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Ontological Meta-Analysis and Synthesis for Public Policy

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Ontological Meta-Analysis and Synthesis for Public Policy

Abstract

Public policy problems are complex and ill-structured. Their impacts can be broad but poorly-understood. Their implementation can be challenging but significant and necessary to individuals, communities, and to a larger extent societies. In this paper, we present ontological meta-analysis and synthesis as a method for public policy analysis, formulation, and assessment. It is a systemic, systematic, and symmetric method that can be applied to public policy research, analysis, and practice. The method encapsulates the combinatorial complexity of the policy problem with little simplification, selectivity, and skewness.

Introduction

Public policy research, analysis, and practice are text-data rich. The logic of these domains, expressed in the natural language of their discourse, can be mapped to the structured natural language of the ontology using the method. The mapping will reveal the 'bright' – heavily emphasized, 'light' – lightly emphasized, and 'blind/blank' – not emphasized elements and themes in the three domains. A 'bright' spot may be so because it is important or easy; a 'light' one because it is unimportant or difficult; a 'blind' spot may have been overlooked, and a 'blank' spot may be infeasible. The method will reveal the gaps within the domains and between them. Knowing the gaps, one can develop roadmaps for the three domains to bridge the internal gaps, and the translational gaps between them. The method has been applied to the analysis of India's higher education policy (Ramaprasad et al. 2016a), and national healthcare policies of Chile, India, China, and Australia. (Dai et al. 2016; Núñez Mondaca et al. 2015; Ramaprasad et al. 2016b; Sastry et al. 2017)

Moreover, the method does not require all text to be translated into natural English or any other language of inquiry. The ontological framework can be translated into the domain language with minimal loss of fidelity, and adapted to its grammar structure. Thus, the text documents can be mapped in the native language without the losses likely from translation and retranslation. China's national healthcare policies, for example, were analyzed in Chinese. (Dai et al. 2016).

Ontological Framework for Meta-Analysis and Synthesis

There is no standard definition of ontology across disciplines. It ranges from the philosophers' definition as the 'logic of being' as opposed to epistemology which is defined as the 'logic of knowing', to the computer scientists' definition as a triple of subject, object, and predicate. Organizational researchers' and social scientists' definitions are more formal than the philosophers' and less than the computer scientists'. We sidestep the debate about the definition of an ontology by using the adjectival form and calling ours an ontological framework. By doing so we simply assert its similarity to an ontology without defending it as one. Its label is less important than the framework's structure and content. It could simply be called a structured natural language framework or a linguistic framework. It is in many ways a logical extension of the 2x2 frameworks (the simplest of the genre) that are ubiquitous in the social sciences and organizational research—with more dimensions and more categories in each dimension. The adjectival label—ontological—will not affect the method and the consequent insights.

Our definition of an ontological framework draws from the those in computer science and biomedical/health informatics, but is different from the organizational researchers' and social scientists'. The ontological framework represents our conceptualization of the domain

(Gruber 2008). It is an "explicit specification of [our] conceptualization," (Gruber 1995, p. 908) and can be used to systematize the description of a complex domain (Cimino 2006). The ontological framework organizes the terminologies and taxonomies of the domain. "Our acceptance of [the] ontology is… similar in principle to our acceptance of a scientific theory, say a system of physics; we adopt, at least insofar as we are reasonable, the simplest conceptual scheme into which the disordered fragments of raw experience can be fitted and arranged." (Quine 1961, p. 16)

In a sense, an ontological framework by itself could be considered a theory of the domain, viewed as a complex system. It draws upon the principles from general systems theory, open systems theory, socio-technical systems theory, cybernetics theory, complexity theory, systems dynamics, and other related theories to deconstruct the complexity of these systems and present an ontological framework to study the same. The framework hierarchically deconstructs the combinatorial complexity of the domain using structured natural English. The dimensions are both social and technical, and organizational and environmental in line with socio-technical and open-systems theories. Feedback, an essential element of cybernetics theory, is an intrinsic part of the framework. It has high descriptive and explanatory power, some predictive power, and potential power to control the efficacy of the systems. It can be extended by adding more dimensions and elements, contracted by eliminating dimensions and elements, refined by more hierarchical levels, and coarsened by combining hierarchical levels. Thus, it can be adapted to future developments in the domain and to other contexts.

The development of the ontological framework is an iterative process of abstraction from and application to (like induction and deduction) the corpus in the domain, till the iterations converge and application becomes attribution. This description is based on the literature in problem formulation (Ramaprasad and Mitroff 1984; Ramaprasad and Syn 2014), which in

turn is based on Piaget's model of cognitive development. The method can be described using the following jigsaw puzzle-solving analogy.

Consider a bag with a mixture of pieces from many different jigsaw puzzles. Let us assume that the player knows the label of the one solution (for example: ship, house, plane) he/she seeks, but not its final image. To assemble the puzzle the player must (a) select/abstract the pieces that belong to that puzzle, and (b) put/apply the pieces together in the right places. The selection and fitting (abstraction and application) of the pieces will be iterative. Initially, some pieces are selected based on attributes such as the edge, color, shape, image, etc. The pieces are grouped based on their expected fit—they may fit different, non-contiguous parts of the puzzle. Those that fit from among the selected pieces will be retained and the others rejected. More pieces are selected and fit in each iteration. With each iteration, the criteria for the selection of the pieces and their grouping will likely be refined as an image of the solution emerges, and the gaps in the image become visible. Further, in each iteration, some pieces retained in an earlier iteration may be rejected, and earlier arrangements of the pieces may be changed. The puzzle is solved when the image fits (is attributed to) the label.

A detailed description of ontological meta-analysis and synthesis is provided by Ramaprasad and his coauthors (Cameron et al. 2017; Ramaprasad and Papagari 2009; Ramaprasad and Syn 2015; Ramaprasad et al. 2014a; Ramaprasad et al. 2014b).

Ontological Framework of National Healthcare Policy

Healthcare is a major public policy issue in almost every country. It is a complex issue and each country's approach to it can vary based the political philosophy of the country and its needs. Consequently, the areas of high, low, and no emphases between the countries are likely to be different. Mapping the policies systematically and systemically can highlight the

'bright', 'light', and 'blank/blind' spots, understand the antecedents and consequences of the same, and redirect the policies to achieve the outcomes. Comparing the maps across countries can also provide insights to improve the policies.

Programs and Policies								Healthcare			
Scope		**Focus**		**Outcomes**		**Care**		**Population**			
Global	**[+]**	Drugs	**[policies on]**	Accesibility	**[of/with]**	Preventive	**[care for/of]**	Individual			
National		Educational		Cost		Wellness		Children			
Local		Financial		Quality		Pregnancy		Pre-natal			
Urban		Insurance		Satisfaction		Illness		Post-natal			
Rural		Information		Safety		Episodic		Adolescents			
Provider		Personnel		Parity		Chronic		Adults			
		Physician		Timeliness		Palliative		Mothers			
		General						Workers			
		Specialist						Aged			
		Nurses						Family			
		Staff						Community			
		Regulatory									
		Technology									
		Treatment									
		Administration									

Illustrative components (total = 5*13*7*6*8 = 21,840):

National financial policies on accessibility of preventive care for family.

Local $_{\text{urban}}$ regulatory policies on cost of palliative care for individual $_{\text{aged}}$.

Provider administration policies on cost of illness $_{\text{episodic}}$ care of individual $_{\text{adolescents}}$.

Figure 1 Ontology of Healthcare Programs and Policies

An ontological framework of national healthcare programs and policies is shown at the top of Figure 1. Three illustrative components derived from the ontology are listed below it. In the following we will discuss the construction of the ontology.

In the ontological framework, the construct 'healthcare programs and policies' is linguistically deconstructed into five hierarchical levels. The first level includes two constructs: Programs and Policies and Healthcare. At the second level: (a) Programs and Policies is deconstructed into Scope, Focus, and Outcomes; and (b) Care and Population. It is

based on the logic that Programs and Policies are designed to have a specified scope, are focused on a particular object, to achieve a desired outcome. Similarly, healthcare is defined by the type of care and the population cared. Each second level construct is represented by a column in the ontological framework – they are labeled the dimensions of the ontological framework. A taxonomy of elements further articulates the second level constructs. The taxonomy of Outcomes is uni-level, that of Scope and Care are bi-level, and of Focus and Population tri-level – these represent the next three levels of the hierarchical deconstruction.

The taxonomies of the dimensions are derived from the common terminology in the body of knowledge on each dimension, especially in the healthcare policy domain. A few categories/subcategories (for example: Pregnancy, Palliative, Adolescents) were added during coding to accommodate the associated policy emphasis. Thus, the Scope of a policy may be geographically Global, National, Local-Urban, Local-Rural, or restricted to the Provider without a geographical boundary. The Focus of the Policy may be Drugs, Educational, Financial, Insurance, Information, Personnel, Regulatory, Technology, Treatment, or Administration. The Personnel focus may be on the Physician, Nurses, or Staff; and further the Physicians may be General or Specialists. The Outcomes of the Policy may be Accessibility, Cost, Quality, Satisfaction, Safety, Parity, or Timeliness of healthcare. Further, the Care could be Preventive, for Wellness, Pregnancy, Illness (Episodic or Chronic), or Palliative. Last, the Population care for may be the Individual, Family, or Community. The Individuals may be Children (Pre-natal or Post-natal), Adolescents, Adults (Mothers, Workers), and Aged. The sub-categories and the sub-sub-categories in the Population taxonomy indicate the fine-grained attention to these groups in the policies and programs.

The dimensions and the elements of the ontological framework are defined in a glossary (not shown). The glossary is used in coding the documents, to assure the reliability and validity of the same.

From a system theoretic perspective, the five dimensions represent the inputs, processes, and outputs of the national healthcare policies and programs. The Scope + Focus constitute the inputs, the Care + Population the processes, and the Outcomes the outputs.

The five dimensions are arranged left to right with adjacent symbols, words, and phrases such that reading left to right concatenating a category from each dimension forms a natural English sentence. Each such sentence is a potential component of healthcare program/policy. Three illustrative components are shown in Figure 1 – the sub-categories of a taxonomy are shown as subscripts. They are:

1. National financial programs/policies on accessibility of preventive care for family – these may include programs/policies to provide financial incentives for families to travel to obtain preventive care.

2. Local urban regulatory programs/policies on cost of palliative care for individual $_{\text{aged}}$ – these may include programs/policies to limit the cost of palliative care of senior citizens.

3. Provider administration programs/policies on cost of illness episodic care of individual $_{\text{adolescents}}$ – these may include providers' programs/policies on cost of care of ill teens.

These three and 21,837 others encapsulated in the ontology are logically the potential components of healthcare programs/policies. The ontological framework presents the combinatorial complexity of healthcare policies and programs concisely comprehensively, and thus helps us take a systemic view of the problems it addresses.

A component may or may not be instantiated in a program or policy. Further, only a fragment of a component may be instantiated in a program/policy. Thus, for example, in the first illustration above, a fragment would be simply 'National financial programs/policies on

accessibility of preventive care' – not specially focused on the Family. The fragments may be dyads (consisting of elements from two dimensions), triads (from three dimensions), and tetrads (from four dimensions). The components are pentads including all the five dimensions. There is thus a very large number of potential fragments (of the 21,840) components encapsulated in the ontological framework.

Studying across programs and policies, some components/fragments may be instantiated frequently, some infrequently, and others not at all. We will label the frequently instantiated components/fragments the 'bright' spots; the infrequent ones the 'light' spots, and the overlooked ones the 'blind/blank' spots.

The luminosity of each spot is a product of two opposing dynamics. A 'bright' spot may be so because it is effective and important; it may also be a consequence of habit and herd effect, irrespective of whether is effective or important. A 'light' spot may be so because it is ineffective and unimportant; it may also be a consequence of difficulty of implementing it, irrespective of its potential effectiveness or importance, or its recent emergence in importance. A 'blind/blank' spot may have been simply overlooked by design or by accident; or, it may be infeasible.

Knowing the 'bright', 'light', and 'blind/blank' spots in the policies and the antecedent reasons will help develop more systemic and systematic approaches to the challenge of healthcare policies. In the following we present an ontological maps of healthcare policies in India and China, highlight the 'bright', 'light', and 'blind/blank' spots therein. Subsequently, we will discuss how the maps can be used to analyze each country's system of policies individually and comparatively.

National Healthcare Programs/Policies in India

The following is based on Sastry et al. (2017) analysis of the national healthcare programs/policies of India. The ontological map of monads – individual element in the ontology – is shown in Figure 2. The number in parentheses adjacent to the category indicates its frequency of occurrence in the 64 programs and policies. The bar below the category is a visual indicator of the same scaled to the maximum number of occurrences of any one category (National – 64). The 'bright' spots are other categories with the larger numbers and bars; the 'light' spots are the ones with the smaller numbers and bars, and the 'blind/blank' spots are the ones with close to zeroes and no virtually no bars. There are no objective frequency cut-offs between 'bright', 'light', and 'blind/blank' spots. Yet, the visualization in Figure 2 clearly highlights the areas of emphases and of limited or no emphasis.

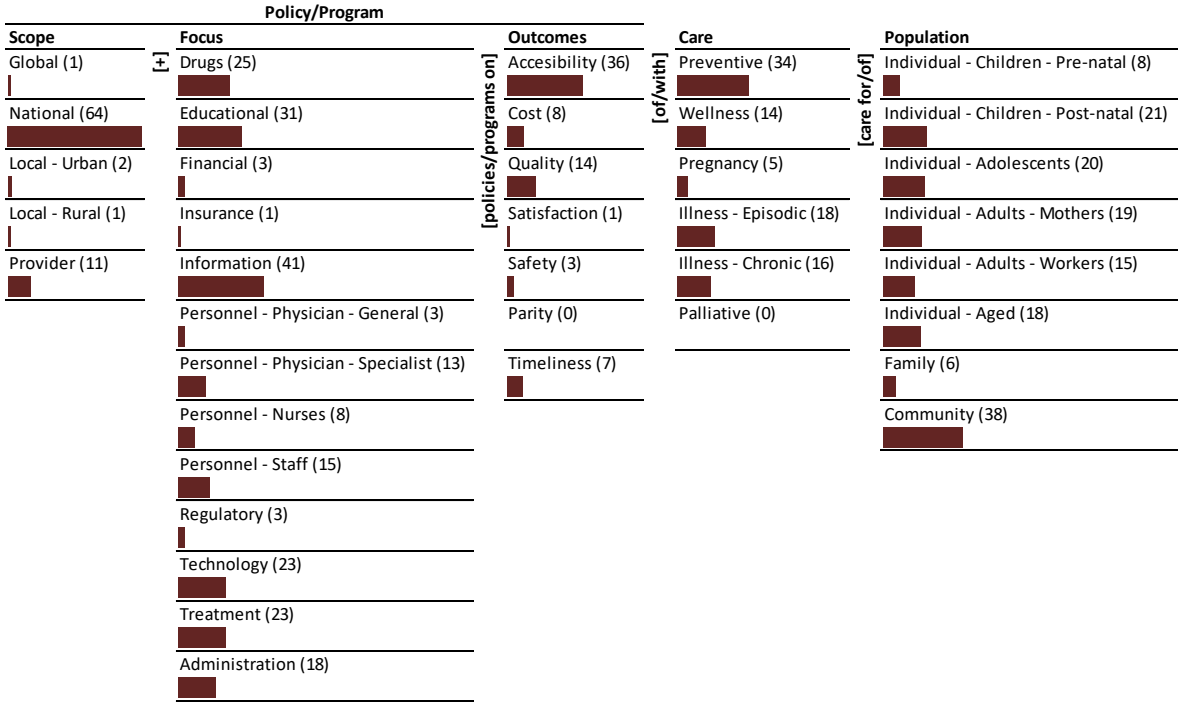

Figure 2 Ontological Map of India's National Healthcare Programs and Policies (Monads)

The ontological map of monads highlights the topography of the country's policies and programs considered as a system. As a system, the dominant focus is on the accessibility of healthcare. There is far less focus on the quality of the same, little focus on the cost and timeliness, and virtually no focus on safety, satisfaction, and parity. The lopsided priorities may be a consequence of the stage of development of the country's healthcare system. While accessibility is necessary, it is not sufficient to ensure the health of its citizens. A systemic analysis such as this can help shift the priorities in the future systematically.

The low emphasis on cost combined with very little focus on financial and insurance aspects also highlights the underlying philosophy of the policies and programs, as a government provided public welfare service. Should the priorities of the outcomes shift to quality and timeliness of care, for example, the emphasis on cost outcomes and the financial/insurance focus may also have to change. Some of these changes are evident on the ground but do not appear to be reflected in the corpus of programs/policies analyzed.

Similarly, the dominant target population of the polices is the community. Individuals are emphasized much less; family even less. Combined with the dominant emphasis on preventive care, the policies and programs appear to place a very significant emphasis on community preventive care. On the other hand, palliative care is given no attention, and family as a target of care is given only some attention. This combination may reflect a significant shortcoming as the population ages and palliative care is likely to increase in importance, and correspondingly the importance of the family which continues to be the most significant unit of care in India.

Thus, the ontological map can be used to analyze the systemic strengths and shortcomings of the national healthcare programs and policies, as a whole. Understanding the antecedents and consequences of the topography will help develop a roadmap for the future.

Illustrative components (total = 6*13*7*8*10 = 43,680):

National financial policies on accessibility of preventive care for family.

国家财政政策针对提高家庭预防性护理的可测性

Local $_{urban}$ insurance policies on cost of palliative care for individual $_{aged}$.

城市医保政策针对减少缓解老年人病痛的治疗费用

Provider administration policies on cost of illness $_{episodic}$ care of individual $_{adolescents}$.

服务提供者的行政管理政策针对减少青少年传染性疾病的治疗费用

Figure 3 Ontology of China's Health Care Policy and Illustrative Components

National Healthcare Policies of China

The following is based on Dai et al. (2016) analysis of national healthcare policies of China. The ontological framework of national healthcare policy in China is shown in Figure 3. It is derived from the same ontological framework used for studying India's national healthcare policies and programs, and adjusted to the context of China's policy environment. It has also been translated into Chinese so that the policy documents could be coded in the original language and does not have to be translated.

The dimensions of the framework are the same but the taxonomies of all but the Outcomes have been adapted to the Chinese context. These adaptations themselves indicate some of the systemic structural differences between India and China's national healthcare strategies. The Regional element of Scope, and Food/Legal elements of Focus are significant additions to the respective taxonomies. Similarly, in Care, Mental Illness, Physiological Illness, and Emergency care have been added. Last, the taxonomy of Individuals in the Population is more refined than in India with the inclusion of Workers and the Disabled.

The ontological map of the 289 current policies studied also highlights a very different topography compared to India. Among the Outcomes, in contrast to India, there is far less emphasis on Accessibility, and far more on Safety, Quality, Cost, and Timeliness. There is also significant emphasis on Satisfaction and Parity. The healthcare system in China may be in a more advanced stage compared to India, thus lessening the emphasis on accessibility and increasing that on other Outcome elements. It may also reflect a very different national healthcare strategy. The profile of Scope and Focus are also very significantly different. Many policies are Provider based in additional to being National. There is a significant emphasis on all the elements of Focus – including Administration, Treatment, and Technology. Again, in contrast to India, all types of Care are given significant attention including Mental-Illness,

Physiological-Illness, Occupational-Illness, and Palliative care. In the Population, the emphasis on the Family is close to that on the Community. These comparisons are illustrative and not comprehensive. They demonstrate how the ontological maps can be used to study and compare the systems of national healthcare policies of a country.

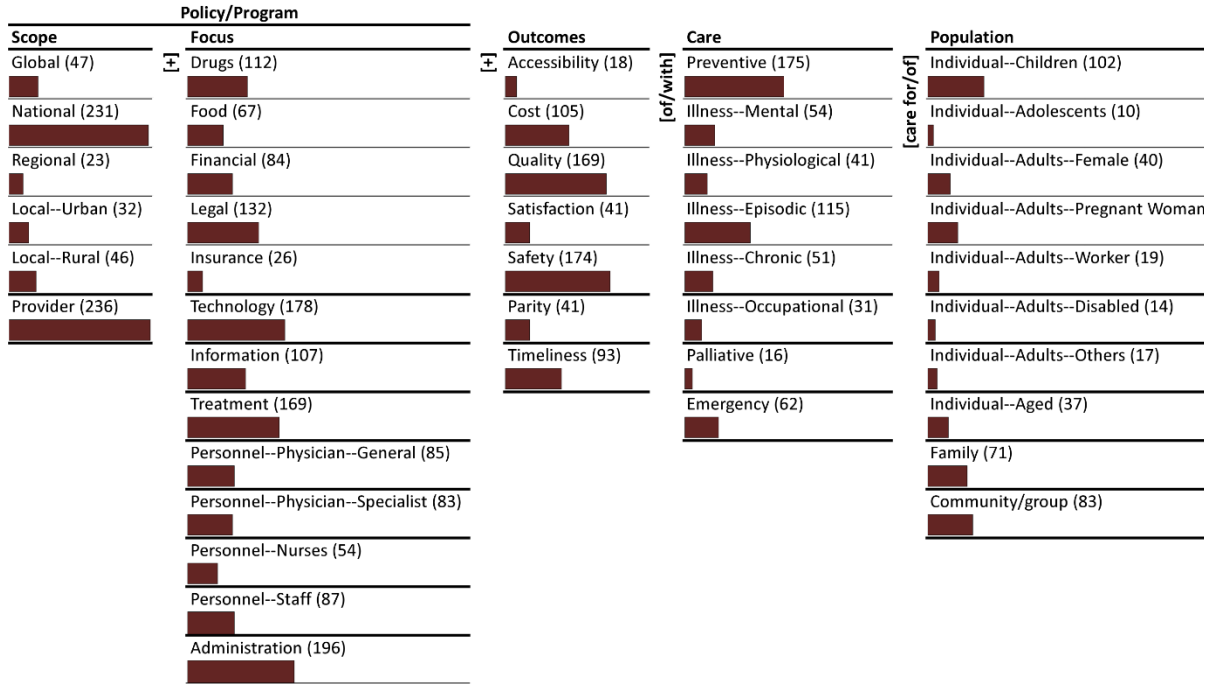

Figure 4 Ontological Map of of China's Health Care Policies (Monads)

Discussion

The ontological frameworks and the corresponding ontological maps help study the national healthcare policies and programs as a system, rather than its individual components or fragments. It makes the 'elephant' visible to the policy makers, researchers, and practitioners. Using structured natural language (English and Chinese), it literally allows one to see how the whole can be greater (or less) than the sum of the parts.

Systems theory and its variants are often invoked as bases of description, explanation, prediction, and sometimes control in public policy making. Ontological frameworks are one

way of encapsulating the combinatorial complexity of the public policy problems, systematically and parsimoniously, without oversimplification or narrow selection. They are semantically meaningful and can be understood easily by all stakeholders. Consequently, it can serve as a common grid for all stakeholders to map their present state, the desired state, the gaps, and pathways to bridging the gaps. It can be used to map the state-of-the-policies, the state-of-the-research regarding the policies, the state-of-the-practice, to determine the gaps within and between the three states, and to develop a roadmap for policies, research, and practice to bridge the gaps.

We have presented two variants of an ontological framework for national healthcare programs and policies, one applied to India and the other toe China. The Chinese framework has been translated without loss of semantic validity to the Chinese language. The structural differences in the two frameworks indicate some of the basic differences in the two countries' systems of national healthcare policies and programs. There are also substantive differences in the two countries' systems. These are highlighted by the differences in the topography of the monads.

The gaps, and the need to bridge them, also help focus epistemological studies of their antecedents and the consequences.

Conclusion

In this paper we have illustrated the application of ontological meta-analysis and synthesis in public policy to understanding national health policies of India and China. The method can be generalized to other domains of public policy. The contribution of the method to any domain would be three-fold. First, a systemic framework in structural natural language that encapsulates the logic of the domain. Second, a map of the luminosity of the different elements and themes (not discussed in this paper) of the domain, based the available evidence.

The maps can be of the state-of-the-policies, -research, or -practice. An epistemological understanding of the antecedents and consequences of the topography of each state and the gaps between the states will help create pathways to more effective policies, and also more effective translation between policies, research, and practice.

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