RESEARCH ARTICLE

On Influencing Factors in Metaphor Variation for Five Elements Translation in TCM: A Binomial Logistic Regression Analysis

YAYUAN QU[1], JIRONG GUO[1], AND XIAOMING WANG [2]
[1]School of Foreign Studies, Xi'an Jiaotong University, Xi'an 710049, China
[2]Office of Academic Research, Xi'an International Studies University, Xi'an 710128, China

Corresponding authors: Jirong Guo (guojr@xjtu.edu.cn) and Xiaoming Wang (wxm@xisu.edu.cn)

ABSTRACT Metaphor variation for English translations of Five Elements will impair the effect of Traditional Chinese Medicine (TCM) international communication. Few studies focus on contributing factors in metaphor variants for Five Elements translations. We model the binary designations for the Five-Element metaphor variants to analyze the internal and external language factors affecting the choice of ontological and structural metaphor, with the data from a corpus of six translations of *the Inner Canon of Yellow Emperor*. Statistical results unveil that the clause type, the syntax of Causer, language varieties, and the interaction of the clause type and language varieties significantly influence the metaphor variants. The complex interplay of the clause type and language varieties can explain people's cognitive differences in conceptualizing five elements. The study sheds light on the research of the Five Elements translation from the view of Construction Grammar and shows the benefit of machine learning technology for quantitatively describing and explaining the metaphor variation. It may hopefully uncover translators' cognitive mechanisms and pave a new way for TCM translation studies.

INDEX TERMS TCM translation, cognitive sociolinguistics, logistic regression.

I. INTRODUCTION

The image-schematic structure is an abstract cognitive model that provides structure to conceptualize the world, entrenched as language knowledge in speakers' minds and conventionalized as constructions in the speech community [1]. In *the Inner Canon of Yellow Emperor*, guided by embodied experiences of real-world events and physiological feelings, ancient Chinese people employed their mental imagery of the features of five elements[1] to refer to human life activities [2], [3], [4],

---

The associate editor coordinating the review of this manuscript and approving it for publication was Wenbing Zhao [ID].

[1]In *the Inner Canon of Yellow Emperor*, the five elements theory appears on two conceptual levels.

On one level it serves to group phenomena. For example, flavors consist of sour, bitter, sweet, acrid and salty; orifices consist of eyes, tongue, mouth, nose and ears; qi consists of wind, heat, dampness, dryness and cold. Ancient authors selected only a limited number in five representatives from the vast array of natural, metaphysical and other categories of phenomena perceived by humankind to express their notions of systematic correspondences in five elements theory.

[5]. In people's mental processes, the metaphorical mapping occurred between the image schema of five elements and the physiological status & pathological conditions [6]. To record the mental and perceptual representation, people used the ancient Chinese characters "生" (shēng), "主" (zhǔ), "伤"

On a second conceptual level the five elements theory serves to depict the human organism as a system of interrelated morphological units as well as physiological functions; to link these units and their functions to man's environment. Accordingly, Chinese scholar claimed the system as "六生一主五在十二其三伤三胜神系." (shénxì of six *shēng*, one *zhǔ*, five *zài*, twelve *qí*, three *shāng* and three *shèng*) The "神系" (shénxì) model aims to explain interactions among the environment and the body & among the various units within the organism. As Li said, "the dynamic model describes a large system with endless circulation, driven by the transmission of spring, summer, autumn and winter. Everything in the universe lives in this system." While the system of correspondences points out associations among phenomena, its metaphorical reasoning allows for a significant degree of ambiguity when it comes to an explanation of interactions occurring among these phenomena. In the current study, we would select "生" (shēng), "主" (zhǔ), "伤" (shāng) and "胜" (shèng) from "神系" (shénxì) model as the language units to analyze the metaphorical variation for five elements translation.

(shāng) and "胜" (shèng)[2] to code the meaning of five elements in TCM [7]. Five-element lexical-causative construction (hereafter referred to as five-element construction) goes far beyond the language unit but substantially impacts the theoretical system in TCM. Expressly, the form-meaning pairings can generally reflect the mental process when people make sense of the meaning of five elements.

According to Newmark [8], the primary issue of text translation relies on translating metaphors. Metaphor embodies human's basic cognitive model, categorization and conceptualization, and the underlying cognitive operation controls our thinking and language use. The translatability of metaphor depends on the degree of overlap between the source and target languages in cognitive experience and cognitive models. The existence of similar metaphorical mapping in the two different cultures would make translating easy [9]. As a universal category of causality, lexical-causative construction can activate the conceptual structures that represent similar human experiences in cross-cultural contexts [10]. Nevertheless, the English translations of five-element constructions are different in the translated texts. Some claimed that specific sociocultural experiences and basic cognitive and experiential models are applied differently, resulting in differences in conceptual domains or structures between languages [11]. This will lead to the difficulties in translating and challenge the effect of cross-cultural communication of five elements in TCM.

Under the guidance of the usage-based theory, Cognitive Sociolinguistics examines the cognitive and social factors that influence language use [12], [13]. Under the methodology framework of Cognitive Sociolinguistics, some scholars have studied language variation from the onomasiological perspective [14]. For example, the alternation of causative constructions in language variants is concerned [15]. The current study aims to contribute to this line of inquiry by examining the five elements metaphor variation by investigating internal and external language factors[3] of the five-element construction [16], [17], [18], [19], [20]. We may possibly find out the factors influencing the similarities and differences of the translators' conceptualization and their cognitive mechanism. It is because translation itself is a metaphorical process subject to cognitive models. The translator maps the concept of five elements in the source language to the target language by activating or modifying his cognitive resources, in terms of various expressions.

Although there are prior studies carried out to compare the semantic difference of the five-element theory in translations from the view of rhetoric [21], [22], very few studies have

observed the issue quantitatively, with construction features from a typological perspective. To fill the gap, we will verify the metaphorical variation for five-element construction on the strength of the knowledge of polysemy link of Construction Grammar. The study also aims to introduce the quantitative methods in Cognitive Sociolinguistics into the field of translation studies and to illustrate the power of multivariate statistical analysis.

Literatures of typological studies we mentioned above demonstrate that semantic, syntactic and social properties of causative constructions affect language variation. Hence, we hypothesize that these features may likewise influence the metaphor variation for five elements translations. By testing the hypothesis, this paper endeavors to answer the following two questions:

1) Which internal and external language factors may cause the metaphor variation for five-element constructions?
2) How do the metaphor variants for five-element constructions compete in different English translations?

We expect the findings will help explore how translators draw on basic and widely shared schematic knowledge that structures our ability to reason and communicate about five-element constructions in TCM. Section 2 reviews the previous studies on situating the issue of lexical-causative constructions in multivariate data for the possible variation, as well as five-element construction metaphor & polysemy in Construction Grammar. Section 3 introduces the research materials and data annotation schema. The modeling & results, and discussion will be presented in Section 4 and Section 5, respectively. Section 6 ends the paper with a conclusion and limitations.

II. RELATED WORK
A. LEXICAL-CAUSATIVE CONSTRUCTIONS WITH MULTIVARIATE ANALYSIS

Typological studies demonstrate that lexical-causative construction is a linguistic and cognitive universal that occurs in most languages when human beings address causality [23]. According to the "Force dynamic" model, in the lexical-causative construction, external argument X (Causer) exerts impact on argument Y(Causee) [24], indicating the pattern of [[x DO-SOMETHING] CAUSE [y BECOME STATE]] [25], [26]. Take "kill" as an example. It encodes the CAUSE (kill) and the RESULT (dead) into a transitive verb [26], [27]. Similarly, in ancient Chinese language, the lexical-causative construction refers to the causative verb containing "action + result," such as "杀" (shā, it means "kill" in English). For example, in the causative event of "A 杀 B" (A kills B), the verb "kill" combines action (A kills) and result (B dies).

The semantic frame of the causative verb has a constraint on the use of lexical-causative construction, determining the syntax and semantic properties of the arguments embedded. Researchers have identified the influencing factors in the construction variation by examining the syntax and semantic

---

[2]According to *the Neijing Dictionary*, "生" (shēng) in the present study means "nourishment" and "promotion". (on Page 348 in *the Neijing Dictionary*). "主" (zhǔ) refers to "to dominate" and "to govern" (on Page 19), "伤" (shāng) means "to impair" and "to damage" (on Page 57) and "胜" (shèng) refers to "to constrain" and "to restrict" (on Page 86) respectively.

[3]Based on the previous findings, we endeavor to apply the internal and external factors researchers have tested in the current research. Details about how we label and identify these factors will be presented in Section 3.

properties of the agents and patients. Scholars such as Speelman and Geeraets claimed that they had provided compelling evidence to justify the (in)direct causation hypothesis proposed by Verhagen, Kemmer and Stukker using logistic regression analysis [18], [28], [29]. Besides, Cognitive Sociolinguistics studies have shown that the multivariate statistical model has been widely recognized to be instrumental in explicating the variation of meaning by investigating the integration of internal and external language factors (such as speakers' region, gender, age, social class and so on) [12], [30]. Empirical researches in this line mainly focus on the semantic difference of causative verbs in varieties of Dutch and the dative alternation in English varieties [17], [18], [31]. This line of research suggests that the present study may analyze the variation of five-element constructions with the indicators tested in these empirical studies. The scope of the previous studies above can be expanded from the meaning disparities of causative verbs or the alternation of dative to provide more insights for five-element metaphorical variation in TCM translation studies.

Furthermore, Weiwei Zhang also used the logistic regression and Poisson models to investigate the (non)metonymic expressions for place names and women's referents in Chinese varieties, and metonymies for PERSON in Chinese and English in the framework of Cognitive Linguistics with an emphasis on cross-linguistic variation [20], [32], [33]. The case studies show that quantification and statistical techniques constitute essential parts of an empirical analysis based on corpus data. The empirical findings demonstrate the essential need to extend research on metonymy in a variationist Cognitive Linguistics direction by studying metonymy's linguistic, cultural, historical, and social-lectal variation. These studies show that the linguistic, cultural, and social elements contribute to the language-specific preferences for metonymies of a given target.

Lastly, we are also enlightened by the engineering work which used machine tools for a comprehensive model to predict the demands in the real world. For example, scholars in Nanyang Technological University used a massive dataset of historical ambulance demand records to model the multinature dependencies of ambulance demand for predicting the next-day demand at all regions of Singapore [34]. The previous work encourages us to leverage capabilities of the machine leaning tools to model the complex pattern within the data.

The above provides a reference paradigm for the present study, i.e., the machine learning technology, such as random forests, the Naïve Bayes and SVM combined with logistic regression model can be applied to analyze the internal and external language factors affecting metaphorical variation for five elements translations.

B. FIVE-ELEMENT CONSTRUCTION METAPHOR AND POLYSEMY IN CONSTRUCTION GRAMMAR
The five-element theory in TCM claims that the world consists of five basic materials, i.e., Metal, Wood, Water, Fire,

and Earth [35]. It is part of the cornerstones of TCM philosophy. Its principle is similar to Conceptual Metaphor Theory in Cognitive linguistics. The five-element theory argues that the five elements work circularly, supplementing each other by seeking balance and harmony [36]. Ancient Chinese used the schema of the five-element theory to explain a wide array of phenomena, from cosmic cycles to the interaction among internal organs [37]. Specifically, the relations and features of five elements are employed as a source domain to metaphorically map the physiological function of human organs, which is stated as the target domain. In *the Inner Canon of Yellow Emperor*, ancient Chinese characters "生" (shēng), "主" (zhǔ), "伤" (shāng) and "胜" (shèng) were applied as linguistic constructions to illustrate the five-element theory in TCM.

Construction Grammar argued that grammatical constructions were polysemous: each pattern was typically associated with several related senses, organized in a radial network, with a central sense and a few semantic extensions [38]. In other words, the schematic and more regular constructions constitute prototypes, while more specific constructions are a metaphorical extension of the central instances of constructions. In the present study, we found translators had different ways of conceptualizing the meaning of the five elements by using five-element constructions that differ in form and meaning.

Take "生" (shēng) as an example. The five-element theory believed that one of the essential relationships among five elements was promotion and nutrition. The English translation of "生" (shēng) varies from each other in the dataset, but the semantic meanings of "生" (shēng) in English varieties is related to the core meaning of "生" (shēng).[4] In the code-switching process, translators with different cultural and linguistic backgrounds allowed the metaphorical mechanism (ontological or structural metaphor)[5] to activate their schema image of "生" (shēng) and realized the extension

---

[4]In the Inner Canon of Yellow Emperor "生" (shēng) conveys the notion of an interaction among the five elements (Metal, wood, water, fire and earth), or among the categories of phenomena they stand for. One promotes the other, with the end of the sequence inevitably being the beginning of another, endless repetition of this same sequence. In the current research, we regard the core meaning of shēng as "promotion."

[5]In the present study, the concepts of the constructions like "生" (shēng), "主" (zhǔ), "伤" (shāng) and "胜" (shèng) allow us to study two metaphor types: ontological metaphor and structural metaphor. The reasons are as follows.

Our experiences with physical objects (especially our own bodies) provide the basis for a variety of ontological metaphors, that is, ways of viewing events, activities as entities. Once we can identify our experiences as entities, we can reason about them. Take the experience of "酸生肝" (Sour [flavor] generates the liver), which can be metaphorically viewed as an entity via the verb "generate". Viewing "酸生肝"(Sour [flavor] generates the liver) as an entity allows us to see it as an event. It gives us a conception that the "生" (*sheng*) has a productive capacity.

Structural metaphors allow us to use one highly structured and clearly delineated concept to structure another. Like ontological metaphors, structural metaphors are grounded in systematic correlations within our experience. Take "酸生肝" (This sour taste can strengthen the liver) as an example. The structural metaphor emerges naturally in a cultural setting of TCM because what the structural metaphor highlight corresponds so closely to the mechanism of five-element theory (one promotes the other).

TABLE 1. Syntax and semantics of five-element constructions and exemplars in corpus.

Five-element constructions	Syntax	Semantics	Exemplars
"生" (shēng) "主" (zhǔ) "伤" (shāng) "胜" (Shèng)	N_1 +VP +N_2	Causer +[Action+Result] +Causee	"风生木" (fēng shēng mù) The wind promotes [the growth] of trees.
			"肝主目" (gān zhǔ mù) Liver determines the eyes.
			"味伤形" (wèi shāng xíng) Excessive flavors damage the physique.
			"冬胜夏" (dōng shèng xià) Winter controls Summer.

TABLE 2. The chapters containing five-element constructions in *the inner canon of yellow emperor*.

Chapter	Chapter's Title	Summary of the Chapter
IV	Discourse on the True Words in the Golden Chest (by Paul U. Unschuld et al.)	The chapter focuses on the concept of four seasons, Yin and Yang, five elements and introduces the relationships between the function of viscera and natural climate change.
V	Comprehensive Discourse on Phenomena Corresponding to Yin and Yang (ibid.)	This chapter elucidates the theory of Yin and Yang and its five elements and uses it to refer to heaven, earth, and men through "image schema," demonstrating the impact of the theory on etiology, pathogenesis, diagnosis, and treatment in TCM.
X	The Generation and Completion of the Five Depots (ibid.)	This chapter describes the relationship between the five organs and their appearances and explains how five tastes of diet improve or impair the five organs to diagnose the disease caused by the deficiency of five organs.
XXII	Discourse on How the Qi in the Depots follow the Pattern of the Seasons (ibid.)	This chapter discusses the symptoms and treatments of the five organs' diseases and demonstrates that the Qi of the five organs of the human body corresponds to four seasons.
XXIII	Wide Promulgation of the Five Qi (ibid.)	This chapter applies the five-element theory to explain the relationship between Qi of five organs and the human body, such as five organs diseases, five veins, and five fluids.

of meaning. Like "酸生肝" (suān shēng gān), it is understood as "in Spring, grass and plant begin to grow since the sun and the wind is warm; wood can produce the sour taste which can nourish the liver in turn" [39]. Therefore, in our corpus data, "酸生肝" was translated as "This sour taste can strengthen the liver" by several translators. Here the translators employed the cognitive mechanism of structural metaphor to establish the mapping between the law of five elements (source domain) and the physiological phenomena of the liver (target domain). However, some translators put it into "Sour [flavor] generates the liver" and interpreted "生" (shēng) in the phrase as "generate". They translated "生" (shēng) based on its basic meanings referring to more explicit, human-related meaning in modern language usage. They equaled "生" (shēng) with "give birth to" or "generate." We determine that the translator used the ontological metaphor here. Thus, we may notice that the metaphor variation of "生" (shēng) is a radial network, with a central sense of "生" (shēng) in the source text and semantic extensions in different translations, reflecting the disparities of conceptualization of translators. The metaphorical reasoning underlying the translating process lead to metaphor variants for five elements translation. It should be noted that ambiguity in five elements translating may have an adverse effect on TCM's cross-cultural communication.

To date, research on English translation studies of TCM has relied primarily on an introspective method by a few examples. Meanwhile, several existing studies have shown that the knowledge of linguistic probability makes the corpus approach better than intuition [40], [41]. The present study will investigate the metaphor variation of five-element constructions (ontological or structural) using machine learning tools with the possible internal and external language factors. Hopefully, the finding will enrich the field of empirical studies on the cognitive mechanism of TCM English translation.

According to Conceptual Metaphor Theory, we have orientational metaphors in addition to ontological and structural metaphors. But it gives a concept of spatial orientation: up-down, front-back. In the source text, the concepts of "生" (shēng), "主" (zhǔ), "伤" (shāng) and "胜" (shèng) are not organized in terms of the orientational metaphor.

III. MATERIALS AND DATA ANNOTATION SCHEMA
A. DATA COLLECTION
We built a parallel corpus to verify what and how the factors influence the variation of the metaphors of five-element constructions. It contains six English translations by Li [42], Yang [43], Ni [44], Wu and Wu [45], Veith [46], Unschuld, *et al.* [47], and original Chinese text of *the Inner Canon of Yellow Emperor* [42]. The texts selected in the study are highly representative in the field of TCM English translations, including three language varieties[6] [5]. Table 1 and Table 2 show how we identify the five-element constructions in the corpus. A total of 579 five-element constructions in six English translations remained for the following analysis.

B. ANNOTATION SCHEMA
Referring to the reviewed studies [17], [18], [20], [48], we annotated the English translations of 579 five-element

---

[6]According to Yang Yu's research work, we categorize the six English translated texts into three language varieties. a) Professor Zhaoguo Li works in Shanghai Normal University. He received his PhD degree from Shanghai University of Traditional Chinese Medicine. Mingshan Yang is a professor in Shanghai University of Traditional Chinese Medicine. His research interest includes TCM translating and English teaching. Both were born and educated in mainland China. Therefore, Li and Yang should be the translators whose native languages are Chinese. b) Ilza Veith was a medical historian in America. She received her PhD degree from Johns Hopkins University. Paul Unschuld is a well-known medical historian in Germany. He was born and educated in Germany. So, Veith and Unschuld are regarded as Germanic translators. c) Maoshing Ni was a registered acupuncturist in California, USA. He was born in a family with a background of TCM practices in America. His bilingual ability enabled him to finish the translating work of *the Inner Canon of Yellow Emperor*. Liansheng Wu & Qi Wu are doctors of TCM in America. So, we classify Maoshing Ni and Liansheng Wu & Qi Wu as bilingual translators who are proficient in Chinese and English.

TABLE 3. Annotation schema.

	Variables		Scoring	Label
Predictors	Internal language factors	Causer's Semantic property	Human, body parts or animate objects =1; Inanimate or abstract entity =2; Natural force = 3; Events or activities = 4	cersem
		Causer's Syntactic property	Noun form = 1; Non-noun form = 0	cersynt
		Causee's Semantic property	Inanimate or abstract entity = 1; human, body parts = 0	ceesem
		Causee's Syntactic property	Noun form = 1; Non-noun form = 0	ceesynt
		Clause type	Simple sentence = 1; Compound sentence = 2; Passive sentence = 3	clausetype
	External language factors	Language variety	Chinese translator = 1; Bilingual translator = 2; Translators of Germanic language (English, German) = 3	variety
		Occupation	Physician = 1; non-physician = 0	clinic
		Gender	Male = 1; female = 0	gender
Responses	Metaphor variants		Ontological metaphor = 1; structural metaphor = 0	meto

TABLE 4. An adaptation of the MIPVU in the case study.

1. Find metaphor-related words by examining the text on a word-by-word basis
2. A word (five-element construction in English translation) is considered an indirect expression of metaphor, if its contextual meaning is related to a more basic meaning by some form of similarity. Then mark the word as structural metaphor. E.g., "This sour taste can strengthen the liver (酸生肝)". (see Section 2.2)
3. A word (five-element construction in English translation) is used directly here if there is no contrast between its contextual and basic meanings. Then mark the word as ontological metaphor. E.g., "Sour [flavor] generates the liver (酸生肝)". (see Section 2.2)

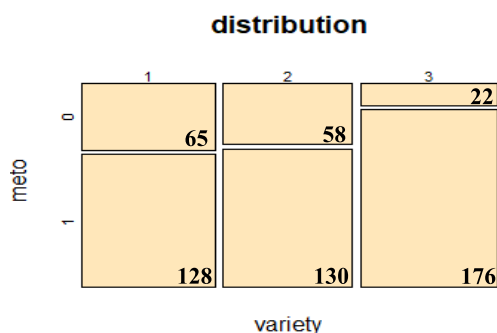*Note* Basic meaning refers to more specific, explicit and human-related meanings in modern language usage [49].

FIGURE 1. Distribution of metaphor variants.

constructions[7] (see Table 3), including eight predictors: syntactic and semantic properties of Causer and Causee, clause types of five-element constructions, language varieties, the translators' gender and occupation; we also used an adaptation of the MIPVU (see Table 4) to identify the response variable [49], which has two possible values: ontological metaphor and structural metaphor, namely, the metaphor variants of the five-element constructions. Coding was conducted manually by the first author of the paper and a trained postgraduate student of linguistics. Two raters first coded 10% of the samples together, and the interrater reliability of Cohen's kappa was 0.89. Disagreements were resolved by discussion. Then the two raters coded the remaining 90% of the data independently.

Figure 1 shows the distribution of metaphor variants of the five-element constructions ("shēng"(生), "zhǔ"(主),

"shāng"(伤) and "shèng"(胜)) in three English varieties. A quick glance shows that the ontological metaphors outnumber the structural metaphors. Compared with Chinese and bilingual translators, Germanic translators use more ontological metaphors than structural metaphors. In the following sections, we will identify the significant factors causing the metaphor variation of five-element constructions by using the logistic regression model and explore how the two metaphor variants compete with each other.

C. PREDICTORS

Due to the methodological issues (collinearity of independent variables) that can arise in the analysis of multifactorial data with generalized linear models (GLM) in corpus linguistics [50], the present study will tackle the issue with the technique of random forests in machine learning that allows researchers to study the effect of multiple predictors on the response.[8] In other words, random forests can offer the functionality of computing variable importance scores, which quantify the size of the effect that a predictor has on the response [51]. Effect sizes will be reported in variable importance scores resulting from the random forests analysis.

---

[7]Take "东方生风" (dōng fāng shēng fēng) (English translation: The east produces wind) as an example. Here is how we label it: Clause type (simple sentence); Causer's semantic property (inanimate or abstract entity); Causer's syntactic property (noun form); Causee's semantic property (inanimate or abstract entity); Causee's syntactic property (noun form); Language variety (Chinese translator); Occupation (non-physician); Gender (male); Metaphor variants (ontological metaphor).

[8]Together with the random forests, we tried the Naïve Bayes and SVM technology in the present study. By comparing with the accuracy index of three models, we found that it is the random forests technique that can produce the optimal result. (The accuracy index of three machine learning models is as follows: SVM (0.70), Naïve Bayes (0.71) and random Forest (0.83).)
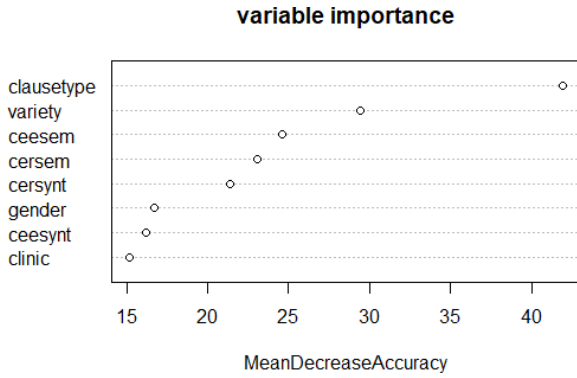
variable importance

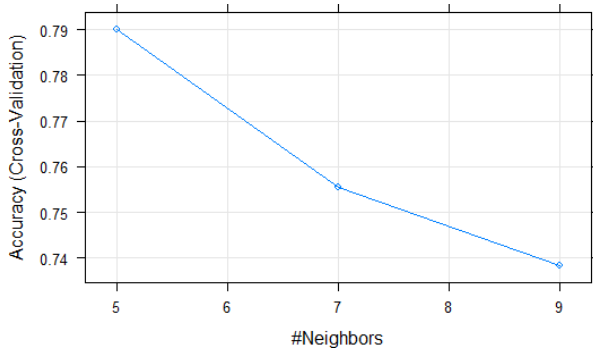**FIGURE 2.** The rank of variable importance by random forests model.

FIGURE 3. Optimal numbers of predictors by five-fold cross-validation.

Hence, we employed the randomForest package of R software to identify the most critical variables that affect the response. The data set (English translations of 579 five-element constructions) was first split into a training set (70%) and a test set (30%). We ranked the importance of predictors with the random forests model grown on the training set (see Figure 2).

Through validating the random forests model with the test set, its Accuracy (0.83) and Specificity (0.99) showed that the model was satisfactory in judging the dependent variable as a structural metaphor, indicating that the model might screen out the influencing factors that could best explain how structural metaphors generate.

Figure 3 depicts that the optimal number of independent variables determined by five-fold cross-validation [52] is five (Accuracy is 0.79).

All above show that the variable of clause type has the most significant influence on the response, followed by language variety, Causee's semantic property, Causer's semantic property, and Causer's syntactic property. Here is a summary of the five predictors with exemplars in the corpus:

·Clause type (labeled as clausetype)

The variable stands for three clause types: simple sentence ("东方生风" (dōng fāng shēng fēng) (English translation: The east produces wind)); compound sentence ("湿生土，土生甘，甘生脾" (shī shēng tǔ, tǔshēng gān, gān shēng pí) (English translation: The damp spreads in the center to fertilize the

earth, which generates the sweet that nourishes spleen)); passive sentence ("化生五味" (huà shēng wǔ wèi) (English translation: By such transformation, five flavors are generated)).

• Language variety (labeled as variety)

The variable represents three English varieties used by six translators, including Chinese translators, bilingual translators, and translators of Germanic language (English and German).

• Causee's semantic property (labeled as ceesem)

The variable represents the properties of Causee's semantics: inanimate or abstract entity ("东方生风" (dōng fāng shēng fēng) (English translation: The east produces wind)); human, body parts ("肝生筋" (gān shēng jīn) (English translation: [the blood stored in] the liver nourishes the sinews)).

• Causer's semantic property (labeled as cersem)

The variable stands for the properties of Causer's semantics: human, body parts or animate objects ("筋生心" (jīn shēng xīn) (English translation: the sinews nourishes the heart)); inanimate or abstract entity ("中央生湿" (zhōng yāng shēng shī)(English translation: The center (the central region) produces dampness)); natural force ("风生木" (fēng shēng mù) (English translation: the wind promotes [the growth] of trees)); events or activities ("道生智" (dào shēng zhì) (English translation: the Dao(rules or principles) enables [human beings] to become intelligent))

• Causer's syntactic property (labeled as cersynt)

The variable represents the syntax of Causer: noun form ("东方生风" (dōng fāng shēng fēng) (English translation: The east produces wind)); non-noun form ("道生智" (dào shēng zhì) (English translation: in the course of adapting the change of all things, the wisdom produced)).

IV. EXPERIMENT AND RESULTS

Though random forests were frequently used in statistical studies since they generate reasonable predictions across a wide range of data requiring trim configuration [53], researchers might find it challenging to analyze and explicate the direction and value of each independent variables in the random forests model. In the section, the present study would solve the problem by combining random forests and logistic regression model [50].

A. MODELLING

The logistic model is used to model the probability of certain classes, such as win/lose represented by ''1'' and ''0'', which is commonly applied in linguistics to assess alternation of synonym constructions [31], [54]. Since the response variables in the present study have two values: ontological/structural metaphors, the data analysis was conducted with the rms and stats packages of R software to model the probability of the output [55], to make a binary classifier following two steps: model selection and diagnostics.[9]

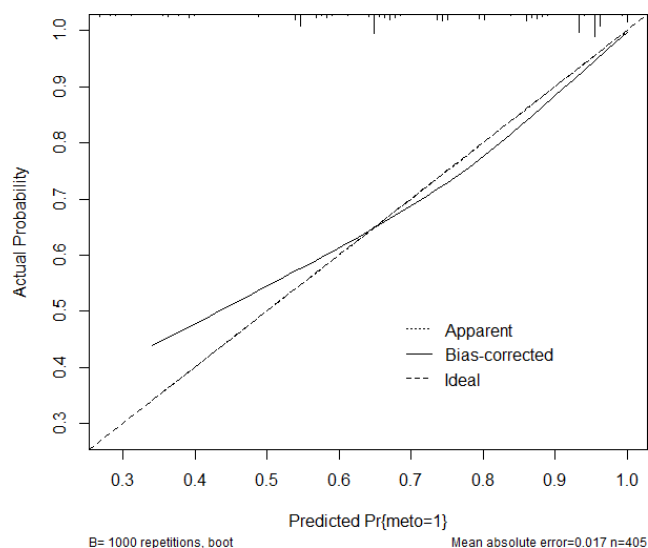[9]The codes of all models in the present study are available in the Open Science Framework repository, https://osf.io/wkuhv/

FIGURE 4. Calibration curve of the logistic regression model.

TABLE 5. The statistical output of the main effect of the predictors in the logistic regression model.

Predictors	Coefficients	Std. Error	z value	P
Intercept	-0.90	0.47	-1.91	0.05*
cersem2	0.42	0.32	1.30	0.19
cersem3	0.48	0.41	1.18	0.23
cersem4	1.67	0.86	1.94	0.05*
cersynt1	1.08	0.38	2.83	0.00**
ceesem1	-0.02	0.28	-0.09	0.92
clausetype2	2.52	0.77	3.23	0.00**
clausetype3	-1.18	0.66	-1.77	0.04*
variety2	0.42	0.40	1.04	0.29
variety3	2.42	0.47	5.13	0.00***

Note *p < 0.05; **p < 0.01; ***p < 0.001; α level (0.01)
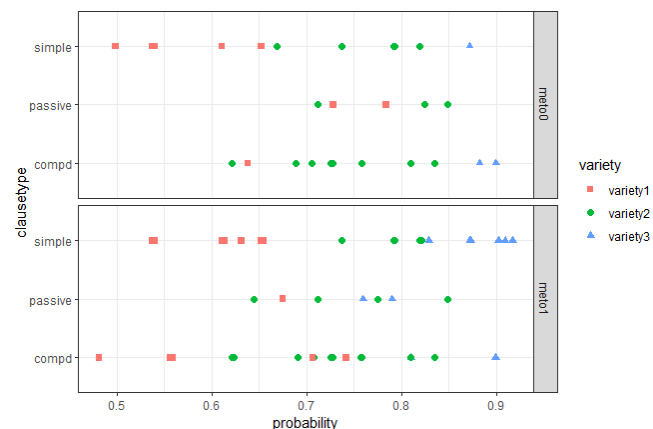
FIGURE 5. Interaction of clause type and language variety.

In the model selection part, we first divided the dataset of English translations of 579 five-element constructions into a training set (70%) and a test set (30%). With the lrm function in the rms package, we fit a logistic function to the training set consisting of the five predictors selected by random forests and the interaction of every parameters, and the responses of the two metaphor variants (ontological metaphor = 1, structural metaphor = 0). We chose the model with the highest C index (0.78) in the end. The R code for the model is as follows:

$$fit1 = lrm(formula = meto \sim cersem + cersynt + ceesem \\ + clausetype + variety + clausetype : variety, data \\ = train\_data, x = T, y = T)$$

Then, we used the glm function in the stats package to model the training data again, with the same parameters in the lrm function model above. Similarly, we produced several models as well. We used the ANOVA function to confirm the optimal model. And the AIC (392.3) of the very model is satisfactory. The R code for this model is as follows:

$$Multi.Model1 \\ = glm(meto \sim cersem + cersynt + ceesem \\ + clausetype + variety + clausetype : variety, data \\ = train\_data, family = binomial(link = ``logit''))$$

Before diagnosing the above Multi.Model1 generated by glm function, we would like to explain two crucial indices: C index (0.78) and the AIC (392.3). The two fit statistics were inspected to see whether the selected model could yield an accurate result. For the C index, a value close to 1 indicates that the model has a good predictive ability. The smaller the value for the AIC (Akaike's Information Criterion), the better the model is.

Second, the model was verified with the test set [56]. Results showed that the model's overall quality is satisfactory,

with an AUC of 0.72 and an Accuracy of 0.72. We also plot the calibration curve of the model (see Figure 4), which showed that the model had good accuracy and substantially higher predictive power. It is expected that the model would produce the best fit indices and would be applied in the present study.

B. RESULTS
In this section, we will interpret the statistical output of the model produced in the experiment (see Table 5). The model's response, in this case, is the logit of meto = 1 (ontological metaphor).

1) MAIN EFFECTS OF THE PREDICTORS
The importance of predictors in the model is displayed in Table 5. From the coefficients in the table, it is evident that the predictors of cersynt1 (Causer's syntax as noun form), clausetype2 (compound sentence), and variety3 (Germanic translators) appear to have a significant impact on the metaphor variation. Besides, Table 5 shows that clausetype2 is the most critical predictor and has the most decisive impact on the response, followed by variety3 and cersynt1.

2) INTERACTION OF THE PREDICTORS
As a significant interaction is found with the predictors of the clause type and language variety, the present study will graphically represent the interaction of the clause type and

language variety in the model (see Figure 5). In the figure, the top and bottom lines are probability plots of two metaphor variants (meto0 in Figure 5 stands for the structural metaphor; meto1 for the ontological metaphor). The x axis in the plot represents the probability, and the y axis represents three clause types (simple, passive, and compound). We tagged the language variety with three graphics in the plot (square for Chinese translators, circle for bilingual translators, and triangle for Germanic translators). The tag's location represents the interactive effect of predictors on the metaphor variation in terms of probability.

The top line of Figure 5 shows the probability that bilingual and Chinese translators used passive sentences in structural metaphors is 85% and 78%, respectively. It is noticeable that Germanic translators used no passive sentences in interpreting five-element construction. In the bottom line of Figure 5, there is a 90% probability that Germanic translators used compound sentences in ontological metaphors, followed by bilingual and Chinese translators (each for 84% and 74%).

In brief, the ontological metaphor mechanism exerts impacts on the conceptual systems of six translators when they convey the meaning of five elements. It is in line with the overall distribution of metaphor variants in Figure 1. All translators would allow more ontological metaphors to explicate the five-element constructions by three clause types. Also, the relationship between language variety and metaphor types changes depending on the variable of Clause type (passive sentence), which may explain the uneven distribution of structure metaphors in Figure 1. The bilingual and Chinese translators tend to employ more passive sentences in structural metaphors (the probability is 85% and 78% as above) than Germanic translators (zero probability). It may explain bilingual and Chinese translators employ more structural metaphors (123 structural metaphors in total) than Germanic translators (22 structural metaphors in all).

V. DISCUSSION
A. IMPACT FACTORS IN METAPHOR VARIATION
1) CAUSER'S SYNTAX
We predict that the syntax of the Causer (noun form) is one of the most critical factors contributing to the generation of ontological metaphor for five-element construction in six translations (as shown in Table 5). In his Autonomy-Dependence Alignment model, Langacker argued that Autonomous components are usually entity nouns, which have directivity and do not need to be attached to other components [25]. Dependent components usually refer to prepositions, verbs, etc. The relationship of autonomy and dependence can clearly indicate the elaboration and correspondence between the substructures of the dependent components and semantic profile of the autonomous components and the composite of the two. In our case, when people use noun form as Subject (Causer) in a sentence, the Causer personified and capable of human's ability to generate power to change the state of the Causee, thus forming a causative construction. Take

"气伤精" (qì shāng jīng) (English translation: [excessive] Qi damages the Essence, translated by Zhaoguo Li) as an example. "气" (Qi, its syntactic property is noun form in translation) is followed by the transitive verb "damage," which causes damage to "精" (the Essence). "伤" (shāng) (English translation: damage) synthesized the two elements of ACTION (cause physical harm) and RESULT (which make sth. less valuable/attractive), entrenched as a lexical-causative construction in TCM. The metaphorical variation for the English translation of the five-element construction is ontological. In this way, the abstract concept of Qi in TCM is personified in English translation. The autonomy-dependence relationship of "气" and "伤" can be considered as the sub-categorization of five-element theory and how it is applied in TCM clinical practice, that is, "气" is capable to hurt "精" (jīng) if it is improperly used.

To sum up, the Causer's syntax impacts the metaphor variation for the five-element construction. It depicts a link between the categories of grammar and the reality. The direct line of form to meaning to experience is maintained intact. The grammatical functions assigned to the arguments in the five-element construction express both the roles of these parts in respect to the whole and translators' selection in meaning. The grammatical pattern bears a natural relation to the meanings they have evolved to express. In this case, the change of Causer's syntax reflects the various metaphorical conceptualization of people from different cultures.

2) CLAUSE TYPE
We also predict that the variable of the clause type is significant for the result of the model (as shown in Table 5). Based on the "Force Dynamic" model, Wolff proposed "force theory" to explain people's cognitive representation of the causal relations [57]. The core of the "force theory" was relation composition [58], which could provide a theoretical perspective for interpreting the phenomena that translators preferred to use a compound sentence in the ontological metaphor. Because the relation composition can provide an account of how individual relations join to form causal chains and how these chains may then derive new overarching causal relations. In the cognitive process, people can enact the process to join forces in the world, including physical, psychological (e.g., intentions), or social forces, through a conceptual metaphor mechanism.

For instance, "中央生湿, 湿生土, 土生甘, 甘生脾" (zhōng yāng shēng shī, shī shēng tǔ, tǔ shēng gān, gān shēng pí) contains four "生" (shēng) (four five-element constructions). According to the force theory, a new overarching configuration of forces was derived by selecting and adding specific forces from the sub-configurations. In this case, it is proper to understand the causal relation composition of four "生" (shēng) as a whole. Mingshan Yang's translation was "The damp spreads in the center to fertilize the earth, which generates the sweet that nourishes spleen." The translator interpreted the causality in each four construction as a whole by using a compound sentence. The translator determined a

force (Causer) from the sub-configuration of forces. In the translation, "The damp" ("湿" (shī)) was chosen as the Causer to transmit the force.

Hence, we can conclude that translators can combine several lexical-causative constructions (A "生" B) in terms of a compound sentence to understand the abstract movement of five elements. It is assumed that experienced translators can specify the origin and direction of the various forces in a configuration of forces. In the cognitive process of composing causal relationships from complex animations of real-world events, people use iconic perceptual codes to parallel the structure of the world. The codes are perceptual because they mirror the internal organization of the mental representations produced from directly perceiving a causal event, which implies that causal reasoning may be based on the ontological metaphor mechanism.

3) LANGUAGE VARIATY

We predict that Germanic translators tend to employ the ontological metaphors to express five-element construction, while Chinese and bilingual translators would like to use the structural metaphors. Hermeneutics holds that the various interpretations of the translations of the classics are the modes of the being of the texts [59]. The translator's preconceived idea and habitus confine the scope of understanding in the text. In other words, the translators' custom may bring about a great sensitivity to understand the classics from multiple perspectives. In the current study, Germanic translators did not share the tradition with Chinese and bilingual translators. They had different opinions of the historical settings, cultures, and folkways. For example, Ilza Veith was one of the pioneer translators of *the Inner Canon of the Yellow Emperor*. Ilza Veith was more inclined to the basic meaning of "shēng" (生), "zhǔ" (主), "shāng" (伤) and "shèng" (胜), which was related to the lack of theoretical training of TCM (Veith was a medical historian) and references at the time. Therefore, Ilza Veith used more ontological metaphors to express the meaning of five elements.

B. INTERACTIVE IMPACT ON THE METAPHORICAL VARIANTS

Figure 5 depicts that there is a significant interactive effect between the clause type and language variety. It is related to the interpretation that people with various cultural backgrounds may have a different cognitive mechanism that affects the choice of metaphor types [60]. Wolff believed that the perceptual representations of causality exist in all languages, but people would categorize and linguistically represent the causal events differently based on their cultural settings and cognitive resources [61]. He further claimed that Causal pluralism consisted of both Dependency and Production theory [62], which could account for how people in various language communities interpreted the causal relations by diverse clause types.

People will regularly use the passive sentence if he holds that the causal relation is determined by the dependency relationship in the causative construction. The reason is that the absence of Causer in causal relation would change the direction of the force. Take "化生五味" (huà shēng wǔwèi) as an example. In Mingshan Yang's translation (By such transformation, five flavors are generated), "化" (huà) lost the grammatical function as being a Subject (Causer) in the source language. In the context, its semantic meaning differs from the literal meaning (transformation) and refers to the changing process of five elements ("In the east, the wind springs up, ... Such great variations are manifested in the cosmology of the heavens, the law among human beings, and transformation on the earth."). In this case, "五味" (wǔwèi) as the new Causer emanated the force because the translator had better knowledge of the five-element theory. Thus, the Chinese translator linguistically presents it in a passive sentence and employed the structural metaphor mechanism.

In comparison, we notice that Germanic and bilingual translators tend to apply simple and compound sentences to express the causal events and apply the ontological metaphor mechanism correspondingly. Wolff argued that it was the direction of force or energy transmission that produced a change in the cognition of causal relation based on Production theory. For example, Veith and Unschuld tend to translate "生" (shēng) in "湿生土, 土生甘, 甘生脾" (shī shēng tǔ, tǔshēng gān, gān shēng pí) as "nourish", "produce" and "generate" and use simple sentences. The translators applied the perceptual codes ("nourish", "produce" and "generate") to represent their cognitive process when interpreting the five-element construction, which involved the ontological metaphor mechanism. Besides, Maoshing Ni translated "风伤筋, 燥胜风" (fēng shāng jīn, zào shèng fēng) in terms of a compound sentence: "When wind invades with dampness, it can injure the tendons, although dryness may eliminate the dampness and wind." It is apparent that the translator employed the ontological metaphor in the conceptualization of five-element construction.

In brief, due to people's varying understanding of causality, the distribution of metaphor variants is uneven in Fig. 1. Contrasted with Chinese and bilingual translators, Germanic translators used the least structural metaphors to express five-element construction. As we have found in the result section, a passive sentence is an essential variable to influence translators' metaphor mechanism when they interpret five-element constructions in English. Figure 5 clearly shows that Germanic translators did not use passive sentences to represent the structural metaphors. It indicates that Germanic translators prefer to categorize and describe causal events according to the principle of Production theory, which explains the phenomenon that they are more likely to use ontological metaphors in their translations.

VI. CONCLUSION

The disparities in English translations of five-element construction caused by the different metaphorical mappings would confuse target readers for one thing and also aroused our interests to detect the reason for the phenomenon. With

the corpus of six English translations of the *Inner Canon of Yellow Emperor*, the study was conducted to investigate the influencing factors in metaphorical variation for five-element lexical-causative constructions, and uneven distribution of metaphor variants in three English varieties.

Existing literatures show how relevant metaphor features can be estimated based on available data by machine learning techniques. Therefore, we have attempted to employ a binomial logistic regression model to determine the significant predictors and the interactive effects of variables in the metaphor variation for five elements translation.

We experimentally validate the Conceptual Metaphor theory, i.e., ontological metaphor was a linguistic and cognitive universal that occurred in all languages [63]. Figure 1 clearly demonstrates that all translators tend to use more ontological metaphors than structural metaphors to interpret five-element constructions. We statistically prove that the Conceptual Metaphor theory can be applied to a wider situation than its original one. Meanwhile, based on the theories of polysemy link of Construction Grammar and Probabilistic Grammar [64], we demonstrate that Causer's syntax, clause type, language variety is of significance to influence the metaphor variation together with the interaction of the clause type and language variety. These provide valid evidences that Germanic, bilingual and Chinese translators used diverse cognitive abilities to categorize their grasps of the five-element theory in TCM.

The current research makes contributions to TCM cross-cultural studies. First, we equate five elements translating with metaphor construal in a cross-cultural context. The research analyzes the varying metaphorical expressions caused by cross-cultural and cross-linguistic similarities and differences in conceptualizing causal events. Second, we provide an analysis of the dataset of Five-element translations quantitatively and show the possibility in utilizing the machine learning technologies to model the cognitive patterns of six translators. To date, we propose a novel approach to describe and explain the cognitive process of TCM translators.

For future work, we expect to overcome three limitations in the current research. First, we may consider the insights from other three well-known TCM classics, e.g., *Golden Chamber*, *Treatise on Febrile Diseases* and *Nanjing*. We expect to build a larger dataset for TCM studies and examine the results we found in the article. Second, to improve the accuracy of the machine learning models on small dataset, we will try the technique of feature engineering and data augmentation strategy in the future study. Lastly, we will endeavor to collect the online data from Psycholinguistic experiments to observe whether people's understanding and application of the five-element metaphor in real life is consistent with our results to realize the convergence of evidence.

REFERENCES

[1] A. E. Goldberg, "Constructions: A new theoretical approach to language," *Trends Cogn. Sci.*, vol. 7, no. 5, pp. 219–224, 2003.

[2] S. Xutian, D. Cao, J. Wozniak, J. Junion, and J. Boisvert, "Comprehension of the unique characteristics of traditional Chinese medicine," *Amer. J. Chin. Med.*, vol. 40, no. 2, pp. 231–244, 2012.

[3] W. Fu, "The Yellow Emperor's Canon of medicine: First complete summary of ancient Chinese medicine," *Chin. Med. Culture*, vol. 1, no. 1, p. 18, 2018.

[4] L. Honghong and Z. Qicheng, "Seasonal thought in natural concept of Neijing," *J. Anhui Univ. Chin. Med.*, vol. 34, no. 3, pp. 1–3, Jun. 2015.

[5] Y. Yu and C. Xiao, "Classified review of the English versions of Huang Di Nei Jing (1925–2019)," *Chin. Med. Culture*, vol. 15, no. 3, pp. 35–45, Jun. 2020.

[6] M. Hanne, "Diagnosis and metaphor," *Perspectives Biol. Med.*, vol. 58, no. 1, pp. 35–52, 2015.

[7] D. and W. C. Zhang, *Neijing Dictionary*. Beijing, China: People's Medical Publishing House, 1990.

[8] P. Newmark, *A Textbook of Translation*. Upper Saddle River, NJ, USA: Prentice-Hall, 1987.

[9] J. R. Taylor, *Linguistic Categorization*. Oxford, U.K.: OUP Oxford, 2003.

[10] M. Shibatani, "The grammar of causative constructions: A conspectus," in *The Grammar Causative Constructions*. Leiden, The Netherlands: Brill, 1976, pp. 1–40.

[11] E. Tabakowska, *Cognitive Linguistics and Poetics of Translation*, vol. 9. Tübingen, Germany: Gunter Narr Verlag, 1993.

[12] G. Kristiansen and R. Dirven, "Introduction. Cognitive sociolinguistics: Rationale, methods and scope," in *Cognitive Sociolinguistics*. Berlin, Germany: De Gruyter Mouton, 2008, pp. 1–20.

[13] M. Reif, M. Pütz, and J. Robinson, *Variation in Language and Language Use: Linguistic, Socio-Cultural and Cognitive Perspectives*. Switzerland: Peter Lang Frankfurt, 2013.

[14] D. Geeraerts, S. Grondelaers, and P. Bakema, *The Structure of Lexical Variation: Meaning, Naming, and Context*, vol. 5. Berlin, Germany: Walter de Gruyter, 2012.

[15] M. Röthlisberger, J. Grafmiller, and B. Szmrecsanyi, "Cognitive indigenization effects in the English dative alternation," *Cogn. Linguistics*, vol. 28, no. 4, pp. 673–710, 2017.

[16] R. M. W. Dixon and A. Y. Aikhenvald, *Changing Valency: Case Studies in Transitivity*. Cambridge, U.K.: Cambridge Univ. Press, 2000.

[17] N. Levshina, "Doe wat je niet laten kan: A usage-based analysis of Dutch causative constructions," Ph.D. dissertation, Dept. Linguistics, Univ. Leuven, Leuven, Belgium, 2011.

[18] D. Speelman and D. Geeraerts, "Causes for causatives: The case of Dutch doen and laten," *Causal Categories Discourse Cognition*. Berlin, Germany: De Gruyter Mouton, 2009, pp. 173–204.

[19] B. Szmrecsanyi, J. Grafmiller, B. Heller, and M. Röthlisberger, "Around the world in three alternations: Modeling syntactic variation in varieties of English," *English World-Wide*, vol. 37, no. 2, pp. 109–137, 2016.

[20] W. Zhang, D. Speelman, and D. Geeraerts, "Variation in the (non) metonymic capital names in Mainland Chinese and Taiwan Chinese," *Metaphor Social World*, vol. 1, no. 1, pp. 90–112, 2011.

[21] Y. Chen and W. Chen, "English translation of long traditional Chinese medicine terms: A corpus-based study," *Terminology*, vol. 24, no. 2, pp. 181–209, Nov. 2018.

[22] X. Ye and M. Dong, "A review on different English versions of an ancient classic of Chinese medicine: Huang Di Nei Jing," *J. Integrative Med.*, vol. 15, no. 1, pp. 11–18, 2017.

[23] S. Kemmer and A. Verhagen, "The grammar of causatives and the conceptual structure of events," *Cogn. Linguistics*, vol. 5, no. 2, pp. 115–156, 1994.

[24] L. Talmy, "Force dynamics in language and cognition," *Cogn. Sci.*, vol. 12, no. 1, pp. 49–100, 1988.

[25] R. W. Langacker, *Foundations of Cognitive Grammar: Descriptive Application*, vol. 2. Redwood City, CA, USA: Stanford Univ. Press, 1987.

[26] B. Comrie, *Language Universals and Linguistic Typology: Syntax and Morphology*. Chicago, IL, USA: Univ. Chicago Press, 1989.

[27] P. Wolff, "Direct causation in the linguistic coding and individuation of causal events," *Cognition*, vol. 88, no. 1, pp. 1–48, 2003.

[28] A. Verhagen and S. Kemmer, "Interaction and causation: Causative constructions in modern standard Dutch," *J. Pragmatics*, vol. 27, no. 1, pp. 61–82, 1997.

[29] N. Stukker, "Causality marking across levels of language structure," Ph.D. dissertation, Dept. Lang., Literature Commun., Univ. Utrecht, Utrecht, The Netherlands, 2005.

[30] D. Geeraerts, G. Kristiansen, and Y. Peirsman, "Introduction. Advances in cognitive sociolinguistics," in *Proc. Adv. Cognit. Sociolinguistics*. Berlin, Germany: De Gruyter Mouton, 2010, pp. 1–20.

[31] M. Röthlisberger, J. Grafmiller, and B. Szmrecsanyi, "Cognitive indigenization effects in the English dative alternation," *Cogn. Linguistics*, vol. 28, no. 4, pp. 673–710, 2017.

[32] W. Zhang, D. Speelman, and D. Geeraerts, "Cross-linguistic variation in metonymies for PERSON: A Chinese-English contrastive study," *Rev. Cognit. Linguistics Published Auspices Spanish Cognit. Linguistics Assoc.*, vol. 13, no. 1, pp. 220–256, 2015.

[33] W. Zhang, D. Geeraerts, and D. Speelman, "Visualizing onomasiological change: Diachronic variation in metonymic patterns for WOMAN in Chinese," *Cogn. Linguistics*, vol. 26, no. 2, pp. 289–330, 2015.

[34] A. X. Lin, A. F. W. Ho, K. H. Cheong, Z. Li, W. Cai, M. L. Chee, Y. Y. Ng, X. Xiao, and M. E. H. Ong, "Leveraging machine learning techniques and engineering of multi-nature features for national daily regional ambulance demand prediction," *Int. J. Environ. Res. Public Health*, vol. 17, no. 11, pp. 1–15, Jun. 2020, doi: 10.3390/ijerph17114179.

[35] P. U. Unschuld, *Medicine in China: A History of Ideas*, vol. 13. Berkeley, CA, USA: Univ. California Press, 2010.

[36] L. Zhaoguo, W. Qing, and X. Yurui, *Key Concepts in Traditional Chinese Medicine II*. Cham, Switzerland: Springer, 2021, pp. 1–121.

[37] D. M. Pachuta, "Chinese medicine: The law of five elements," *India Int. Centre Quart.*, vol. 18, nos. 2–3, pp. 41–68, 1991.

[38] A. E. Goldberg, *Constructions: A Construction Grammar Approach to Argument Structure*. Chicago, IL, USA: Univ. Chicago Press, 1995.

[39] J. Pun and W. Chor, "Use of questioning between traditional Chinese medicine practitioners and patients to realize TCM philosophy: Holism, five elements and Yin-Yang in the context of doctor–patient communication," *Health Commun.*, vol. 37, no. 2, pp. 163–176, 2020.

[40] G. Sampson, "Quantifying the shift towards empirical methods," *Int. J. Corpus Linguistics*, vol. 10, no. 1, pp. 15–36, 2005.

[41] D. Jurafsky, "Probabilistic modeling in psycholinguistics: Linguistic comprehension and production," *Probabilistic Linguistics*, vol. 21, pp. 1–50, Oct. 2003.

[42] Z. Li, *Yellow Emperor's Canon of Medicine Plain Conversation*. Xi'an, China: World Publishing Corporation, 2005.

[43] M. Yang and J. Fu, *Yellow Emperor's Classic Of Medicine, The-Essential Questions: Translation Of Huangdi Neijing Suwen*. Singapore: World Scientific, 2019.

[44] M. Ni, *The Yellow Emperor's Classic of Medicine: A New Translation of the Neijing Suwen With Commentary*. Boulder, CO, USA: Shambhala Publications, 1995.

[45] W. Bing, N. L. Wu, and A. Q. Wu, *Yellow Emperor's Canon Internal Medicine*. Beijing, China: China Science and Technology Press, 1997.

[46] I. Veith, *Huang Ti Nei Ching Su Wên*. Berkeley, CA, USA: Univ. California Press, 1966.

[47] P. U. Unschuld and H. Tessenow, *Huang Di Nei Jing Su Wen*. Berkeley, CA, USA: Univ. California Press, 2011.

[48] R. M. W. Dixon, "A typology of causatives: Form, syntax and meaning," in *Changing Valency: Case Studies in Transitivity*. Cambridge, U.K.: Cambridge Univ. Press, 2000, pp . 30–83.

[49] G. Steen, *A Method for Linguistic Metaphor Identification: From MIP to MIPVU*, vol. 14. Philadelphia, PA, USA: John Benjamins, 2010.

[50] S. Th Gries, "On classification trees and random forests in corpus linguistics: Some words of caution and suggestions for improvement," *Corpus Linguistics Linguistic Theory*, vol. 16, no. 3, pp. 617–647, Dec. 2020.

[51] L. Breiman, "Random forests," *Mach. Learn.*, vol. 45, no. 1, pp. 5–32, 2001.

[52] S. Yadav and S. Shukla, "Analysis of k-fold cross-validation over hold-out validation on colossal datasets for quality classification," in *Proc. IEEE 6th Int. Conf. Adv. Comput. (IACC)*, Jun. 2016, pp. 78–83.

[53] C. Strobl, J. Malley, and G. Tutz, "An introduction to recursive partitioning: Rationale, application, and characteristics of classification and regression trees, bagging, and random forests," *Psychol. Methods*, vol. 14, no. 4, p. 323, 2009.

[54] N. Levshina, D. Geeraerts, and D. Speelman, "Towards a 3D-grammar: Interaction of linguistic and extralinguistic factors in the use of Dutch causative constructions," *J. Pragmatics*, vol. 52, pp. 34–48, Sep. 2013.

[55] C. Manning, "Logistic regression (with R)," *Changes*, vol. 4, pp. 1–15, Nov. 2007.

[56] S. Rana, H. Midi, and S. K. Sarkar, "Validation and performance analysis of binary logistic regression model," in *Proc. Int. Conf. Environ., Med. Health Sci. (WSEAS)*, 2010, pp. 23–25.

[57] P. Wolff, "Representing verbs with force vectors," *Theor. Linguistics*, vol. 38, nos. 3–4, pp. 237–248, Jan. 2012.

[58] P. Wolff and A. K. Barbey, "Causal reasoning with forces," *Frontiers Hum. Neurosci.*, vol. 9, p. 1, Jan. 2015.

[59] H.-G. Gadamer, *Truth and Method*. New York, NY, USA: A&C Black, 2013.

[60] D. Geeraerts and S. Grondelaers, *Looking Back at Anger: Cultural Traditions and Metaphorical Patterns*. Berlin, Germany: De Gruyter Mouton, 2010.

[61] B. Malt, P. Wolff, and P. M. Wolff, *Words and the Mind: How Words Capture Human Experience*. Oxford, U.K.: Oxford Univ. Press, 2010.

[62] P. Wolff, "Causal pluralism and force dynamics," in *Forces in Grammatical Structures: Causation Between Linguistics and Philosophy*, 2014, doi: 10.1093/acprof:oso/9780199672073.003.0005.

[63] G. Lakoff and M. Johnson, *Metaphors we Live by*. Chicago, IL, USA: Univ. Chicago press, 2008.

[64] N. Levshina, "Probabilistic grammar and constructional predictability: Bayesian generalized additive models of help," *GLOSSA J. Gen. Linguistics*, vol. 3, no. 1, pp. 1–22, 2018.

YAYUAN QU received the B.A. degree in English language & literature from Xi'an International Studies University, in 2007, and the M.A. degree in translation studies from The Chinese University of Hong Kong, in 2008. She is currently pursuing the Ph.D. degree with the School of Foreign Studies, Xi'an Jiaotong University, China. Her research interests include cognitive linguistics and intercultural communication studies.

JIRONG GUO received the B.A. and Ph.D. degrees from Shanghai International Studies Universities, in 1991 and 2010, respectively. He is currently a Professor at Xi'an Jiaotong University and works as the Executive Director of National Language Teaching Research Association for Non-English Major Postgraduates in China. His research interest includes intercultural communication studies.

XIAOMING WANG received the Ph.D. degree from Northwestern Polytechnical University, Xi'an, China, in 2020. He is currently an Associate Professor with Xi'an International Studies University. His research interests include cognitive computing and artificial intelligence.

• • •