1b).

juxtaposed. In this case, Glucksberg argues that instead of taking the literal meaning as the referent, a metaphor looks for a metaphorical, superordinate category of the referent (Glucksberg 2011, 9). For instance, a *shark* is no longer seen as a marine creature that has teeth and rough skin; it becomes *shark**, which denotes a metaphorical category of predatory creatures and retains attributes such as viciousness and aggressiveness (see Figure 5). As a result, the word shark has dual references—one referring to the literal *shark,* and the other connoting to *shark**.

Since the categorization mechanism involves the search for a metaphorical category, one might assume that this method does not require any comparison. However, this is far from the truth; the process of creating a metaphorical type, which contains the relevant attributes of the target, demands comparison. Gentner and Bowdle assert that the comparison and categorization methods are not two unique processing mechanisms but somewhat similar methods of comparison with different directions of alignment. For the traditional comparison view, the correspondences are horizontally aligned between target and the source; for the traditional categorization view, a metaphor establishes vertical alignments between the literal category of the target and the metaphorical category of the source (Gentner and Bowdle 2008, 116). Then, both comparison and categorization require finding correspondences between the twodomains.

Although there are different voices about the precise cognitive processing of a metaphor, both comparison and categorization schools put forward a few highlights. First, a metaphor is the process of understanding one domain of experience in terms of another. The comparison between two

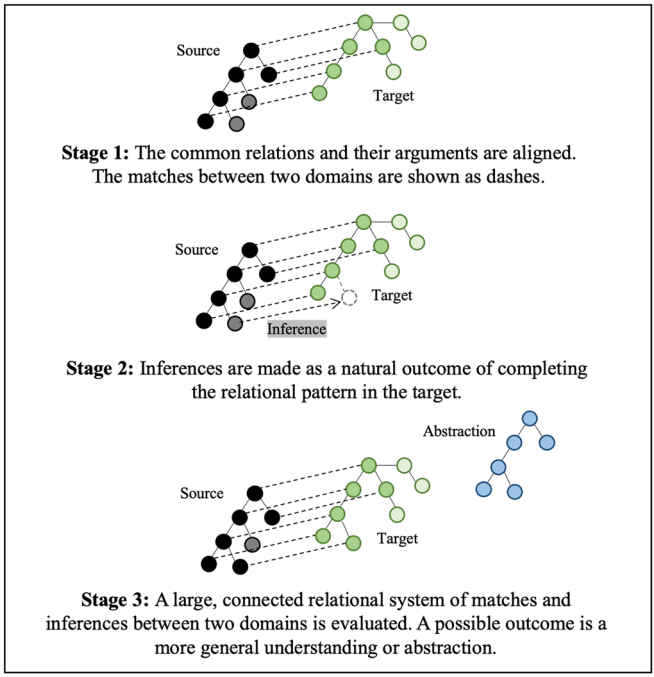


Figure 6. The stages of processing an analogy (adapted from Gentner and Smith 2012, figure 2).

distinct domains is implicitly suggested by the sentence structure. Second, a metaphor can be processed through various mapping methods, including domain mapping, structure mapping, and mappings between categories. Also, the mapping between two semantically distant domains can often result in blending the two. Third, although conventional pairings of two domains (e.g., love is a journey) are processed more or less automatically, novel pairings of two domains are cognitively rigorous and yield more vivid and forceful understanding than literal descriptions.

Analogies, in cognitive science, are the processes of identifying common relational system between two situations and producing further inferences (Gentner and Smith 2012, 130). According to Gentner (1998, 107), "analogies are partial similarities between different situations that support further inferences." She argues that analogies undergo the following processes: (1) retrieval, (2) mapping, and (3) evaluation (Figure 6). The first step of *retrieval* is when the features of the source domain in the working memory remind a person of a prior analogous situation in long-term memory (Gentner and Smith 2012, 131). The second step involves *mapping*, specifically structure-mapping, which requires aligning the two represented

situations based on their common relational structure and then projecting assumptions (Gentner et al. 2001, 200; Gentner and Smith 2012, 131). The final step is *evaluating* the analogy and its inferences. Some criteria for evaluation include, but are not limited to, factual correctness, adaptability, goal relevance, and productivity of new knowledge (Gentner and Smith 2012, 133). In order to be an analogy, there must be two domains that are similar in their relational structure. Without this overlap in relational structure, it is not possible to align the two domains for structural mapping.

Analogies are like metaphors in many ways. They both operate via mapping and highlight commonalities between two domains. They also project inferences from the better-known source to the less familiar target. However, there are also differences. First, analogies are more explicit than metaphors in terms of comparing similarities (Saha 1988, 49; Duit 1991, 651). In an analogy, the two situations or domains have marked similarities in their relational structure. On the other hand, the two domains of a metaphor do not have explicit relational similarities and, therefore, must be examined to uncover commonalities. This creative process drives one to reconstruct the relationship intended by the author and perceive new relationships. Second, as Gentner et al. (2001) argue, "metaphors can be more structurally variable than analogies." Although metaphors examine commonalities including concrete attribute matches, relational matches, or both, analogies only survey common relational structure. Third, during the mapping process, the two domains of a metaphor can blend into one, but the two domains of an analogy remain distinct. Finally, another dimension of difference is the pragmatic function of the two. Gentner et al. suggest that unlike analogies, which are typically used for explanatory-predictive context, metaphors can be used in either explanatory-predictive or expressive-affective context (Gentner et al. 2001, 240). Given these differences, metaphors cannot be reduced to analogies and vice versa.

Having explained the relationship between metaphors and analogies through cognitive science, what about models? In the field of cognitive science, there is much research focusing on two different classifications of models. First is a *mental model*, which is often defined as a naturally evolving, personal, internal representation of external reality that people use to interact with the world around them (Jones et al. 2011, 494). In 1983, two influential works, both with the same title *Mental Models*, took different approaches in researching mental models. The first, edited by Dedre Gentner and Albert Stevens, explains how mental models are used for organizing knowledge structures relating to physical systems, mainly mechanical and technological devices developed by people (Gentner and Stevens 1983). This strand of research proposes that salient aspects of objects, situations, and processes are captured and systematically organized in long-term memory as mental models, which are then used for many reasoning and comprehension tasks (Nersessian 2002, 140). According

to this field of research, mental models are incomplete, unstable, do not have well-defined limits, and are easily affected by people's beliefs upon the represented system, but they serve an important function of enabling the person who constructs the model to explain and make predictions about the physical system (Norman 1983, 7–8). The second strand of research, by Philip Johnson-Laird, turns attention to how mental models serve as temporary structures employed in working memory during a specific comprehension and reasoning processes (Johnson-Laird 1983). For Johnson-Laird, a mental model is an *iconic* representation, meaning "its parts are interrelated in the same way that the parts of the entities that it represents are interrelated" (Johnson-Laird 2013, 652–53). In other words, a mental model is an analogy of the structure of the situation being modeled. A mental model, according to Johnson-Laird, is not the same as visual images or propositional representations because it can represent properties and relations that cannot be visualized without any syntactic rules of mental language (Johnson-Laird 2013, 652). Although Johnson-Laird's view is restricted to comparing structural relations, Nancy Nersessian argues that mental models involve behavioral and functional relations as well. As a result, she denotes a mental model as "a structural, behavioral, or functional analog representation of a real-world or imaginary situation, event or process" (Nersessian 2008, 93). Although the two strands of research situate mental models at different loci of memory, they both underscore the function of a model—to enable the user to understand, explain, interpret, acquire new information, and make predictions and inferences about the represented system.

The second type of model often discussed in cognitive science is called a *conceptual model.* According to Ileana Greca and Marco Moreira, a conceptual model is "an external representation created by researchers, teachers, engineers, and so on that facilitates the comprehension or the teaching of systems or states of affairs in the world" (Greca and Moreira 2000, 5). Unlike a mental model, which is internal, personal, idiosyncratic, incomplete, and unstable, conceptual models are external, accurate, consistent, and complete representations endorsed by a given community (Norman 1983, 7–8; Greca and Moreira 2000, 5). Mental models are what people have in their minds; conceptual models are tools for understanding a particular system and communication of that knowledge. Since a conceptual model is a simplified and idealized representation of phenomena or situations, the interpreter of a conceptual model must have the necessary knowledge of the field to extract information that is considered important and relevant accurately. In reality, even if the interpreter is equipped with the necessary background knowledge, his or her mental model of the conceptual model is not always isomorphic to the actual conceptual model.

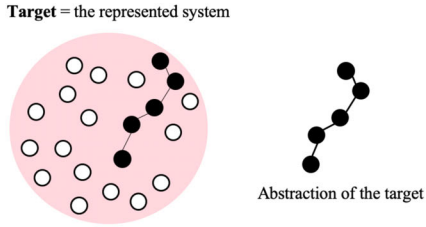
Whether a model is a mental or conceptual model, the general modeling process involves the following steps: construction, simulation, evaluation,

and adaptation (Nersessian 2008, 184). The *model construction* process begins with a rudimentary understanding of the target phenomena (Banks 2010, 3). With the goal of representing the system in a reliable fashion, one determines relevant details while simultaneously ignoring irrelevant ones. Furthermore, recognizing the constraints posed by the target system, the modeler carefully selects an analogical source domain to represent the target (Nersessian 2008, 185). *Simulation* is the process of examining the interaction of constraints and generating inferences and predictions. *Evaluation* is confirming whether the source domain of the model highlights all salient properties of the target required for establishing a structure mapping between the source and the target. Finally, *adaptation* is modifying the model in accordance with the enhanced understanding of target, source, and model constraints. Overall, as Stewart Robinson et al. claim, "modeling is the task-driven, purposeful simplification and abstraction of a perception of reality that is shaped by physical and cognitive constraints, leading to a conceptualization of the relevant subset of the problem domain" (Robinson et al. 2015, 2820).

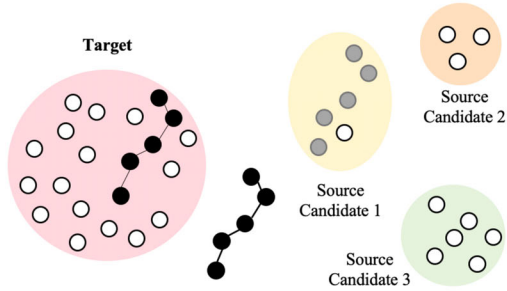
In cognitive literature about mental and cognitive models, there is a clear emphasis on how a model is an analogical representation of reality. However, the relationship between an analogy and a model is underdeveloped in the current discussion. For instance, when Nersessian uses the term "analog" in her definition of a mental model, she does not stress the structure mapping process. Instead, she underscores the transfer of the constraints of the represented phenomenon made possible by the analogical relationship (Nersessian 2002, 145). In addition, she argues that the "evaluation of the analogical modeling process is in terms of how well the salient constraints of a model fit the salient constraints of a target problem, with key differences playing a significant role in further model generation" (Nersessian 2002, 146). Therefore, considering the recent cognitive findings of models and analogies, what is the relationship between a model and an analogy?

In line with Johnson-Laird and Nersessian's view of the model as an analogy, I assert that a model is an analogy about a particular phenomenon in the world and also propose further that the model construction process involves reversing the structure-mapping of analogy (Figure 7). The construction process begins by identifying the salient features and their relations and abstracting a general understanding. The abstracted concept is used as a tool to identify a source domain with the same relational structure. Each source domain candidate is tested for the structural alignment with the abstraction of the target. Once the best matching source domain is identified and verified for mapping all salient features of the target, the modeling process is completed.

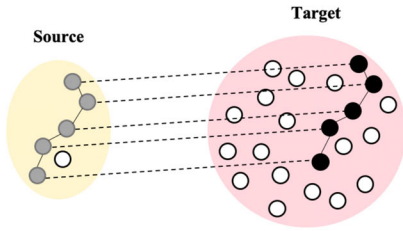
A few things must be pointed out about the modeling process. First, the abstraction of the generalization process of the target system is crucial for modeling. During abstraction, the specific details of the target are



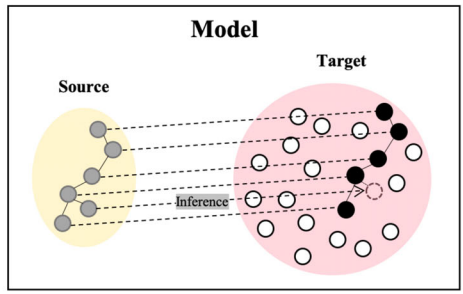
Stage 1: The salient features of the phenomenon being represented by a model and their relations are identified and abstracted.



Stage 2: There is a search for a source domain that can be structurally aligned and mapped with the target phenomenon.



Stage 3: The source and the target are structurally aligned.



Stage 4: The source domain is used to make inferences and predictions about the target phenomenon. The model construction process is completed.

Figure 7. The model construction process by reverse structure-mapping.

removed while the salient objects and relations are preserved in order to retrieve and transfer information across domains efficiently. In other words, the abstraction is context-independent information useful for identifying potential similarities across various source domain candidates. Second, the source domain is selected based on preserving the relational system and creating an isomorphic mapping of objects and relations. Many effective models use a familiar, simple, easily grasped conceptual domain as their source domain. For example, Ernest Rutherford uses the idea of the familiar solar system to explain the unobservable target domain of an atom. In religion, God, as a father model, exploits people's relationships and experiences with a father figure to illustrate God's fatherly love and care. However, there are times when there is no source domain that can be structurally mapped with the target domain. In such cases, many model builders choose to create new terminologies, new concepts, and new relations to represent the desired phenomenon. For example, when Erwin Schrödinger proposed the quantum mechanical model of the atom, he introduced a new conceptual domain of treating the matter as waves with distinct mathematical functions. This new source domain included new terms such as the *principal quantum number*, *angular momentum quantum number*, *magnetic quantum number*, and *spin quantum number* and highlighted concepts such as probability and shape. In the field of religion, a concept of *ousia*, *hypostasis*, and the hypostatic union had to be introduced in order to create the Trinity model. Regardless of the familiarity of the source domain employed by the model, all models are analogies of the world. Third, the source domain is never an accurate, exact representation of the target system. In Figure 7, Stage 3, out of the six features in the source domain, only five features (represented by the five solid dots) are mapped. There is also one feature that does not have any correspondence with the target system. Likewise, when a model is built, one can recognize that a model has many similarities as well as some differences with the phenomenon it represents.

To summarize, under the cognitive view, metaphors, analogies, and models are cognitive processes that enable an understanding of one domain, which is often too small, or too big, or too complicated for direct observation, using another more familiar domain. The three terms undergo mapping, which finds correspondences or similarities between the source and the target domain.

Despite these commonalities, there are some crucial differences. One critical difference is that analogies and models are processed through point-by-point structure mapping, while metaphors can be processed via various mechanisms, including domain mapping, structure mapping, categorization, and blending. In structure-mapping, analogies and models undergo a more systematic and structured comparison because only the internal relational structures of the source domains correspond to the target domains. On the other hand, in metaphors the correspondences of both attributes

and relations between the source and target domains are searched in a more random, nonspecific fashion. Moreover, metaphors also examine similarities as well as differences to interpret its nonliteral, metaphorical meaning. When a metaphor is first introduced, positive correspondences are the most conspicuous elements of exploration. However, in later stages of metaphor processing, the features that are not immediately mapped onto the target become points for further exploration and investigation and such process can yield a fruitful understanding of the target domain.

This difference in the processing method entails some significant consequences. First, compared to analogies and models that have particular relational structures intended by the author, metaphors allow the interpreter more freedom to explore his or her idiosyncratic and contextualized source domain. For example, consider the analogy "a cell is like a factory," and a metaphor "a cell is a factory." In the analogy, the interpreter will most likely focus on relevant relational structure involving the ideas of the assembly line, manufactured goods, raw materials, heavy machinery, buildings, modes of transportation, power source, factory management, and warehouses. However, as a metaphor, the source domain "factory" can accommodate a broader range of thoughts, including personal experiences, attitudes, and feelings. If a person has a negative attitude with a factory, he or she can summon ideas such as factory accidents, pollution, energy waste, unfair trade, and third world countries in understanding a cell.

Second, models, metaphors, and analogies have varying degrees of emphasis on extracting the author's intended mapping pattern. When building a model, the builder carefully selects a source domain with the hope that the interpreter can effectively make structural alignments with the target. If the interpreter fails to make the connection between the source and the target, the model is considered useless or unhelpful. Therefore, models stress the importance of recreating the mapping pattern intended by the model-builder. Compared to models, analogies allow the interpreter more freedom in finding correspondences. Nevertheless, analogies have a more systematic, structured method of mapping due to the constraints posed by the source domain. Metaphors have the least emphasis on replicating the exact mapping pattern intended by the author. Instead, metaphors invite the interpreter to undergo an adventurous exploration of ideas about the source domain. Thus, metaphors, compared to analogies or models, are less practical in exporting a particular understanding of the target, but more effective in inviting diverse interpretations.

Another vital difference between metaphors, analogies, and models is the function of the three processes. A metaphor is a powerful heuristic tool that invites the interpreter to actively explore a wide range of ideas in order to derive a nonliteral, metaphorical understanding of the sentence. This active on-line processing of the metaphorical meaning can lead to a better understanding of the target domain and the creation of a vivid, expressive

mental picture useful for communication. Sometimes, a metaphor activates specific sensory-motor and perceptual representations in the brain and elicits particular emotional responses (Citron and Goldberg 2014; Lakoff 2016). Additionally, a metaphor can be particularly potent for persuasion and expression of subjective attitudes (Sopory and Dillard 2002). Thus, a metaphor functions to allow a *creative exploration* of ideas that yields an enduring insight with a strong emotional impact and persuasive power. Unlike a metaphor that permits extensive testing of ideas, an analogy focuses on the identification of resemblance by diverting attention away from the differences to similarities in the relational structure. Through systematic structure mapping, it enables a *transposition of relational structure* from the source to the target and yields more in-depth knowledge. Finally, a model's primary function is to represent the complex target domain in a more straightforward form useful for further application and inferences. In other words, it provides easy access to the target system that is difficult to be perceived directly. Besides, models restructure how one conceptualizes the target system. Therefore, a model's purpose is to *represent* a particular target domain in a manner that is *useful* for communication and further application.

Implications for the Study of Science and Religion

One of the main themes in the study of science and religion is understanding the relationship between science and religion. However, this has not been an easy task for two reasons: (1) the difficulty in defining the terms "science" and "religion," and (2) the difficulty in generalizing the complex relationship without naive stereotyping. Since the domains of science and religion are extensive, science and religion could be a shorthand for a range of different concepts including sets of belief, ways of life, natural human phenomena, academic fields, and mediators of meaning. Moreover, since science and religion are not only intellectual entities but also human activities, both are embedded in the sociocultural, historical context of the community involved in the scientific and religious activity. Then, how can we comprehend the complex notions of science, religion, and their relationship in the sociocultural-political context?

The solution is quite simple: to use a useful model. As discussed in the section above, the process of building a good model requires identifying and selecting a suitable source domain. Although some source candidates need some time and effort to construct correspondences, other candidates naturally align with the target domain. Among the latter group, the candidate that most efficiently highlights the desired features of the target system is the best candidate for a good model. Unfortunately, finding the appropriate source domain is the real challenge.

In the past, many scholars have alluded to different source domain candidates to model the science–religion relationship. Perhaps the most famous among all science–religion models is Ian Barbour's fourfold model. According to Barbour, there are four typologies—namely, C*onflict, Independence, Dialogue,* and *Integration*—that dominate the discussion about the science–religion relationships (Barbour [1990] 1998, 77). By offering these classifications, Barbour hopes "to give a systematic overview of the main options today" (Barbour [1990] 1998, 77). However, his attempt has been criticized for giving too much credence to the conflict theory and depicting science and religion as fixed, temporally independent, and purely intellectual entities (Cantor and Kenny 2001).

For Willem Drees, who sees science and religion as human phenomena in a sociocultural context, the 3×3 classification is the best source candidate to illustrate the science–religion interaction. In this model, Drees identifies nine areas of discussion concerning the relationship between religion and science. He pinpoints three challenges of religion from the natural sciences (new knowledge, new views of knowledge, appreciation of the world) interacting with the three core elements of religion (cognitive claims, experience, tradition) (Drees 1996). Overall, Drees presents the science–religion relation in a simple, categorical manner, but the overall view is still limited to his naturalistic framework (Drees 1996, 45).

Another scholar, Stephen Jay Gould, proposes the notion of "nonoverlapping magisteria (NOMA)" as the source domain for representing the complex relationship. For Gould, science and religion are disciplines, each with its legitimate magisterium or teaching authority. For instance, science deals with the empirical constitutions of the universe, whereas religion engages with moral values and spiritual meanings of human lives (Gould 2001). Consequently, he sees science and religion as having nonoverlapping magisteria and argues that their relationship can only be that of independence.

Although Barbour, Drees, and Gould offer useful models for compartmentalizing the intricate science–religion relationship, their source domain concepts are unfamiliar and unintuitive, thereby requiring additional effort to learn about the categories. Considering this weakness, others have developed analogical or metaphorical models that utilize familiar and concrete concepts to address features of the target system. For instance, Charles Coulson and Donald MacKay use Niels Bohr's theory of complementarity or wave-particle duality in quantum physics to describe the positive nature of the science–religion interaction (Barbour 1974, 76–77). Coulson suggests science and religion as "complementary accounts of *one* reality." Similarly, MacKay sees science and religion as complementary descriptions of a *common* referent from different perspectives just like the wave-like and particle-like behaviors of an electron (Coulson 1955, chapter 3; Feyerabend and MacKay 1958, 120–21). Unlike Coulson and MacKay, Barbour

expresses his doubts about the use of this metaphor, contending that science and religion do not refer to the same entity, but arise in differing situations and serve different functions in human life (Barbour 1974, 77–78).

Beside his fourfold model, Barbour also uses a "building bridges" image as a source domain for explaining the interaction between science and religion. He states,

> "Building bridges" serves as a generalized, metaphorical description of much of the dialogue that takes places in theology and science. The metaphor expresses the fact that there is a breach evident at the surface between theology and the sciences in our present cultural context. There will be no intellectual traffic without active *construction.* All the elaborate engineering detail that goes into bridge building aptly expresses the sometimes technical and painstaking labors associated with making connections and free traffic possible between these aspects of our culture. (Barbour 1996, xii)

In this analogical model, Barbour highlights various ways that theology and science have in common acting together as the solid, stable bedrock that connects the landmasses to be bridged. He suggests that the bridge-building between science and religion is important because it brings human beings closer to "a vision of a unified conception of human rationality and of the world, a vision in which the spiritual and the intellectual impulses of humanity are harmonized in an ethically, socially, and environmentally healthy way" (Barbour 1996, xiv). Although this analogy maps relational similarities between building bridge and the science–religion interaction, it is not without liabilities. As Barbour acknowledges, the implication of independent, well-defined "landmasses" of science and religion, the permanence of the interface, and the artificiality of the intellectual connections drawn between science and religion could be very misleading (Barbour 1996, xiii).

Considering the complex, dynamic, historical, and contingent nature of science and religion, James D. Proctor employs the "three body problem" in celestial mechanics as the source domain. He asserts that just as the introduction of a third celestial body to the orbit of two celestial bodies form "a complex, beautiful, but unpredictable phenomenon," the human experience shifts and complicates the interaction between the two entities of science and religion (Proctor 2005, 8). Proctor's source domain recognizes how science and religion take place in its historical, political, geographical, psychological, and other contexts. However, it presents distorted views of science and religion as static, stable, and always separate bodies.

Over the past few years, Peter Harrison has been promoting the map-territory image as a source domain. He criticizes that the current conceptual map, which shows the two divided territories of science and religion with some unitary and enduring essence that persists over time, is

constructed without careful consideration of the historical conditions and the problematic nature of categories in question (Harrison 2015, 6). In order to overcome such historical amnesia in the present scholarship, Harrison presents the history of how the territories of science and religion have shifted, and consequently, how the boundaries between the two have changed. Although Harrison's map-territory analogy emphasizes the fluid nature of science, religion, and their relationship, science and religion are only portrayed as intellectual concepts with extensive, complicated history rather than parts of human experience, which informs the present situation and shapes future actions and values.

Compared to the source domains with different categories, the four analogies—wave-particle duality, building bridges, three body problem, and map-territory—offer more dramatic and evocative organizing images that facilitate the access to the complex target system of science and religion. However, none of the candidates successfully represents the complexity arising from both the dynamic nature of science and religion and the fluid interaction between the two in the context of human life. These source domains, as a result, fail to generate a pervasive model for the science–religion relation.

Among the myriad of candidates, the concept of language stands out as the optimal choice for facilitating the access to comprehending science, religion, and their interaction. Since the second half of the twentieth century, philosophers and theologians have been associating various notions of language with religion. Ludwig Wittgenstein is probably one of the first influential figures to recognize the close correspondences between language and religion. In *Philosophical Investigations*, he writes, "Grammar tells what kind of object anything is (Theology as Grammar)" (Wittgenstein [1953] 2009, par. 371). For Wittgenstein, grammar is not mere rules that govern syntactic and semantic usage; it describes the usage and meaning of words in reality. Similarly, he contends that language is participatory, contextual, and emergent. By relating grammar to theology, he is effectively arguing that theology brings out what religious terms, concepts, and statements mean in ordinary life situations such as attending church, praying, singing, being baptized, and going on pilgrimages. Furthermore, noting that "how words are understood is not told by words alone (theology)," Wittgenstein highlights that theological language is understood only in relation to its pragmatic context (Wittgenstein [1967] 1998, par. 144). Overall, Wittgenstein underscores the context-sensitive and social nature of religion and sees it as a way of life that finds meaning in the day-to-day lives of the religious community.

Influenced by Wittgenstein's view on linguistic meaning, the post-liberal theologian George Lindbeck also endorses a "cultural-linguistic" approach to religion. Opposing the "cognitive-propositionalist" or "experiential-expressivist" views, he claims that religion does not aim to make truth

claims about spiritual reality or to characterize religious experiences in symbolic expressions (Lindbeck 1984, 16–17). Instead, he construes religion as "a kind of cultural and/or linguistic framework or medium that shapes the entirety of life and thought" (Lindbeck 1984, 33). Moreover, he argues that doctrine is "a communally authoritative teaching regarding beliefs and practices considered essential to the identity of the group" (Knight 2013, 204). Just as grammar informs how words are used in context, doctrine illustrates the biblical understanding of the life in Christ and guides the religious community to structure their beliefs and experiences around the narrative of love and salvation (Lindbeck 1984, 73–90).

Recently, in response to the effort to naturalize and reduce religion, Lluis Oviedo offers a more "holistic" and "multilevel" description of religion through the concept of language (Oviedo 2015). He notes that language is a complex system of references "comprising external symbols, rituals, images, a calendar, a set of social roles and rules, and established behavior codes" and "giving rise to a functional whole assuming often an institutional shape" (Oviedo 2015, 993). He also argues that language offers an interpretive framework that shows religion rooted in the actual reality of human life, expressed through various practices, adapted to the sociocultural and historical environment, and facilitating meaningful communication.

Besides characterizing religion, language has been used to describe a diverse science–religion relationship. For example, Langdon Gilkey and Ian Barbour treat science and religion as two separate, independent languages. Gilkey argues that science seeks to explain objective, public data of proximate origins (asking "how?"), whereas religion asks about the ultimate questions regarding the origin, meaning, and destiny, and the experience of one's inner life (asking "why?") (Gilkey 1965; Gilkey 1985, 108–16). Focusing on functional differences, Barbour contends that science is designed for prediction and control, while religion recommends a particular way of life (Barbour [1990] 1998, 87).

Unlike Gilkey and Barbour, Fraser Watts expounds the complementary relationship between science and religion in terms of two languages or discourses. He argues that the difference between science and religion arise not from referring to two different realities but from representing different levels of the same world. Religious discourse is a higher level discourse; it is broader in its scope and reference, being personal and moral, as well as making claims about the nature of reality. On the other hand, scientific discourse attends to specific aspects of the reality that fall under the purview of religion. The two discourses are not identical because they approach reality from different angles, but both are linked as they bear on aspects of the same reality. Hence, a two-discourses image can feature complementary science–religion interaction.

In the literature so far, scholars use specific features of language *analogically* to highlight comparable aspects of religion or its relationship with science. For instance, the importance of the linguistic community and meaning in context is transposed to underscore the sociocultural aspect of religion, and two discrete languages reflect the independent science–religion relation. However, there is no conversation about how language affects the definition of science or how complementary languages can open up many doors of shared understanding, constructive dialogue, and mutual enrichment in science and religion.

For that reason, what is needed is to take language *metaphorically*. That is to say, instead of handpicking particular relational structures of language and searching for correspondences, all views related to language must be juxtaposed with the target system. Then, such a process of exploration of ideas yields a better understanding of science and religion. By way of illustration, let us consider some definitions of language. If language is defined as a complex system of words and grammar, science is treated as a system of facts, guided by a particular scientific method, and religion as a complex entity composed of beliefs, practices, symbols, and a community of believers called the church. With the emphasis on the social nature of language, science is seen as a socially constructed body of knowledge vulnerable to biases, mistakes, and accidents, and religion as the process of building a relationship with God and with others. Focusing on the communicative function of language, science performs essential functions such as building technology, improving health, solving environmental problems, changing policies, and fighting social injustice; religion serves various functions such as transforming one's worldview, ensuring individuals' well-being, creating a sense of identity, strengthening social solidarity, and exercising social control and responsibility. Since the domain of language is vast, it offers a wide range of definitions and multiple levels of investigation applicable to science and religion.

In addition, processing a metaphor prompts more profound knowledge about the science–religion relationship. Although Gilkey, Barbour, and Watts's views of the two languages endorse either the independence or conflict thesis, the relationship of two languages of a bilingual person or a language learner can serve as a platform for exploring the dynamic interaction between science and religion. For example, many bilingual people tend to have two languages serving different roles. Some might use their first language for mathematical calculation and the second language for academic writing. Some might pray in their first language while reading the Bible in another language.

Although the separations of functions suggest independence, there are other occasions when the two languages demonstrate the complementary or integrated relationship. For a bilingual person, two languages offer an expanded lexicon for recounting particular tastes or sensations that are not

possible in one language. Additionally, a bilingual speaker can blend and use two languages as an integrated communication system. For instance, many Malaysian English speakers integrate *-lah* ending in their English (e.g., *Don't be so worried-lah*) and continuously alternate between English and Malay.

The relationship between the two languages can also model the antagonistic relationship between science and religion. When learning a second language, new vocabularies, grammar, and linguistic culture may confuse the first language system, leading to frustration and anxiety. Nevertheless, through repeated exposure to the second language, the conflict between two languages is resolved.

Besides the improved comprehension of science, religion, and their relationship, a metaphorical approach to language leads to novel insights and even conceptual changes by introducing new information to associate with the target. In linguistics, dialects form due to variation in factors such as geography, social status, and ethnicity. Transferring these ideas to science and religion uncovers various dialects within science and religion. In science, chemistry, physics, and biology become scientific dialects with unique jargons, rules for research, and communities of researchers. In religion, Baptists, Methodists, Presbyterians, Catholics, and Anglicans can be seen as Christian dialects with varying degrees of social status and power.

The notions of lingua franca, power, and linguistic diversity can be another area of a fresh understanding of science and religion. Today, English, as lingua franca, enables people from all over the world to communicate with each other. The dominance of English is less due to its linguistic quality and more due to its presence in large parts of the world and in global trade, business, and cultural interaction. Translating this phenomenon to the field of science and religion, the logical positivist movement can be seen as a group of community members trying to establish science as a lingua franca for communicating all forms of knowledge. However, just as every language and dialect carries unique social meaning, science and religion both convey important personal and sociocultural values. Therefore, one cannot impose on another to adopt the logical positivistic worldview.

Taking the linguistic relativity theory, which asserts that language shapes thought, to the study of science and religion, one can argue that engaging in scientific activities inclines one to adopt a more naturalistic worldview, whereas participating in religious activities opens up a distinctive framework for visualizing and engaging the natural world and understanding the capacities and responsibilities of the human agent. Although these are just a few examples of how the concept of language can be mapped onto the domains of science and religion, there are numerous possibilities of how

language can improve the current understanding of the science–religion system.

Overall, language is a superb source domain candidate for representing science, religion, and their relationship for many reasons. First, the concept of language is very versatile and has multiple levels of investigations. Language is not just a mental faculty; it is also a human endeavor. It can be studied at the level of an individual as well as at the level of the discourse community. The field of linguistics is closely related not only to psychology and neuroscience, but also to sociology, politics, and anthropology. Second, it helps to see science and religion not as abstract systems of thought but as specific discourses taking place in the lives of individuals and communities (Barbour [1990] 1998, 87). It does not treat scientific and religious activities as the "views from nowhere" and recognizes the impact of sociocultural context. Third, the language domain can address both the problem of defining science and religion and the difficulty in characterizing the science–religion relationship. The concept of language restructures science and religion as parts of human experience and, moreover, enlightens on the interaction by alluding to the notion of bilingualism. Finally, the idea of language is accessible and straightforward. When introducing the "three body problem" metaphor to a student without much knowledge in celestial mechanics, he or she will not be able to understand how science and religion work together. In such a case, the source domain is ineffective for advancing comprehension. However, the notion of language does not require one to acquire mastery of how language works because everyone speaks a language in one form or another. In consideration of these factors, the language domain is a useful heuristic source domain for unlocking the full potential to conceptualize science, religion, and their relationship.

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Notes

1. Although Barbour argues that models are critical intellectual tools used to understand the structures of the world, he insists that they do not tell us anything about the world.
2. In his explanation of the role of analogy in understanding, Barbour also argues that the analogy provides a middle way between literalism and emptiness of imagination and alludes to both similarities and differences between the objects of comparison (Barbour 1974, 19).
3. In cognitive linguistics, the difference between concrete and abstract concepts has often been based on what can be observed from the physical world. Things, events, and properties that can easily be experienced by the senses have been called "concrete"; ideas and concepts that are distant from immediate perception have been called "abstract." However, many scholars doubt whether physicality is a good criterion for making a distinction between two domains of

metaphor. An alternative to the abstract/concrete dichotomy is the abstract–concrete spectrum, with concepts having varying degrees of concreteness, which is understood as having symbolic, structural, orientational, and/or embodied information that can be mapped onto another domain. The supporters of this view argue that the mapping of the conceptual metaphor is from more concrete to less concrete domain.

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