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Cognitive metaphor theories in translation studies: Toward a dual-model parametric approach

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Abstract: Cognitive metaphor theory provides a systematic framework to better understand the working mechanism of metaphor. Its recent development further allows translation researchers to have a clearer insight into the movement of metaphor across languages and culture. Building on an empirical study, this paper examines the complementary relationship between two prominent cognitive metaphor theories – Conceptual Metaphor Theory (CMT) and Conceptual Blending Theory (CBT), and discusses the practical contribution that this relationship could make to the existing research on metaphor translation. To construct a comparable basis for CMT and CBT, two parameters are adopted for data analysis, which is proven useful to serve the purpose. The two chosen parameters are: projection and provenance, denoting the content and the type of metaphor respectively. Metaphorical expressions analyzed in this paper are sourced from cosmology-themed articles published in *Scientific American* in 2017 and their Simplified Chinese translations published in *Huanqiukexue*. Findings show that delineated by the two parameters, CMT and CBT indeed share a complementary relationship owing to their different focuses and organizing mechanisms. Furthermore, the collaboration between CMT and CBT offers a well-rounded analytical framework for translation studies. In turn, the correlation between metaphor parameters and translation solutions provides detailed clues for studying metaphor across culture. Finally, the reflection of this dual-model parametric approach regarding its pros and cons is also shown to shed light on future research.

Keywords: conceptual metaphor theory, metaphor in translation, parametric analysis, descriptive translation studies

1 Introduction

As a medium connecting the knowns to the unknowns, metaphor has been facilitating scientific discoveries for the entirety of recorded history. Even though

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scientific metaphors are used to promote understanding among people, this is not always the case since not all of them are universally shared. As Merakchi and Rogers (2013: 342) exemplify, scientific metaphors can lose their explanatory power during translation.

Zooming out to metaphor research, since the 1980s, it has become a prominent topic for cognitive linguists, who argue that metaphor reflects our bodily experience and plays an essential part in human cognition. Within this cognitive strand, two key models emerge: 1) conceptual metaphor theory (CMT) introduced by Lakoff and Johnson (1980), which examines systematic mappings between source and target conceptual domains at a general level; and 2) conceptual blending theory (CBT, a.k.a. conceptual integration theory) shown in Fauconnier and Turner (2002), which discusses the blending process of the source and target mental spaces at a more specific level. As shown later, these theories present important insights into the cognitive mechanism of metaphor, which further provide useful tools to study the intercultural transformation of metaphor.

Fueled by cognitive metaphor theory, translation research on metaphor has witnessed considerable advancement. For Metaphor in Translation (MiT)[1], investigating translation solutions for different types of metaphor is a continuing concern. With the help of cognitive metaphor theories, translation researchers can tailor different aspects of these theories as the basis for metaphor categorization depending on research needs, which has led to a better understanding of the relationship between metaphor types and translation solutions. In the meantime, MiT researchers also started to evaluate translation from a cognitive perspective (e.g., Mandelblit 1995), which complements the previous research on the linguistic and the cultural aspects of metaphor translation.

Nonetheless, most studies in this field have only focused on CMT with the translation patterns it yields at a generic level, whereas recent developments have heightened the need to bring CBT with the contextual information it can present into conversation. As Fauconnier and Lakoff (2014: 397) stress, "there would be no conceptual blending framework without conceptual metaphor theory." Even though there seems to be a conflict in the choice of analytical methods, researchers are in fact entitled to use both, depending on specific purposes (Fauconnier and Lakoff 2014). Given that MiT research deals with both general movement and specific contextual information, a combined framework of CMT and CBT has the potential to offer a well-rounded insight into the translation pattern of conceptual metaphors at a macro level (CMT) as well as the contextual feature conveyed by metaphorical expressions at a micro level (CBT).

1 Coined in Schäffner (2004), MiT denotes the research of translation activity in relation to metaphor.

In fact, metaphor scholars have argued that there is a complementary relationship between CMT and CBT based on detailed theoretical examination (e.g., Dancygier 2016; Grady et al. 1999). However, this speculation has not been empirically proven and its application into a wider context remains underexplored. Against this backdrop, this paper aims to: 1) empirically examine the complementary relationship between CMT and CBT, and 2) test the feasibility of applying a dual model parametric method to MiT research inspired by this complementary relationship.

Situated within the popular scientific context, this paper investigates metaphorical expressions identified in eleven cosmology-themed English articles published in *Scientific American* in 2017 and their corresponding Simplified Chinese translations published in *Huanqiukexue*. With two sets of metaphor parameters applied to both CMT and CBT models, findings provide empirical support to the complementary relationship between the two models, and further reveal the potential of this dual-model parametric approach in translation research.

The rest of this paper proceeds as follows. Section 2 contains a review of existing literatures on cognitive metaphor theories and MiT research, as well as the theoretical grounding for aligning CMT and CBT. Section 3 provides methodological details of the dual-model parametric approach and its application to a pilot study. Section 4 displays findings obtained from the pilot study before a discussion on this approach is presented in Section 5. Section 6 concludes with summative remarks and future research potentials.

2 Theoretical and methodological review

2.1 Cognitive metaphor theories

2.1.1 Conceptual metaphor theory (CMT)

The two-dimensional CMT model was first proposed by Lakoff and Johnson (1980) in their seminal book *Metaphors We Live By*, which was later revised in 2003. In this book, Lakoff and Johnson introduce the notion *conceptual metaphor*, which consists of a *source domain*, a *target domain* and *mappings*. In this model, domain means "a conceptual package including a range of connected elements" and is "potentially referred to by a shared term" (Dancygier 2016: 29). The target domain represents the target topic that people intend to talk about, whereas the source domain provides referential resources to facilitate this intention. Mappings, on the other hand, are the systematic correspondences between the constituent elements in the source and target domains, with the purpose of understanding and

characterizing the relationship between two concepts (Kövecses 2010: 7). It is often expressed in the form of A IS B, denoting the metaphorical concept it stands for (Lakoff and Johnson 1980: 7).

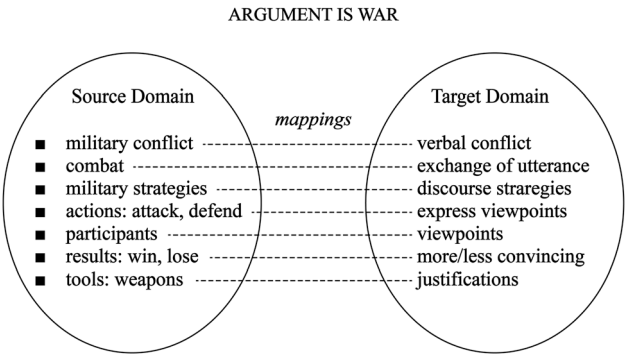

Figure 1: ARGUMENT IS WAR Conceptual Metaphor based on Dancygier (2016: 30).

In the conceptual metaphor ARGUMENT IS WAR presented in Figure 1, the target domain on the left-hand side contains information about ARGUMENT while the source domain WAR on the right-hand side provides referential resource to resemble and support the coherence in between. Corresponding features of these two domains are linked by mappings, which are illustrated as dashes in the figure. For example, the "results: win, lose" in the source domain and the "more/less convincing" in the target domain collectively facilitate the understanding of metaphorical expressions such as "I can't lose this argument".

As Dancygier and Sweetser (2014: 14) point out, it is important to notice that the actual labeling of a domain is context sensitive. For instance, in the general expression "I can't lose this argument", the source domain can be verbalized as COMPETITION or more concretely as FOOTBALL MATCH, depending on the contextual information contained in its specific usage. More radically, if ARGUMENT is used in "having an argument is the most effective way for us to communicate", it is conceptualized as COMMUNICATION or COOPERATION, both of which contradict the information delivered by WAR. In this cooperation aspect, argument can be viewed as someone giving each other their precious time and emotion to achieve a mutual understanding for an enhanced relationship.

2.1.2 Conceptual blending theory (CBT)

In contrast to the two-dimensional model of CMT, CBT operates on a multi-dimensional basis (Figure 2). CBT was systematically introduced by Fauconnier

and Turner in *The Way We Think* (2002), building on the authors' earlier works of human cognition (for example, Fauconnier 1994; Fauconnier and Turner 1998; Turner and Fauconnier 1995). Basic components of this model are called mental spaces, which represent the "small conceptual packets constructed as we think and talk, for purpose of local understanding and action" (Fauconnier and Turner 2002: 40). These mental spaces contain both long-term schematic and specific knowledge (Fauconnier and Turner 2002) which collectively facilitate our cognition process as a whole.

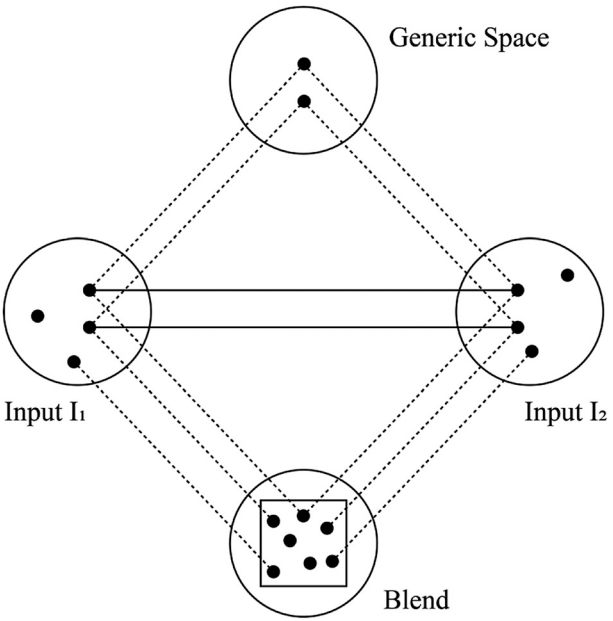

Figure 2: Reproduction of the Basic Diagram of CBT in Fauconnier and Turner (2002: 46).

As shown in Figure 2, one CBT network comprises several mental spaces, including input spaces, a generic space and a blending space. In fact, mental spaces that are activated for cognition are also connected to other mental spaces that are currently inactive, though these peripheral connections are not illustrated in this basic diagram. Input spaces contain source and target knowledge, functioning as the basis for human cognition. Generic space includes only common structures shared by both input spaces whereas the blending space includes both shared structures and different ones. The solid square in the blend is known as the emergent structure, where relevant information becomes integrated and the new structure for new meaning, which does not exist in either input spaces, is formed.

For the same example "I can't lose this argument", the keywords "lose" and "argument" evoke two main input spaces "competition" (or "war" etc.; similarly, the verbalization for input spaces in CBT is also context sensitive) and "argument". The most prominent similarity shared by these two mental spaces is "conflict", with its affiliated concepts such as "competitor", "strategy", "motivation", etc. To understand the meaning of this sentence, similar schemas shared by these input spaces as such are mapped into the generic space, which facilitates and regulates further cognition in the blend. In some cases, this referential power of generic space is strong, leading to a direct and clear understanding of a metaphor. However, sometimes it can be weak where the fuzziness of metaphor prevails, especially in poetry and other genres of literary texts. Informed by the contextual information, the blend then brings all relevant elements from the input spaces to develop the emergent structure. Nourished by the constructive information included in the blend, the emergent structure enables us to retrieve the meaning of this sample expression, with or without our consciousness.

It is interesting to note that cognition is a one-way process. Therefore, once a cognition is done, it cannot be naturally undone. For example, this "lose the argument" saying is already well-understood by most people since this is not the first time we have ever encountered an expression as such, which means we have already passed the point of no return in this case. However, for those who have never heard of this metaphor before, the whole integration process will be run through his/her brain before s/he obtains the meaning.

2.2 Metaphor in translation (MiT)

Similar to most contemporary disciplines, the interdisciplinary nature of Translation Studies provides sustainable and substantial power for its development. By adapting theories from neighboring fields such as history, literature and sociology, translation research expands its theoretical scope and establishes itself as a network with various research strands including MiT.

Regarded as "the ultimate test of any theory of translation" (Toury 1995: 81), metaphor is a major area of interest in translation studies. With a similar etymological root, the history between translation and metaphor can be traced back to ancient Greece. In contemporary scholarship, one of the most influential works is the list of metaphor translation procedures proposed by Newmark (1980). According to Peter Newmark, there are five types of metaphor: dead, cliché, stock, recent, and original metaphors, which should be translated in different ways (an additional type named "adapted metaphor" was included later in Newmark 1988). Motivated by this belief, Newmark (1980: 88–91) proposed a list of translation

procedures, which was later developed by Toury (1995: 81) following a descriptive approach, indicating the evolvement of metaphor in Translation Studies from the "problem" to "solution" (Schäffner 2004: 1257).

As one of the recent developments of MiT research, a corpus approach was recruited by Deignan and Potter (2004). Informed by the criticism of the *ad hoc* tendency in metaphor researches, the authors analyze the genuine translation products of metaphor in English and Italian. Moreover, by setting the research within specific discourse, Schäffner (2004) investigates the translation of political texts between English and German to discuss translators' decisions and their potential influence on the target culture. Apart from the discourse approach, she also argues that larger corpora help to understand the relationship between metaphor and culture, as well as promoting translation research. More recently, Shuttleworth (2014) offers a comparative review of translation studies and metaphor studies showing the reciprocal and mutual beneficial relationship of the two disciplines, which further unveils the potentials for an interdisciplinary collaboration.

Informed by the corpus-based and discourse-oriented approaches, MiT research on popular scientific texts has witnessed a considerable breakthrough. For example, Merakchi and Rogers (2013) develop Newmark's (1980/1988) categorization idea and examine a specific type of metaphor informed by discourse and corpus approaches. Building on the Arabic translations of *Scientific American*, the authors investigate the translation strategies of pedagogical metaphors (see Boyd 1993), which play a vital role in popular scientific writing. Through extensive analysis, they list seven translation strategies of pedagogical metaphor in popular scientific context. As an important strand of MiT research following a categorization perspective, this article contributes to the overall study of Scientific Metaphor in Translation by offering detailed insights into the translation of pedagogical metaphors from English to Arabic.

The introduction of metaphor parameters to translation research can be traced back to Shuttleworth (2011), which offers new lights to conduct quantitative analysis in MiT research. Based on a corpus with 62 articles published in *Scientific American* and their corresponding translations into five European languages including French, Italian, German, Russian and Polish, the author adopts different parameters of CMT to analyze the translation behavior of identified metaphors. This novel introduction of parametric analysis disintegrates metaphor into different parts and offers an effective angle to observe translation shifts between source and target texts. Meanwhile, its multilingual coverage also gives higher credibility in generalizing multilingual patterns of metaphor translation based on comprehensive analysis on both micro- and macro-levels, unmasking future paths for relevant researches (Olohan and Salama-Carr 2011: 184; Schäffner 2017: 254).

More recently, Shuttleworth (2017) further develops the parametric approach and expands the corpus with Taiwanese version included, which provides a deeper yet broader insight in this field. This book examines the translation of metaphorical expressions identified in neurobiology and biotechnology texts based on six interconnected parameters: existence category, mapping, purpose, conventionality, provenance and richness. Based on a larger corpus, the author presents and discusses the translation strategies adopted by translators for each metaphor parameter as well as demonstrating the movement of metaphor parameter through translation process in all six target languages. As Wang and Xu (2017: 291) review, this research contributes to the existing researches on Scientific Metaphor in Translation from both theoretical and methodological respects. Theoretically, its "undogmatic treatment and context-oriented testifications" allow authentic data to revisit conceptual metaphor theory. Methodologically, the application of corpus analysis based on both quantitative and qualitative discussions advances the reliability of findings in general. Building on the methodological innovation of introducing parametric analysis to MiT research presented in Shuttleworth (2011, 2013), this book reinforces the credibility of observing translation shifts based on metaphor parameters, the idea of which inspires the current project.

In sum, MiT research has witnessed remarkable development facilitated by the corpus analysis and discourse analysis approaches. In addition, the groundbreaking parametric approach introduced by Shuttleworth (2011, 2017) opens a new window for MiT research. Nevertheless, this mono-model parametric method emphasizes on CMT, whereas bringing CBT into conversation could provide useful comparative information to deepen our understanding of metaphor translation.

2.3 Aligning CMT and CBT for translation research

After the cognitive turn of metaphor studies in the 1980s, our understanding of CMT has been developing yet inevitably, defects of this model start to show. As shown earlier in Figure 1, CMT model only includes systematic similarities shared by the source and target domains whereas the differences, which are apparently part of our cognition, are nowhere to find. In addition, traditional criticism of CMT rests in its insufficient analytical process with an *ad hoc* tendency (Knowles and Moon 2006: 35) and the credibility of its power in revealing the underlying conceptual system (Yu 1998: 16). Furthermore, scholars including Charteris-Black (2004: 11) and Semino (2008: 9) also criticize the narrow focus on generalized mappings and advocate the inclusion of contextual information informed by the discourse analysis approach. Moreover, chain metaphor identified by Shutova et al. (2013: 1281), where single metaphorical expression triggers two conceptual

mappings that are both essential for interpretation, shows the inconvenience of explaining complex metaphors within the CMT framework. In response, metaphor scholars adopt CBT from Cognitive Linguistics as a complementary angle to CMT and attempts have been made to evaluate these two models in a comparative way.

This insight also sheds lights on the potential development of MiT research. Existing literature suggests that the similarities between CMT and CBT mainly lie in two aspects: the consideration of metaphor as a conceptual phenomenon and the recognition of selective projection in this cognitive process (see for example, Bort-Mir et al. 2020; Dancygier 2016; Grady et al. 1999).

As for differences, in addition to the dimensional deviation mentioned earlier, the building block and focus also vary between these two. On one hand, the term *domain* is used in CMT while *mental space* is used in CBT. According to Kövecses (2017: 323–24), mental space has a higher level of specificity than domain. Clearly, although domain and mental space represent different levels of human cognition, they are also interconnected at the same time. On the other hand, based on Grady et al. (1999), Dancygier (2016: 29–33) compares the different focuses of CMT and CBT. First, CMT emphasizes more on expressions, which can be generated from one conceptual metaphor. In contrast, CBT concerns more about the "online spontaneous communicative effect of giving a tight and unique form to a complex set of various issues and attitudes". Second, CMT is "more specific about the nature of changes in the target domain" while CBT describes the changes from a "more general process". Third, CMT is more interested in consistent lexical usages and their discourse consequences whereas CBT shows more of the spontaneous emergence of various communicative forms. In addition, Dancygier also points out that CMT has been used to discuss tropes while CBT is for broad conceptual process. Informed by these discrepancies such as expression form vs. communicative effect, specification vs. generalization, etc., Grady et al. (1999) argue that these two approaches are complementary to each other. More specifically, Dancygier (2016: 36) argues that CMT is ideal for discourse works owing to the general mapping it shows, while CBT is more suitable for clarifying complex meanings for referencing and discourse-manipulating purposes.

Building on these similarities and differences, the connection between CMT and CBT is obvious. As Kövecses (2020: 180) summarizes, as an extension of CMT, CBT describes the construction process of metaphor blends "at the level of mental spaces in working memory", yet this process is based on "all the higher level metaphorical structures in long-term memory".

Existing MiT research centered at CMT discusses mappings at a macro level, with the contextual information functioning as an additional yet essential part for qualitative analysis. Even though generalized mapping provides the convenience to trace the situation of source and target domains on a macro level, this model

fails to integrate contextual information into a complete cognitive mechanism. As a potential solution to this mechanical defect, the complementary relationship between CMT and CBT offers a clue, especially for developing the mono-model parametric method in this project.

However, the problem of aligning these two models in practice lies in the fact that they work with different cognitive units – domain and mental space. Fortunately, since both models accommodate themselves in the framework of Cognitive Linguistics, the generalization commitment shared by CMT and CBT provides the possibility to compare and discuss them on the same scale.

According to Evans (2015: 1–2), Cognitive Linguistics investigates "the relationships among human language, the mind, and sociophysical (embodied) experience". It distinguishes itself from other strands of Linguistics by two commitments: cognitive commitment and generalization commitment. Cognitive commitment highlights the cognitive aspect of language, which requires that the characterization of language must not violate the empirical findings of other brain and cognitive sciences in any sense. On the other hand, generalization commitment means cognitive linguists should aim at "identifying general principles that apply to all aspects of human language". This provides a solid ground to align CMT alongside CBT with the same set of parameters to observe the general relationship between translation solution and metaphor parameter.

With this support, this paper is able to develop the theoretical comparison of CMT and CBT onto an empirical level and introduce a dual-model method to MiT research. However, the first question is how to compare CMT and CBT based on translation examples? To answer this question, the parametric analysis approach introduced by Shuttleworth (2017) offers a feasible solution.

In this monograph, six parameters were discussed in pairs across three chapters, namely: existence category and mapping; purpose and conventionality; provenance and richness. In the current project, however, only *mapping* (the content of a metaphorical expression) and *provenance* (the mechanical categorization of a metaphor) are recruited. In addition to the outstanding findings that these two parameters yield in the original study, the main reason for this selection is that they are in line with the scope of the current project. On one hand, as a macro-level parameter (Shuttleworth 2017: 70), mapping represents the core content of a conceptual metaphor with the flexibility to be contextualized at a micro level, which is essential to the alignment between CMT and CBT. On the other hand, *provenance* not only provides a feasible basis for quantitative analysis across different languages, but more importantly, it denotes the mechanical difference between CMT and CBT, the alignment of which can enhance the credibility to the complementary relationship between these two models.

For the four other parameters, first, since this project focuses on cosmology-themed articles published in a popular scientific magazine, the diversity of *existence category* and *purpose* in the corpus are limited. Second, for *conventionality*, although this parameter offers an interesting perspective on metaphor, the determination of cross-lingual evaluation criteria to assess the conventionality of metaphor in translation is beyond the scope of the current project. Third, *richness* parameter is closely related to image metaphor and has a strong CMT connotation, which is discussed under provenance parameter in this paper.

Inspired by the fruitful application of parametric analysis in metaphor translation research, this paper attempts to generalize the two CMT parameters and apply them to both CMT and CBT models in order to provide a parallel platform for further comparison. Since *mapping* is a typical term in CMT, it is thereby replaced by *projection* in this paper. As for *provenance*, it is preserved for its compatibility with both models. Details are presented in the next section.

Therefore, the following sections will answer these inter-related questions. First, what insights can this comparative parametric analysis offer? Second, what are the pros and cons of CMT and CBT models in their application to translation research? Methodological information and a pilot study leading to the discussion of these questions are presented in the following sections.

3 Method overview

3.1 Background information and data selection

Scientific American enjoys great popularity among popular science audience and metaphor translation researchers. Therefore, it is selected as the source material in this article for the intercultural impact it has on our society and the comparable basis it can offer. Categorized as a popular science magazine by Knudsen (2003: 1250) and Olohan (2016: 174), *Scientific American* includes articles written by specialist scientists for educated readers who are interested in but only with little understanding of science from their targeted domains.

Informed by the discourse analysis approach mentioned earlier, data sample comprises Source Text (ST) found in cosmology-themed articles published in *Scientific American* in 2017 and the corresponding Target Text (TT) identified in the Chinese Mandarin edition《环球科学》*Huanqiukexue* ('Global Science', published in the PRC). Details can be found in the appendix.

According to its official website (2018), "*Huanqiukexue* inherits the authoritative status of *Scientific American* by consulting scientists, translators and

journalists in order to preserve the original essence" (《环球科学》沿袭了《科学美国人》严谨客观的编辑风格,坚持"科学家+翻译家+记者"的编辑方针,力求原汁原味的呈现《科学美国人》精髓。). At the same time, Liu (2014: 35–36), the deputy director of *Huanqiukexue*, mentions that "this magazine aims to establish a standard for scientific translation: to eliminate the trace of translation in order to make the target text more naturally understandable and interesting to read, and to meet the reading habits of the Chinese audience" (这个标准表述起来其实很简单,那就是消除翻译痕迹,让译文通俗晓畅,生动有趣,符合中文阅读习惯。).

The metaphor identification guidance of this project is twofold: as the basis, Pragglejaz Group's (2007) Metaphor Identification Procedure (MIP) is adopted to identify all metaphors used in texts, and the categorization of metaphor in scientific communication in Boyd (1993: 485–486) is applied as a filter for further identifying scientific metaphors.

Cameron (1999: 105) argues that in practice, metaphoricity can only be identified in particular social-cultural groups and discourse contexts. Therefore, rather than trying to find necessary and sufficient conditions for categorizing metaphor, identification shall begin by comparing possible metaphors with non-controversial, or typical instances (Cameron 1999). In line with this idea, Pragglejaz Group (2007) provide a basic structure for metaphor identification that can be applied to different metaphor research contexts in a flexible manner. Detailed procedure of MIP is presented as follows.

1. Read the entire text–discourse to establish a general understanding of the meaning.
2. Determine the lexical units in the text–discourse.
3. (a) For each lexical unit in the text, establish its meaning in context, that is, how it applies to an entity, relation, or attribute in the situation evoked by the text (contextual meaning). Take into account what comes before and after the lexical unit.
   (b) For each lexical unit, determine if it has a more basic contemporary meaning in other contexts than the one in the given context. For our purposes, basic meanings tend to be:
   - More concrete [what they evoke is easier to imagine, see, hear, feel, smell, and taste];
   - Related to bodily action;
   - More precise (as opposed to vague);
   - Historically older;

   Basic meanings are not necessarily the most frequent meanings of the lexical unit.

(c) If the lexical unit has a more basic current–contemporary meaning in other contexts than the given context, decide whether the contextual meaning contrasts with the basic meaning but can be understood in comparison with it.

4. If yes, mark the lexical unit as metaphorical.

Identification Procedures, Pragglejaz Group (2007: 3)

In Boyd (1993), the author identifies two types of metaphors which are significant to scientific communication and advancement: exegetical (or pedagogical) metaphors and theory-constitutive metaphors. This provides the guidance for identifying scientific metaphors based on the raw data obtained from MIP. According to Boyd (1993: 485–486), exegetical metaphors are applied to teach or explicate theories which are acknowledged as adequately non-metaphorical formulations and they do not convey theoretical insights or decide theoretical change (e.g., wormholes, electron cloud and miniature Solar System). For theory-constitutive metaphors, they are used by scientists "in expressing theoretical claims for which no adequate literal paraphrase is known" (e.g., information processing) (Boyd 1993: 485–486).

3.2 Models and parameters

As mentioned earlier, this project compares the application of CMT and CBT to translation research based on two parameters: projection and provenance, denoting the content and type of metaphors respectively.

Projection parameter, on one hand, covers the selectivity and conceptualization of metaphors. In CMT, mapping is selected as projection, denoted by source domain and target domain. Following the CMT tradition, mapping is expressed as A IS B or As ARE Bs. In CBT, projection is composed of input spaces, cross-space mappings, a generic space, and a blending space containing an emergent structure as illustrated in Figure 2 earlier. For data management purposes, CBT projection is pinned by input spaces, which convey both contextual and metaphorical information of selected examples. Previously, the verbalization of mapping in CMT model has been critically evaluated by metaphor scholars for its inevitable subjectivity (see for example, Semino et al. 2004; Shutova et al. 2013). This argument holds true for verbalizing input spaces in CBT model. With this information in mind, the verbalization of mapping in this

article is based on the assessor's knowledge aided by established conceptual metaphor lists such as METALUDE (http://www.ln.edu.hk/lle/cwd/project01/web/home.html) and Master Metaphor List by Lakoff et al. (1991). In addition, the determination of word choices is also informed by the original contexts. For example, in "black hole's lifetime", mapping is coded as BLACK HOLE IS A LIVING CREATURE hinted by the keyword "lifetime". The reason why "LIVING CREATURE" is selected here is that "lifetime" applies for animal, plants, and even virus depending on how one defines "life". Therefore, a more general term – living creature – is used here.

On the other hand, provenance parameter, first introduced to translation studies as a CMT parameter by Shuttleworth (2013: 47), denotes the classification of metaphors in the current project. Based on Lakoff (1987: 194–95), it distinguishes four types of metaphors in the CMT framework: image schematic metaphor, propositional knowledge based metaphor, image metaphor and Aristotle's metaphor. First, image schematic metaphor represents basic cognitive structures resulted from repeated bodily experience such as "reach out" for "BODY IS A CONTAINER". Second, propositional knowledge based metaphor refers to the mappings of knowledge from one domain to another such as "TROUBLE IS A FRIEND". Third, image metaphor generally relates to one-time resemblance, e.g., "FULL MOON IS A PEARL". Fourth, Aristotle's metaphor is a type of single but very general metaphor following the form of SOMETHING IS WHAT IT HAS SALIENT PEROPERTIES OF such as "JORDAN BELFORT IS A WOLF" in the *Wolf of Wall Street* (2003) film.

To fit this parameter to the CBT model, Fauconnier and Turner's (2002: 119–35) classification of four blending networks – simplex, mirror, single-scope and double-scope – is chosen as provenance. Simplex network represents a simple type of integration, which has only one frame in one input space and pure values that can fit into this frame in the other input space. For example, "father" provides a frame while "Paul and Sally" hosts values that can fit in to this frame, as "Paul is the father of Sally".

In a mirror network, all mental spaces share one organizing frame at a topological level with differences existing at basic levels. Mirror network compresses vital relations of time, space, identity, etc., and does not create clashes of frames since there is only one available. For example, comparing the Earth-Moon system as a telescope (No.180, *Scientific American* August 2017) is a mirror network since they share the same spatial relation.

A single-scope network has two input spaces with different frames but only one of them is projected in the blend. For example, in "full moon is a pearl", moon

and pearl resemble two different frames, yet only pearl provides the organizing frame in the blend. According to Fauconnier and Turner (2002: 127), "single-scope networks are the prototype of highly conventional source-target metaphors" – with two input spaces identified as the source and the target.

Double-scope network has input spaces with different organizing frames. Parts of each frames are mapped in the blend to form the emergent structure. For example, computer desktop involves "throwing the trash" and "print" which are two different types of actions. The authors believe that this network could offer challenges to imagination and boost creativity. Noticeably, double scope networks can lead to clashes in action if an opposite pair of information is communicated in a shared pathway. For example, the scrolling direction in the Windows system is completely opposite to the Apple OS system. If a mouse (not Apple Magic Mouse since it is trackpad based) is used in these two systems as the action medium, the user can be easily confused by the direction that s/he should actually scroll. Even though this feature is not very relevant in the observation of language output, it shows the complicated yet dynamic nature of double scope networks.

In addition to metaphor parameters, the list of grand translation solutions developed from Shuttleworth (2017: 66–67) is applied to obtain an overview of translation solutions adopted by translators. As shown in the literature review, different terms such as translation strategy, translation procedure and translation solution have been used by researchers. In the current project, the term "translation solution" is selected to emphasize the aiding role of metaphor to translators rather than merely a translation problem, the argument of which will be justified in forthcoming research. The list of translation solutions examined in this paper are:

1) Retained: when the original metaphor in the ST is preserved in the TT;
2) Modified: when the original metaphor in the ST is replaced by a non-identical metaphor in the TT;
3) Removed: when the meaning conveyed by the original metaphor in the ST is retained in the TT, but the metaphor is removed;
4) Omitted: when meaning and metaphor are both omitted;
5) Added: when there is no metaphor in the ST but translators add metaphor in the TT.

Software used for data management is Microsoft Excel 2016 with a spreadsheet containing sample number, ST, context, TT, grand translation solution, parameters,

article information and notes. An example for the information that individual metaphorical expression contains is presented below.

Example 1:

No. 199 – "Cassini at Saturn", October 2017.		
Source Text (with context)		Target Text
They (spacecrafts) **gave** the planet dimension and personality but left behind questions that demanded answers.		他们**查明了**土星的大小和特性 [they ascertained the size and features of Saturn]
Translation solution		modified
Mapping	SPACECRAFTS ARE HUMANS	SPACECRAFTS ARE HUMANS
Provenance CMT	Propositional knowledge based	Propositional knowledge based
Input Space 1	Spacecrafts produce information to scientists	Spacecrafts help scientists to clarify cosmic hypotheses
Input Space 2	*Give* means to hand something to somebody	*Cha ming* (查明) means to clarify and to find out the truth about something
Provenance CBT	Single scope	Single scope

4 Findings

Among the 12 issues of *Scientific American* published in 2017, 11 articles themed at cosmology were identified, together with their translations published in *Huanqiukexue*. The English corpus comprises 32,109 words, with the average word count for each article standing at 2,919. Its parallel Chinese corpus has 57,111 Chinese characters in sum and the average character for each article is 5,191.[2] Dataset sourced from these corpora consists of 235 pairs of metaphorical expressions in total, including 23 added cases identified in the TT. As shown in Table 1, retention is the most preferred option, which doubles the cases of removal followed by modification and omission. This list of frequency is in line with the results of existing popular scientific metaphor researches looking into other languages though percentages vary.

2 As a reference, the ratio of translation from English (words) into Chinese (characters) is approximately between 1.5 and 1.8, depending on genres.

Table 1: Grand translation solution overview.

Grand translation solutions	Frequency	Percentage (%)
Retained	120	56.6%
Removed	60	28.3%
Modified	16	7.55%
Omitted	16	7.55%
Total	*212*	*100%*
Added	23	n/a
Total	*235*	*n/a*

4.1 CMT

Provenance parameter in CMT model reveals interesting translation patterns across metaphor parameters. Similar to what Shuttleworth (2011, 2017) found, there is no trace of Aristotle's metaphor in the database. As Table 2 shows, the four translation solutions weigh differently across the three active types of metaphor.

Table 2: CMT provenance overview.

	Retained	Removed	Modified	Omitted	*Total*
Image schematic	12 (66.7%)	5 (27.8%)	0 (0%)	1 (5.5%)	*18* (100%)
Pkb	91 (56.2%)	49 (30.2%)	10 (6.2%)	12 (7.4%)	*162* (100%)
Image	17 (53.1%)	6 (18.75%)	6 (18.75%)	3 (9.4%)	*32* (100%)
Aristotle's	null	null	null	null	null
Total	*120*	*60*	*16*	*16*	*212*

Pkb, Propositional knowledge based.

To start with, 18 image schematic metaphors, which are associated with basic repetitive bodily experiences, were identified in the ST yet none of them was modified. Instead, this category witnesses the highest proportion of retention (66.7%) and the lowest of omission (5.5%) among the three active categories.

Moreover, as Shuttleworth (2017: 147) shows, propositional knowledge based metaphor is the most prevalent type in popular biology and genetics texts with a noticeable percentage of 88.4%. This situation is also true in popular cosmology texts, even though the proportion in the current project (162 out of 212, 76.4%) is less significant. This shows that the metaphorical usage in different disciplines can be different. Given this dominant position, it is not surprising to see that the distribution of translation solutions for this category is relatively similar to the

overall distribution of the whole data pool as shown in Table 1. However, for this category, the large quantity of samples does not guarantee a smooth distribution of translation solution. Instead, it has the highest proportions of removal cases with the other three translation solutions hoovering among the averages.

Furthermore, although retention is the most preferred solution chosen by translators for all three categories, the percentage of retaining the image metaphors (53.1%) makes this category the least retention-friendly option. The same situation applies for removal, which only weighs 18.75% in total, falling short by 10% on average compared to the other two categories. Meanwhile, a surging tendency towards modification can be seen with a remarkable percentage of 18.75%. With the most evenly spread distribution of translation solutions among all three categories and the rich one-shot image resemblance that image metaphor conveys, it is worth analyzing these cases in more details in future research.

Last but not least, for the 23 cases where metaphorical expressions were added in the ST, 17 of them fall into the propositional knowledge based category. Three were image schematic metaphors and another three were image metaphors. It is interesting to notice that among all added cases, two Chinese four-character idioms were found – *li jing pan dao* (离经叛道, literally: departing from the classics and revolting against the doctrine) and *cang hai yi su* (沧海一粟, literary: one grain of the vast ocean) – and both of them fall into the propositional knowledge based category.

On the other hand, projection provides a straightforward organizing tool for translation research, which not only contains general information of each mapping but also the concrete translation shift. Given that these articles are themed at cosmology, the top five mappings identified in the ST are: A BLACK HOLE IS A HUMAN, A BLACK HOLE IS AN ANIMAL, A STAR IS A HUMAN, A SPACECRAFT IS A HUMAN, and UNIVERSES ARE BUBBLES, the list of which were also the same in the TT. In addition, some highly conventionalized expressions in non-scientific fields were also found in data set. For example, KNOWLEDGE IS A BOOK, RESEARCH IS CULTIVATION and DISCUSSION IS A ROLLER COASTER. More interestingly, there are also some novel metaphors such as BLACK HOLES ARE WARPS and EXISTENCE IS A SANDWICH, yet most of them were removed in the TT. Given that this paper aims at demonstrating the methodological application of parametric analysis to translation studies, detailed insights into the translation solutions of specific projections will be presented in future research.

As presented in example 2, data number 209 shows how projection helps to visualize the change of focus in contrast to the pure descriptive method. In this example, the focus of this metaphor was shifted from “Titan” in English to “the detectors on the spacecraft” in Chinese. The two projections, in this case,

collectively offer a convenient coding scheme for data analysis facilitated by the filtering option in Microsoft Excel. Further, by coding projection labels at both micro and macro levels, translation researchers can easily specify or generalize this parameter based on what they need. Nevertheless, this sample also gives rise to the major operational defect of CMT projection, that is, projection needs to be considered alongside its context since even the micro level mapping can be highly skeletal. Luckily, the dual-model approach tested in this pilot study offers a solution to this problem, which is presented in the discussion section.

Example 2:

[No. 209]	ST	tease
	Context	*Titan…nonetheless **teased** observers with hints of a possible ocean of liquid hydrocarbons.*
	GTS	Modified
	Projection	TITAN IS A HUMAN
	TT	探测器还是发现了一些蛛丝马迹
		[Back translation: Detector managed to find some traces]
	Projection	DETECTOR IS A HUMAN

4.2 CBT

As for CBT, all four types of networks were found in the data pool and their frequency varied as expected (Table 3).

Table 3: CBT provenance overview.

	Retained	Removed	Modified	Omitted	*Total*
Simplex	1 (50%)	1 (50%)	0 (0%)	0 (0%)	*2 (100%)*
Mirror	11 (47.8%)	6 (26.1%)	5 (21.7%)	1 (4.4%)	*23 (100%)*
Single scope	96 (56.2%)	51 (29.8%)	10 (5.8%)	14 (8.2%)	*171 (100%)*
Double scope	12 (75%)	2 (12.5%)	1 (6.25%)	1 (6.25%)	*16 (100%)*
Total	*120*	*60*	*16*	*16*	*212*

For the two simplex networks identified, one of them was retained while the other one was removed. The STs of both cases are "candidates" – "the first TDE candidates" (No.55) and "black holes are … ideal candidates for dark matter" (No.149). No.55 was retained as *houxuanzhe* (候选者, literally: people waiting for selection, with *zhe* indicating people) whereas the translation of No.149 is *houxuan* (候选, literally: waiting for selection), which removes the humanization aspect

conveyed by "candidate" in the ST. Both translations make sense in Chinese language. Nonetheless, for No.149, a more natural rendering in the TT context would be *renxuan* (人选, literally: human choice, with *ren* denoting human) for it forms the colloquial phrase *lixiang renxuan* (理想人选, literally: the ideal human choice) in comparison to *lixiang houxuan* (理想候选) found in the actual translation. However, the reason why the humanization element of No.149 was removed could be that *ren* (人, human) explicitly compares black hole as human, which can create an obvious conceptual conflict for some readers. This example reveals interesting dynamics between metaphor usage and language authenticity.

For mirror networks, 47.8% of them were retained and 26.1% were removed, followed by modification (21.7%) and omission (4.4%). Among these cases, 12 out of 23 are about "bubble universe", which compares individual universe as a bubble enlightened by the multiverse hypothesis. There are many modified cases of this bubble universe metaphor, for that *qipao yuzhou* (气泡宇宙, literally: bubble universe) was consistently used in the TT whereas a combination of both "bubble universe" and "bubble" were found in the ST.

In terms of single scope networks, popularity again goes to retention (56.2%) and removal (29.8%). It is interesting to see that this is the only type of metaphor where omission (8.2%) becomes more favorable than modification (5.8%). This situation is similar to that of propositional knowledge based metaphor, which is the most pervasive type of metaphor in the CMT framework.

Considered as the most complex type for the integrated frame it has in the blend, double scope networks were mostly retained (75%) followed by removal (12.5%). The remaining 12.5% spreads evenly between modification and omission cases.

On the other hand, for projection parameter, organizing the content of this parameter in an efficient way is a challenge given that every single data entry (both ST and TT) has four values: input space 1, input space 2, generic space, and the blend. As a solution, each data sample was coded with two values: input space 1, which contains the original meaning of source information supported by three corpus-based online dictionaries in English (*Oxford Advanced Learner's Dictionary*, *Macmillan Dictionary* and *Longman Dictionary*) and two Chinese dictionaries (*Xiandai Hanyu Cidian* 'Modern Chinese Dictionary' and *Xiandai Hanyu Guifan Cidian* 'Standard Dictionary of Modern Chinese'); and input space 2, which contains the factual target information extracted from the context. The rationale for this decision is that all human readers have highly identical cognitive structure in our brains and cultural differences only exist on top of this shared neurological level. Therefore, instead of verbalizing the whole process, only vital information contained in these input spaces is provided which is sufficient to trigger the similar cognition process in our brain.

Take the same sample as an illustration, it is shown that this arrangement of input spaces does present enough contextual information for retrieving metaphorical meanings. The Context row in Example 3 is not as important as it is in CMT projection given that the contextual information is already included in the input space. In the ST, input space 1 contains the literal explanation of "tease". Input space 2 conveys the contextual clue: scientists have been trying to detect the existence of liquid hydrocarbons on Titan to prove their hypotheses, yet so far, they can only retrieve some hints. Based on these two input spaces, the blend is then formed, and the metaphorical meaning of how Titan "teased" observers is obtained. The blend in the ST provides the basis to generate new blends in the TT. Out of many possibilities provided by the ST blend, the TT in this example focuses on the detection element, depicting the difficulty and the outcome of this activity with "detector" emerging as the main component in input space 2 and "find" in input space 1.

Example 3:

[No. 209]	ST	tease
	Context	*Titan…nonetheless **teased** observers with hints of a possible ocean of liquid hydrocarbons.*
	GTS	Modified
	Input Space 1	To tease someone is to make someone desire more about something by showing a tiny part of it, to annoy someone for fun.
	Input Space 2	Scientists hypothesise that there may be liquid hydrocarbons on the surface of Titan but were not able to prove it.
	TT	探测器还是发现了一些蛛丝马迹 [Detector managed to **find** some traces]
	Input Space 1	To find something is to discover something by searching for it or by chance.
	Input Space 2	Scientists used physical information of Titan gathered by the detectors carried by the spacecraft gathered for new discoveries.

Nonetheless, even though the values for managing CBT projection were cut down to two essential ones, the overall workload was doubled compared to CMT projection. In addition, given the large amount of detailed information contained in input spaces, it is more difficult to organize this parameter based on individual categories. Fortunately, CMT provides a feasible way to solve this management challenge, as discussed in the next section.

5 Discussion

Pilot study shows that the applications of CMT and CBT models to translation analysis have their own advantages and disadvantages owing to their different organizing mechanisms. In general, although both models are cognitive by nature, their emphases are different: CMT categorizes original knowledge sources and CBT classifies different usages of frames; CMT draws on generalized domains and CBT relies on concrete mental spaces. Specifically, CMT focuses on the general contents represented by mapping in the form of A (target) IS B (source). This format makes it easier to compare the translation shifts of source and target domains, which also enables researchers to identify the frequency of mappings used in the chosen discourse. On the other hand, informed by the contextual information of metaphorical expressions, CBT model is organized by frames in mental spaces with both differences and similarities between mental spaces involved. This model accommodates discoursal elements in one integrated cognitive framework and provides the feasibility for more comprehensive qualitative analyses.

Starting with the pros, both models offer clear operation platforms to decode the complex compound of metaphor through selected parameters and provide the possibility for conducting both qualitative and quantitative analyses. For projection parameter in the CMT model, mapping presented by a pair of nouns simplifies the comparison between STs and TTs, thereby making it easier to identify conceptual shifts in translation process. At the same time, the categorization of metaphors based on CMT provenance also offers a clearer insight into the relation between metaphor types and translation solutions. As for CBT, building on the multi-dimensional nature of this model with detailed information contained in each input space, projection parameter helps to integrate the multi-facets of a metaphor into a single model. In addition, four different types of networks recruited as provenance parameter provide alternative perspectives to better understand the dynamics between metaphor types and translation solutions. Interestingly, for provenance parameters in both models, the correlations between certain parameters and translation solutions are relatively higher than the others, which can lead to further research potentials.

When working on concrete data samples, defects of this dual-model method also emerged. First, since both CMT and CBT parameters were applied to the same data set, it is unavoidable that certain amount of the information provided by this parallel process is overlapping. Second, in the example presented above, it is shown that mapping on its own, serving as the CMT projection, is not as robust as it is with reference to concrete contextual information for understanding metaphorical expressions. As a result, to retrieve the meaning of a metaphorical

expression in CMT, one needs to refer to contextual information, which is recorded separately from the main cognitive framework. Third, the management of CBT projection is relatively difficult due to the considerable amount of information contained in each input space, which hinders further grouping of all data entries listed under this parameter.

Fortunately, these questions offer promising solutions to each other owing to the complementary relationship between CMT and CBT. On one hand, CMT projection offers the potential to generalize the contents conveyed by metaphorical expressions. This can contribute to the analysis of which type of content in general, tends to be retained, removed, omitted, modified or added. For example, UNIVERSES ARE BRANCHES metaphor, which compares each universe as a branch of multiverse existence, has been largely removed since the corresponding Chinese translation for "branches" does not have a metaphorical sense. In addition, novel metaphors such as DISUCSSION IS A ROLLER COASTER and EXISTENCE IS A SANDWICH were also removed in the Chinese translation.

On the other hand, CBT projection, organized by the more general mappings of CMT projection, can offer concrete insights based on the contextual information included in input spaces and in turn, facilitates the discussion of specific translation shifts as a complement to what CMT projection offers. For example, from BLACK HOLES ARE DANCERS metaphor, it is difficult for us to understand what this conceptual metaphor really means without referring to its contextual information as "two black holes in the distant universe spiraled around each other in a deathly dance until they merged" (No.158, *Scientific American* July 2017). However, with both CMT and CBT models at hand, one can either generalize DANCERS as HUMANS or specify this metaphor by drawing on the contextual information of two merging black holes. In fact, the combined application of two models provides more informative insights compared to the stand-alone adoption of individual model, which further supports the theoretical speculation of this complementary relationship.

6 Conclusion

The cognitive perception of metaphor boosts the development of metaphor studies, the fruitful findings of which have been adopted by many neighboring disciplines including Translation Studies. Inspired by previous researches focusing on the identification of translation solutions based on metaphor types and the application of metaphor parameters to translation studies, this paper demonstrates the practicality of the dual-model parametric approach and provides a comparative insight into MiT research. The parameters of projection and

provenance together break the compound of metaphor down to two primary dimensions: the content it carries and the categories it falls into, which facilitate further analysis of the correlation between translation solution and metaphor parameter. Empirical results obtained from the pilot study show that the two chosen parameters help to analyze translation shifts and validate the complementary relationship between CMT and CBT as existing literature suggests.

Apart from validating this new dual-model method and providing the grounding for more detailed discussion within this framework, the pilot study also provides constructive directions for future research. First, the correlations between specific metaphor parameters and concrete translation solutions can be further analyzed with a larger size of corpus across different languages. With the expansion of data and inclusion of more languages, more patterns can be revealed through the comparative insights offered by these two metaphor models. Second, for CMT provenance, Aristotle's metaphor (although no case was found in the current corpus), in the concrete form of SOMETHING IS WHAT IT HAS SALIENT PROPERTIES OF, does not have a widely acknowledged corresponding syntax in Chinese, whereas XX SHI XX (literally, XX is/are XX) can be an option. Third, although many evidences shown in the pilot study are in line with the previous findings of other languages, the usage of four-character Chinese idioms identified in *Huanqiukexue*, especially in added cases, is relatively different from other metaphorical usages. Existing literature on Chinese idioms in metaphor studies suggests that this language phenomenon can be analyzed with the help of both metaphor and metonymy (e.g., Yu 2000), which requires further discussion in future research.

Appendix

Articles in Scientific American (English)

Clara Moskowitz. January 2017. Tangled up in spacetime. *Scientific American* 316(1). 32–37.

Anna Ijjas, Paul J. Steinhardt, and Abraham Loeb. February 2017. Pop Goes the Universe. *Scientific American* 316(2). 32–39.

S. Bradley Cenko, and Neil Gehrels. April 2017. How to swallow a sun. *Scientific American* 316(4). 38–45.

Kimberly Cartier, and Jason T. Wright. May 2017. Strange news from another star. *Scientific American* 316(5). 36–41.

Yasunori Nomura. June 2017. The quantum multiverse. *Scientific American* 316(6). 28–35.

Juan García-Bellido, and Sébastien Clesse. July 2017. Black holes from the beginning of time. *Scientific American* 317(1). 38–43.
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Carolyn Porco. October 2017. Cassini at Saturn. *Scientific American* 317(4). 78–85.
Caleb Scharf. November 2017. The zoomable universe. *Scientific American* 317(5). 70–74.
S. Alan Stern. December 2017. Pluto revealed. *Scientific American* 317(6). 40–47.

Translations in Huanqiukexue (Simplified Chinese)

Minyong Guo. February 2017. 时空本源是量子纠缠 ('The origin of spacetime is quantum tangling'), via Huanqiukexue HD (Apple Store App).
Taotao Qiu. March 2017. 宇宙大爆炸不曾发生？ ('The Big Bang did not happen?'), via Huanqiukexue HD (Apple Store App).
Yanting Dong, and Dongyue Li. May 2017. 现场直击：黑洞吞噬恒星 ('Live: Black hole gorges stars'), via Huanqiukexue HD (Apple Store App).
Ensi Liang. June 2017. 1000光年外的恒星，存在高级文明？('Is there any advanced civilisation 1000 light years away?'), via Huanqiukexue HD (Apple Store App).
Wei Pang. July 2017. 多重宇宙是一种量子态 ('Multiverse is a quantum state'), via Huanqiukexue HD (Apple Store App).
Lei Qian. August 2017. 暗物质是原初黑洞？('Is the dark matter the original black hole?'), via Huanqiukexue HD (Apple Store App).
N/A. August 2017. 未来1000年的2354次日食 ('The 2345 eclipses in 100 years'), via Huanqiukexue HD (Apple Store App).
Xiaoxiao Ma. August 2017. 2017日全食：解开太阳谜题 ('The solar eclipse in 2017: Solving the puzzle of sun'), via Huanqiukexue HD (Apple Store App).
Jianghui Ji, and Mengrui Pan. November 2017. 卡西尼号的三大遗产 ('The three heritages of Cassini'), via Huanqiukexue HD (Apple Store App).
Zhe Zhang. December 2017. 跨越62个数量级的宇宙旅程 ('The universe journey leaping over 62 orders of magnitude'), via Huanqiukexue HD (Apple Store App).
Yongchun Zheng, and Han Liu. January 2018. 新视野号：重新认识冥王星 ('New Horizon: Renewing our understanding of Pluto'), via Huanqiukexue HD (Apple Store App).

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