ECONOMY IS A TRANSPORTATION_DEVICE: CONTRASTIVE REPRESENTATION OF SOURCE DOMAIN KNOWLEDGE IN ENGLISH AND CHINESE

Siaw Fong Chung*   Chu-Ren Huang**   Kathleen Ahrens*

Graduate Institute of Linguistics, National Taiwan University* Academic Sinica**
No. 1, Section 4, Roosevelt Road, Taipei, Taiwan China 106*
No.128, Sec. 2, Academia Road, Nangang, Taipei, Taiwan China 115**
Tel: +886-2-23630231-2179*   Tel: +886-2-2652-3108**
claricefong6376@hotmail.com, kathleenahrens@yahoo.com,churen@gate.sinica.edu.tw

ABSTRACT

This paper offers a preliminary study of how knowledge may be represented differently in different languages. In particular, we account for the contrast between English and Chinese when identical target domain knowledge is represented with two different, yet related, source domains in each language. We incorporate corpora analysis in English and Chinese with SUMO to delimit the source domains identified using the Conceptual Mapping Model (Ahrens, 2002). In particular, this paper investigates economy metaphors with the source domains of AEROPLANE and MOVING VEHICLE. These two source domains are found in Chinese and English respectively. Hence, we ask the question whether these source domains should be conflated under a general source domain such as TransportationDevice or should they form independent source domains. Our study addresses this issue by using the SUMO ontology as well as the Mapping Principles found in the corpora analysis. Our studies contribute to automatizing the source-target domain mappings in conceptual metaphors.

1. INTRODUCTION

Metaphors differ cross-linguistically in a principled way. Teasing out these principles will help us understand better how knowledge is organized and represented linguistically and cognitively. Chung, Ahrens and Huang (2003) used upper ontology to show how it would help to capture identical knowledge in English and Chinese. A challenging task is to account for how metaphor can be mapped differently onto two different languages in the same knowledge domain, such as TransportationDevice. This task is solved by referring to SUMO, an upper level ontology constructed by an IEEE-sanctioned workgroup. SUMO "provides definitions for general-purpose terms and acts as a foundation for more specific domain ontologies" (Niles and Pease, 2001).

The goal of this paper is to demonstrate how these metaphorical phenomena can be predicted using

SUMO. Working within the same framework of Chung, Ahrens and Huang (2003), this paper asks the question whether these two source domains can be conflated under a general knowledge domain such as TransportationDevice. This paper also investigates the correspondences of AEROPLANE and MOVING VEHICLE in terms of knowledge representation predicted by SUMO. In the following section, we first introduce the theoretical bases on which the metaphor expressions are analyzed.

2. CONCEPTUAL MAPPING MODEL AND THE SUMO ONTOLOGY

The Conceptual Mapping (CM) Model (Ahrens 2002) is an extension of the Contemporary Theory of Metaphor (Lakoff and Johnson, 1980; Lakoff, 1980). It provides a bottom up approach by examining the linguistic expressions found within a particular source domain. This analysis of the linguistic expressions contributes to finding out what are actually mapped in a conceptual metaphor in real world uses.

A Mapping Principle is proposed as formulas to indicate the most frequent source-target mapping in a conceptual metaphor. This Mapping Principle forms the underlying reason for the source to target domain mappings.

For example, for IDEA IS BUILDING, the following sentences are found:

(1) 你的　論點　根基　是　什麼？
    nide   lundian   genji   shi   sheme
    your   argument   base   BE   what
    'What is the foundation of your argument?

(2) 他的　思想　架構　快　成形　了。
    tade shixiang jiagou   kuai chengxing   le
    his thought   framework soon take_shape   ASP
    'His thought's framework is taking shape.'

Examples (1) and (2) are instances of how IDEA (*lundian* 論點 'argument' and *shixiang* 思想 'thought) is mapped onto BUILDING (*genji* 根基

'base' and *jiagou* 架構 'framework') in real word uses of language. Based on examples such as these, Ahrens (2002) proposed that the Mapping Principle for IDEA AS BUILDING for Mandarin Chinese is: *Idea is building because building involves a (physical) structure and idea involves an (abstract) structure.*

In Ahrens, Chung and Huang (2003), they further proposed that this Mapping Principle can be extracting through corpora analysis based on the most frequent mapping.

Other works towards representing metaphors using computational tools are Lönneker (2003) and Tsai, Ahrens and Huang (2003). Both research work on metaphors analysis using corpora data. Lönneker used French and German database as well as EuroWordnet; Tsai, Ahrens and Huang used both the Academic Sinica Corpus as well as a corpus of lyrics to demonstrate the application of SUMO in metaphor analysis. They suggested that the concepts of love are described through the knowledge representation of 'Process,' 'Object' and 'Attribute' in SUMO.

In Ahrens, Chung and Huang (2003), they incorporated the CM model in cross-linguistic corpora analysis. In the corpora analysis, the Mapping Principle is extracted from the most prototypical mapping in a conceptual metaphor. For instance, the most prototypical mapping for ECONOMY IS A COMPETITION is the concept of 'ViolentContest,' a knowledge representation in the upper ontology of SUMO.

Working within the same framework, Chung, Ahrens and Huang (2003) further investigated the metaphor of ECONOMY IS A PERSON. They found that in two different languages, there exists a similar main mapping and other subsidiary mappings. The main mapping underlines the similarities of the same conceptual metaphors in two languages whereas the subsidiary mappings underline the cultural variations of two languages.

Motivated by the comparison of ECONOMY IS A PERSON in both Chinese and English, this paper further investigates the similarities and differences in

the source domains of AEROPLANE and MOVING VEHICLE. In the following section, we first elaborate on the methodology with which we have adopted in the corpora analysis.

3. METHODOLOGY

In our corpora search, we limit our target domain by searching for the term 'economy' in Chinese (*jingji*) and in English.

For the Chinese data, 2000 results were obtained for the term *jingji* 'economy' from the Academic Sinica Balanced Corpus (available at http://www.sinica.edu.tw/SinicaCorpus/). For the English data, 500 search results of the term 'economy' were looked at from the corpus of Wall Street Journal 1994 under the Linguistic Data Consortium (available at http://www.ldc.upenn.edu/ldc/online/index.html). Both corpora are of similar size with over 5 million words. All the search results were analyzed for conceptual metaphors manually. The results of analysis for the Chinese data are shown in Table 1 and those of the English data are shown in Table 2.

Economy metaphors	Chinese *jingji*	
	Types	Tokens
1. ECONOMY IS A PERSON	11	121
2. ECONOMY IS BUILDING	10	102
3. ECONOMY IS COMPETITION	23	63
4. ECONOMY IS JOURNEY	9	15
5. ECONOMY IS AN AEROPLANE	3	10
TOTAL	56	311

Table 1: Economy Metaphors in Chinese

Economy metaphors	English 'economy'	
	Types	Types
1. ECONOMY IS A PERSON	26	131
2. ECONOMY IS BUILDING	8	12
3. ECONOMY IS COMPETITION	3	15
4. ECONOMY IS A MOVING VEHICLE	17	34
5. ECONOMY IS AN ENGINE	8	17
TOTAL	62	209

Table 2: Economy Metaphors for English

The shaded conceptual metaphors in Tables 1 and 2 are the similar recurring metaphors in both languages. The similar source domains are PERSON, BUILDING and COMPETITION. The source domain of PERSON was discussed in Chung, Ahrens and Huang (2003) and the source domain COMPETITION was discussed in Ahrens, Chung and Huang (2003). In this paper, we look at the source (knowledge) domains of AEROPLANE and MOVING VEHICLE, since these concepts are related– i.e., they can be argued to belong to the same source domain of TRANSPORTATION. They can also be argued to perform as source domains independently of each other. We address this issue by using (a) our cross-linguistic corpora analysis in English and Chinese and (b) the SUMO ontology.

4. ECONOMY IS A TRANSPORTATION_DEVICE

When we compare Tables 1 and 2, we notice two source domains that are potentially related to 'Transportation'-- AEROPLANE and MOVING VEHICLE. In order to look at the scope of the mappings, we present the linguistic expressions that are mapped within these source domains.

	Metaphors	Frequency
Functions	起飛 (take off)	8
	飛升 (ascending (while flying))	1
	突飛 (sudden ascending (while flying))	1

M.P.: Economy is an aeroplane because aeroplane ascends and economy rises.

Table 3: ECONOMY IS AN AEROPLANE

	Metaphor	Frequency
Entities	slowing	1
	track	2
	slowdown	3
	turn	1
	turnaround	1
	driver	1
Quality	on track	2
	slower	1
	slowing	1
Functions	slow down	3
	speed	1
	to slow	**11**
	turns around	1
	adding fuel	2
	to race	2
	barreling down thee highway	1

M.P.: The economy is a moving vehicle because moving vehicle has speed of movement and economy has speed of development.

Table 4: ECONOMY IS MOVING VEHICLE

From Tables 3 and 4, we notice that the source domain of AEROPLANE is used prototypically in Chinese to map a 'rising action' whereas the source domain of MOVING VEHICLE is used to map the 'speed' of movement in English economy metaphors.

Examples of sentences for these metaphors are given in (3) and (4):

(3) ECONOMY IS AEROPLANE

臺灣	經歷	了	經濟	起飛
taiwan	*jingli*	*le*	*jingji*	*chifei*
Taiwan	experience	ASP	economy	take off

"Taiwan has experienced the rises of economy"

(4) ECONOMY IS MOVING VEHICLE

a. the economy is going to **slow down**,

b. the U.S. economy were **barreling down the highway** at 100 miles '

In order to check whether this source domain can be captured by a structured ontology, we searched for the key concepts in the Mapping Principles for AEROPLANE and MOVING VEHICLE.

The key concept of 'ascend' was searched for ECONOMY IS AN AEROPLANE and the concept of 'speed' was searched for ECONOMY IS A MOVING VEHICLE. These concepts represent the most *prototypical mappings in the corpora analysis.*

4.1 AEROPLANE

The results from SUMO show that the concept of 'ascend' is defined as 'travel up' and is corresponded with the node of 'Motion,' which comprises the subclasses of 'BodyMotion,' 'DirectionChange,' 'Transfer,' 'Transportation' and 'Radiating' (refer to (6)).
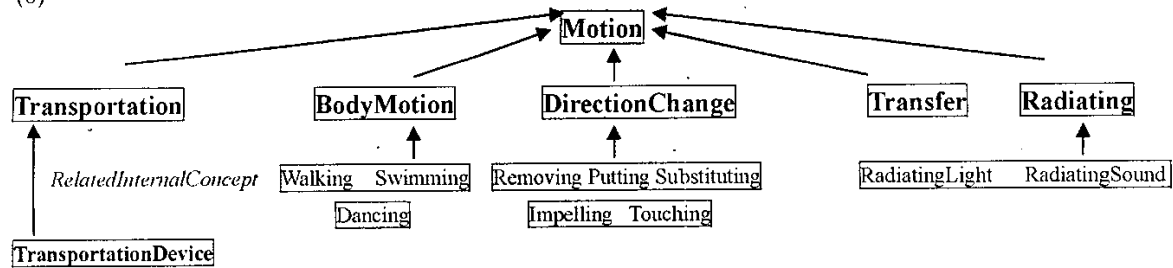
Among these subclasses, 'Transportation' possesses the following definition, which corresponds with the source domain we have identified – i.e., AEROPLANE for 'ascend.'

(5) Motion from one point to another by means of a TransportationDevice.

If trans is an instance of transportation, then there exists transportation device device so that device is an instrument for trans.

(=> (instance transportation)(exists ()(and
(instance transportation device) (instrument))))

(6)

```
                                    ┌──────┐
                          ┌────────▶│Motion│◀────────┐
              ┌───────────┘      ┌─▶└──────┘◀─┐       └──────────┐
              │                  │      ▲      │                  │
┌──────────────┐    ┌─────────┐  ┌──────────────┐   ┌────────┐  ┌─────────┐
│Transportation│    │BodyMotion│ │DirectionChange│  │Transfer│  │Radiating│
└──────────────┘    └─────────┘  └──────────────┘   └────────┘  └─────────┘
       ▲                 ▲              ▲                             ▲
       │                 │              │                             │
 RelatedInternalConcept ┌──────────────┐ ┌────────────────────────┐ ┌──────────────────────────┐
                        │Walking Swimming│ │Removing Putting Substituting│ │RadiatingLight  RadiatingSound│
                        └──────────────┘ └────────────────────────┘ └──────────────────────────┘
       │                   ┌──────┐          ┌────────────────┐
┌──────────────────┐       │Dancing│         │Impelling Touching│
│TransportationDevice│      └──────┘          └────────────────┘
└──────────────────┘
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From (6), one may argue that the subclass of 'DirectionChange' is also a possible corresponding node for the metaphor ECONOMY IS AN AEROPLANE. However, when the subclasses of 'DirectionChange' are displayed in (6), they are not directly related to the ascending aeroplane. Therefore, the prototypical occurrences of *chifei* 'take off' do not reflect 'DirectionChange:' rather, it refers more to the motion of the transportation device.

In (7), the ontological relations of the concept Transportation is shown.

(7) Process

   ↑

   Motion

   ↑

   Transportation

   ↑   *RelatedInternalConcept*

   TransportationDevice
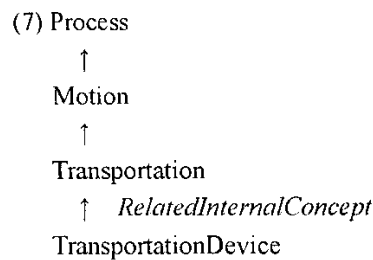
Transportation is internally related to TransportationDevice. This relation is defined in (8) and the definition of TransportationDevice is given in (9).

(8) transportation is internally related to transportation device.

   (relatedInternalConcept   Transportation TransportationDevice)

(9) *If ⸳ ⸳⸳⸳ is an instance of transportation device, then ⸳ ⸳ is capable to do transportation in role instrument.*

   (=> (instance ?DEVICE TransportationDevice)

   (capability Transportation instrument ?DEVICE))

Therefore, the source domain of AEROPLANE in Mandarin Chinese have mappings corresponding to the node of 'TransportationDevice,' which is an lower node for 'Motion' in SUMO.

In order to find out whether the knowledge domain of MOVING VEHICLE is also represented by the same node, we search for the concept of 'speed,' which is identified as the most prototypical mapping of ECONOMY IS A MOVING VEHICLE.

4.2 MOVING VEHICLE

The concept of 'speed' is represented in SUMO as two separate linguistic functions, i.e., 'speed' as noun and verb. 'Speed' as noun possesses the corresponding nodes in (10).

(10) Motion

   BiologicallyActiveSubstance

   FunctionQuality

   RationalNumber

   SpeedFn(Function)

'Speed' as a verb has the corresponding nodes in (11).

(11) Motion

   RationalNumber

   Increasing

   NormativeAttribute

Among these nodes, 'Motion' reflects the majority linguistic expressions in Table 4, with the most prototypical mapping of 'slowing down.' ⸳

If the concept of 'speed' shares the similar corresponding nodes of 'Motion,' its subclasses are predicted to be similar to the hierarchy shown in (7).

With this hierarchy, 'speed' also has a corresponding node with 'Transportation' and 'TransportationDevice.'

5. DISCUSSION

By using an ontology tool, this paper has demonstrated that a similar source domain ('TransportationDevice') can co-exist in two languages. Both languages use the same hierarchical source knowledge structure, incorporating the parent concept of motion, daughter concept of 'Transportation,' and the related concept of 'TransportationDevice,' as illustrated by (7). However, the two languages choose two different entities to instantiate the concept of TransportationDevice. AEROPLANE is used in Chinese, and VEHICLE in English. They are mapped differently in Mandarin Chinese and English due to the conceptual variations between the two speech communities. For instance, the 'ascending' of the economy is conceptually salient in the Taiwanese society because of the economic expansion in 1985. The use of the car in the English speaking communities is similarly a general experience of life, which is mapped to the experience of a cyclical economy. It is crucial to point out that modern Chinese speakers do not share the same experience with cars and a cyclical economy in the latter half of the twentieth century as the American speakers. In addition, English also has the subsidiary function of 'Speed' represented in the metaphor, while there is no such instantiated case in Chinese.

These variations are factors that contribute to language variations especially in metaphoric expressions. Hence, through contrasting the conceptual metaphors in these two languages, this work also underlines the cognitive and conceptual motivations of which these mappings are formed.

The findings discussed above have several implications: First, the source domain knowledge in a metaphor can be structured, instead of just an atomic

conceptual node. This structure can be precisely captured by an ontology, such as SUMO. Second, metaphors have strong conceptual motivation. Hence, even though that metaphors may be parochially realized with different terms in different languages, there is a good possibility that these terms may actually represent identical conceptual structure. This is shown in this paper with the contrast between English VEHICLE and Chinese AEROPLANE, both of which turn out to represent identically structured source knowledge. Third, while conceptual structures are shared, the choices in which subsidiary components may be instantiated may be motivated by the shared experience of the speakers of that language.

6. CONCLUSION

In addition to the findings on the contrasts between two languages, this study also brings out an important observation. Although the source domains (i.e., AEROPLANE and MOVING VEHICLE) appear at the lower ontological node of 'TransportationDevice,' the Mapping Principles occur at the higher ontological node of 'Motion.' This poses a significant implication on visualizing the conceptual metaphors. Our hypothesis is that a majority of our real life use of metaphoric expressions reflect knowledge that is at a lower ontological node (instances of 'TransportationDevice'). However, the conceptual mappings that govern these metaphoric expressions occur at a higher ontological node ('Motion').

This finding raises the question whether conceptual metaphors occur at word level, i.e., the expression level, or at a higher conceptual level. Through using the CM Model as well as the SUMO ontology, this paper presents an insight into tackling this question. In addition, this study is also advantaged in providing a framework for cross-linguistic comparison of conceptual metaphors in corpora analysis.

This paper contributes to delimiting the source domain by using a corpora- and ontological-based

framework. The analysis aims for automatization of metaphor processing. For future work, Wordnet will be incorporated in the corpora metaphor analysis. With the examination of the hypernyms for each linguistic expression, analysis that is done manually can be reduced.

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