Source Domains as Concept Domains in Metaphorical Expressions

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Abstract

The use of lexical resources in linguistic analysis has expanded rapidly in recent years. However, most lexical resources, such as WordNet or online dictionaries, at this point do not usually indicate figurative meanings, such as conceptual metaphors, as part of a lexical entry. Studies that attempt to establish the relationships between literal and figurative language by detecting the connectivity between WordNet relations usually do not deal with linguistic data directly. However, the present study demonstrates that SUMO definitions can be used to identify the source domains used in conceptual metaphors. This is achieved by identifying the relationships between metaphorical expressions and their corresponding ontological nodes. Such links are important because they show which lexical items are mapped under which concepts. This, in turn, helps specify which lexical items in electronic resources involve conceptual mappings. Looking specifically at the concept of PERSON, this work also establishes connectivity between lexical items which are related to "Organism." Therefore, the methodology reported herein not only aids the categorizing of lexical items according to their conceptual domains but also can establish links between these items. Such bottom-up and top-down analyses of lexical items may provide a means of representing metaphorical entries in lexical resources.

Keywords: Concept, Ontology, Conceptual Metaphor, Source Domain, WordNet, SUMO

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1. Introduction

Many studies have found that metaphors are not represented separately in lexical resources [Alonge and Castelli 2002ab, 2003; Peter and Wilks 2003; Lönneker 2003]. When metaphors are found in lexical resources, they are most often represented using meaning entries in addition to non-metaphorical ones. WordNet [http://www.cogsci.princeton.edu/~wn/; Fellbaum 1998] is one of the lexical resources that sometimes lists metaphorical meanings as different senses along with other non-metaphorical ones.

However, where conceptual metaphors [Lakoff 1993; Lakoff and Johnson 1980] are concerned, there is no uniform representation of source (concrete) and target (abstract) domains in WordNet. Due to this fact, studies have been carried out which have attempted to represent figurative meanings by indicating the source-target domain pairing in addition to the literal meaning [Lönneker 2003; Alonge and Lönneker 2004; Peters and Wilks 2003]. In order to do so, these studies first established the relationship between the literal and figurative entry in the lexical resource. As a result, the mapping between the source and target domains could then be extracted.

Researchers who have attempted to incorporate metaphors into WordNet include Eilts and Lönneker [2002], who created the Hamburg Metaphor Database, a database which provides French and German metaphors by creating links between metaphorical expressions and their related synsets in WordNet. Another possible way to establish the relationships between literal and figurative entries is to determine the semantic relations between lexical entries. For instance, Lönneker [2003] and Peters and Wilks [2003] suggested that the meronymic relations in WordNet can be used to identify the links between lexical items by establishing a connection between the *event* and its *participants* or the *action* carried out by the participants. However, neither of these studies used ontologies to link the concepts in the source or target domain. Alonge and Castelli [2003] were the first to suggest that the EuroWordNet Top Ontology needs to be extended with more concepts in order to deal with figurative language. The advantages of ontologies have been outlined by Navigli and Velardi [2004]; they include the fact that a) an ontology has a wide "coverage" of domain concepts; b) that it is a result of "consensus" reached by a group of people and c) that most importantly, it is easily accessible through electronic resources.

Most of the above mentioned works, which tried to generate the underlying connectivity between synsets, have based their mechanisms on distributed models of processing [Rumelhart and McClelland 1986] or the coarse-coding of lexicons [Harris 1994]. Harris stated that the "representational units" in a coarse-coding mechanism "do not match the information represented…in a one-to-one fashion" [Harris 1994]. Rather, they are connected to one another, and when one unit is activated, the others will also be activated. It is through

these units that clusters of information (which contain one or more concepts) are built. This activation of concepts governs the generation of underlying relations between WordNet relations.

Working within this framework, our aim in this work is to establish links between metaphorical items by identifying the shared concept carried by a cluster of lexical items. For instance, when one active concept (from a lexical item) such as "Growth" is activated, the related concept, such as "Organism" is also activated. This link between lexical items in the same domain is necessary to show which lexical items are mapped under which concepts; i.e., lexical items with the same shared concepts will be sorted into the same source domain of a metaphor. In this paper, the building of a "concept" involves the use of knowledge nodes from an ontology, which is a shared understanding of some domain of interest [Uschold and Gruninger 1996]. Keil [1979] stated that the knowledge representation in an ontology "has unique properties and is highly structured. Moreover, it constrains the nature of semantic and conceptual knowledge." The particular ontology we use in this paper, SUMO, was developed by the IEEE Standard Upper Ontology Working Group. Huang, Chung and Ahrens (In press) applied SUMO to explore how an ontology can be used to predict metaphorical mappings. Our work herein extends that of Huang *et al*. (In press) by focusing on how the source domain of a metaphor can be determined via SUMO definitions.

All metaphorical instances in this work are identified using the Conceptual Mapping (CM) model [Ahrens 2002], and data in this study come from both English and Chinese corpora. Searching for ontology nodes is facilitated by the Academia Sinica Bilingual Ontological Wordnet [Sinica BOW, Huang, Chang and Lee (2004) http://BOW.sinica.edu.tw], a system that integrates WordNet, the English-Chinese Translation Equivalents Database (ECTED), and SUMO.

2. Conceptual Metaphor, Concept Domain and Ontology

Ahrens [2002] suggested that the metaphorical expressions can be analyzed in terms of the entities, qualities and functions that can map between a source and a target domain. When these conventionalized metaphorical expressions have been examined, an underlying reason for these mappings can then be postulated. This particular study collected data from native speaker intuitions to determine the mappings from the source to the target domain. For example, in the three examples from the metaphor LOVE IS PLANT, given below, the Mapping Principle (MP) of "Love is understood as plant because plants involve physical growth and love involves emotional growth" was extracted based on the fact that all the examples in some way had to do with growth.

1. (a) 兩　　人　　的　　愛　　苗　　最近　　才　　剛　　萌芽
　　　　liang　ren　de　ai　miao　zuijin　cai　gang　mengya
　　　　two　people　MOD　love　seedling　lately　just　recently　sprout
　　　　'Their love just begins to sprout lately.'

　　(b) 我　對　他的　愛意　漸漸　滋長
　　　　wo　dui　tade　ai-yi　jianjian　zizhang
　　　　I　for　his　love　gradually　grow
　　　　'My love for him has grown gradually.'

　　(c) 愛情　需要　辛勤　的　灌溉
　　　　aiqing　xuyao　xinqin　de　quanqai
　　　　love　need　industriously　water
　　　　'Love needs to be watered industriously.'
　　　　[Ahrens 2002]

Ahrens, Chung and Huang [2003] extended this study by proposing a corpus-based approach to establish the systematicity between source and target domain pairings (i.e. Mapping Principles (MPs)). They suggest that each source-target domain pairing will have a prototypical instance of mapping determined by the most frequent mapping, as compared with other mappings. In a later paper, Ahrens 2004, they use Suggested-Upper-Merged-Ontology (SUMO) in combination with WordNet to determine Mapping Principles when there is no highly frequent mapping. SUMO can be used to infer knowledge through automatic reasoning as well as to constrain the falsifiability of the MP.

This study extends the previous works of Ahrens, Chung and Huang [2003, 2004] by using SUMO to define the concepts involved in source domains through the use of two major databases -- WordNet (1.6), and SUMO nodes along with their definitions. The integration of WordNet and SUMO by Niles and Pease [2003] enables us to examine the ontological nodes in SUMO that have hyperlinks to WordNet semantic definitions.

3. Metaphor Analysis: CAREER IS A PERSON as a Sample

In order to find conceptual metaphors in corpora, a single target word was used for the target domain. Four target domains were chosen, namely, CAREER, CULTURE, STOCK MARKET and ECONOMY, of which the latter two are composed Chinese-English data (see Table 1).

The target domains of STOCK MARKET and ECONOMY have been discussed by Ahrens *et al.* [2003] and Chung, Ahrens and Sung [2003], and in this paper, we further refine the previous findings. In this paper, also, the Chinese only CAREER and CULTURE target domains will be added to strengthen the methodology discussed herein.

Table 1. The sources and frequencies of the corpora instances found

Target domains	Sources	Number of hits	Number of metaphorical expressions
(Chinese) *Shiye* 事業 CAREER	Sinica Corpus (http://www.sinica.edu.tw/SinicaCorpus/)	1062	84
(Chinese) *Wenhua* 文化 CULTURE	Sinica Corpus	2000	335
(Chinese-English) *Gushi* 股市 STOCK MARKET	1997 *Huashishingwen* 華視新聞焦點 1997 *Gungshangshibao* 工商時報 [Chung, Ahrens and Sung, 2003]	NA	135
	1994 Wall Street Journal (Available at the Language Data Consortium http://www.ldc.upenn.edu/ldc/online/index.html)	500	130
(Chinese-English) *Jingji* 經濟 ECONOMY	Sinica Corpus	2000	311
	1994 Wall Street Journal	500	215

The four target domains were used to extract instances from the corpora. After all instances were extracted, they were analyzed manually for the instances of metaphors. A metaphor was identified when there was a source-target domain mapping. The following sentence shows a metaphorical instance for the target domain CAREER: 他事業的生命力日趨旺盛 "the life-force of his career is becoming exuberant day-by-day," the concrete meaning of "life force" is mapped onto CAREER. In another example,事業創傷 "the wound of career," the more concrete source "wound" is mapped onto the abstract target CAREER. Through similar analysis, all metaphorical instances were marked and extracted. Once all the metaphorical instances had been identified, the next step was to define the source domains of these instances. In order to do so, the corresponding WordNet and SUMO nodes for each lexical item were searched for in Sinica Bow. Through this system, each metaphorical instance was keyed in at the WordNet page. This was done to extract the WordNet explanations which were linked to the corresponding SUMO nodes in the system. In order to obtain the WordNet explanation, a prior step was performed, i.e., the most appropriate meaning was selected from the list of senses available. This selection was done manually, but most often, the most appropriate meaning was found to be the most concrete meaning in the list. For example, when the Chinese keyword *chuangshang* 創傷 "wound" from the target domain CAREER was searched for in Sinica Bow, the senses listed in Table 2 were extracted.

Table 2. The search result for chuangshang 創傷 "wound" in Sinica Bow

WordNet (1.6)	WordNet Explanations	Corresponding SUMO Nodes
Sense 1:trauma	an emotional wound or shock often having long-lasting effects	EmotionalState(情緒狀態)
Sense 2:wound	any break in the skin or an organ caused by violence or surgical incision	Injuring(傷害)

Among these senses, the more concrete sense (i.e., the more concrete meaning that was mapped from the source domain) was selected. In this case, sense 2 was selected and then the corresponding node (the rightmost column in Table 2) was found. In this case, it is "Injuring." The SUMO definition for "Injuring" is "The process of creating a traumatic wound or injury. Since injuring is not possible without some biologic function of the organism being injured, it is a subclass of biological process." The keywords in the SUMO definition (shaded in the previous sentence) are the terms that helped us categorize the metaphorical instances. Through the collection of SUMO definitions for all the metaphorical instances, all the similar metaphorical expressions with the same related nodes are grouped into categories. For instance, all the metaphorical expressions related to "Organism" were grouped together. Then, from these instances, the source domains were decided. The expressions that were grouped under the same source domain formed a cluster of lexical items under a domain. In the following discussion, we will provide a detailed example using the CAREER domain.

For the target domain CAREER, all 84 metaphorical instances are listed in Table 3. Each of the items in Table 3 was looked up using the Sinica Bow system to find their corresponding WordNet senses and, later, the SUMO nodes.

Table 3. Metaphorical expressions related to shiye 'career' (tokens are in brackets)

新創(1)	紮實(1)	溶進...之中(1)	軌道(1)	意識(1)	異軍(1)	幕後功臣(1)	前途(2)
創造(5)	起步(1)	收起來(1)	轟轟烈烈(2)	搖身一變(1)	改革(1)	玩掉(1)	投入(1)
開創(1)	走向(2)	投身...中(1)	走上(1)	創傷(1)	兵符(1)	投向(1)	壯大(1)
共創(1)	第一步(1)	基礎(5)	火車頭(1)	打拼(1)	前程(1)	開發(1)	成長(1)
再創(2)	闖(2)	追求(4)	退出(2)	掙(1)	競爭(1)	登上...位子(1)	角色(1)
挑戰(1)	關(5)	風險(1)	躍進(1)	拼(1)	抗爭(1)	包袱(1)	
策略(2)	關卡(1)	供輸(1)	放手(1)	大舞台(2)	投(1)		
趨勢(3)	過程(1)	賭(1)	生命力(1)	階梯(1)	衝刺(1)		

Table 4 shows how the SUMO definitions help us differentiate between source domains. However, due to limited space, only selected instances from Table 3 will be discussed.

Table 4. Defining source domains through WordNet and SUMO

Expressions	WordNet senses	WordNet explanations	SUMO nodes	SUMO definitions
策略 'tactic'	6: ambush	the act of concealing yourself and lying in wait to <u>attack</u> by surprise	ViolentContest (暴力性的競爭)	A Contest where one participant attempts to physically injure another participant.
軌道 'track'	2: track	a pair of parallel <u>rails</u> providing a runway for <u>wheels</u>	Transportation Device (運輸工具)	A TransportationDevice is a Device which serves as the instrument in a Transportation Process which carries the patient of the Process from one point to another.

For the expressions listed in Table 4, their SUMO definitions (the rightmost column) provide the keywords referring to the source domain to which these expressions might belong[1]. For instance, the keyword "Contest" for 策略 "tactic" might refer to WAR or COMPETITION, whereas "TransportationDevice" and "Transportation" for 軌道 "track" might refer to VEHICLE. When all the lexical items in Table 3 are looked up, the similarities of these items at the upper ontological levels can be established. In this paper, we will use CAREER IS A PERSON as an example. All items in (2) are found to have "Organism" as the shared concept[2].

(2)   意識 "consciousness"   生命力 "the force to live"   成長 "grow"
       創傷 "wound"   第一步 "first step"   起步 "start a step"
       放手 "let go"   走向 "walk towards"

Table 5 below shows the SUMO definitions for the items in (2). The original method produced the list of all instances in Table 3 in the form shown in Table 5; however, due to space limitations, this paper does not include the full list of all 84 items in Table 3. Only the ones related to "Organism" are shown. Among the SUMO nodes listed in Table 5, "Awake" and "Emotional State" are related to the upper node "State of mind" or a psychological process. The other nodes are related to a physical aspect of the organism, such as "Body

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[1] There are also underlined keywords in the "WordNet Explanations" column. Although these keywords might also contribute to determining the source domains of metaphors, what we wish to discuss is connectivity at the ontological level.

[2] Note that though an item like *tousheng* 投身 "to throw oneself to" can be intuitively linked to PERSON, it is not listed in (2). This is because this lexical item is not found in the Sinica Bow. These items are not categorized in this paper. The limitation of the Sinica Bow will be discussed later.

motion" for "Walking."

Table 5. CAREER IS A PERSON: SUMO definitions

Expressions	WordNet senses	SUMO nodes	SUMO definitions
意識 "consciousness"	1: consciousness	Awake (清醒)	Attribute applies to Organisms that are neither Unconscious nor Asleep.
創傷 "wound"	2:wound	Injuring(傷害)	The process of creating a traumatic wound or injury. Since Injuring is not possible without some biologic function of the organism being injured, it is a subclass of BiologicalProcess.
放手 "let go"	1: let_go	EmotionalState (情緒狀態)	The Class of Attributes that denote emotional states of Organisms.
生命力 "life force"	1: animation	Living (活的)	This Attribute applies to Organisms that are alive.
成長 "grow"	3: mature	Growth (生長)	The Process of biological development in which an Organism or part of an Organism changes its form or its size.
起(步) "start a step"	1: pace	Walking (行走)	Any BodyMotion which is accomplished by means of the legs of an Organism on land for the purpose of moving from one point to another.
(走)向 "walk toward"	1: foot		
第一(步) "first step"	1: pace		

Although the linking concept is found to be "Organism," the concept of "Organism" is too broad, because it comprises all living things, including all plants and animals. For conceptual metaphors, preference is given to source domains that are in contact with human conceptualization, i.e., more concrete concepts which human can easily recall when describing an abstract idea. Furthermore, as indicated in Table 5, the type of organism should not only have the abilities to grow and to walk, but should also to have an emotional state. Based on these criteria, PLANT and ANIMAL are ruled out as possibilities, and HUMAN or PERSON is suggested.

Table 5 also lists the keywords in SUMO that are related to "Organism" (shaded). These keywords are important because, as explained in the parallel distributed model, one active unit will lead to the activation of other representation units. If a semi-automatized program is to be generated for the purpose of metaphor extraction, one first needs to establish the link between active units. In this case, the active units can be these keywords, and in the future research, the links between these keywords can be established using a computerized program. However, at the present stage, the analysis of metaphors, the selection of WordNet senses, and the selection of keywords has to be carried out manually.

In this paper, we incorporate more target domains to test the reliability of using SUMO nodes. If the same repeated SUMO nodes are found, then there is a systematic pattern that

links the lexical items within a similar source domain. In the following sections, we will skip the steps for obtaining SUMO nodes and focus more on comparing the different target domains which share the same source domain (of PERSON).

3.1 CULTURE IS A PERSON

The example CULTURE IS A PERSON is shown in (3) below.

(3) 使   客家   文化   走入   現代   現實   之中   啊！
     shi   *kejia*   *wenhua*   *zouru*   *xiandai*   *xianshi*   *zhizhong*   *Exclam*
     cause hakka   culture   walk into   modern   reality   inside   Exclaim
     "To make Hakka culture walk into the modern world!"

In this example, CULTURE is seen as something that can "walk." Comparing it with CAREER IS A PERSON, we find that the similarities and differences are those summarized in Figure 1.
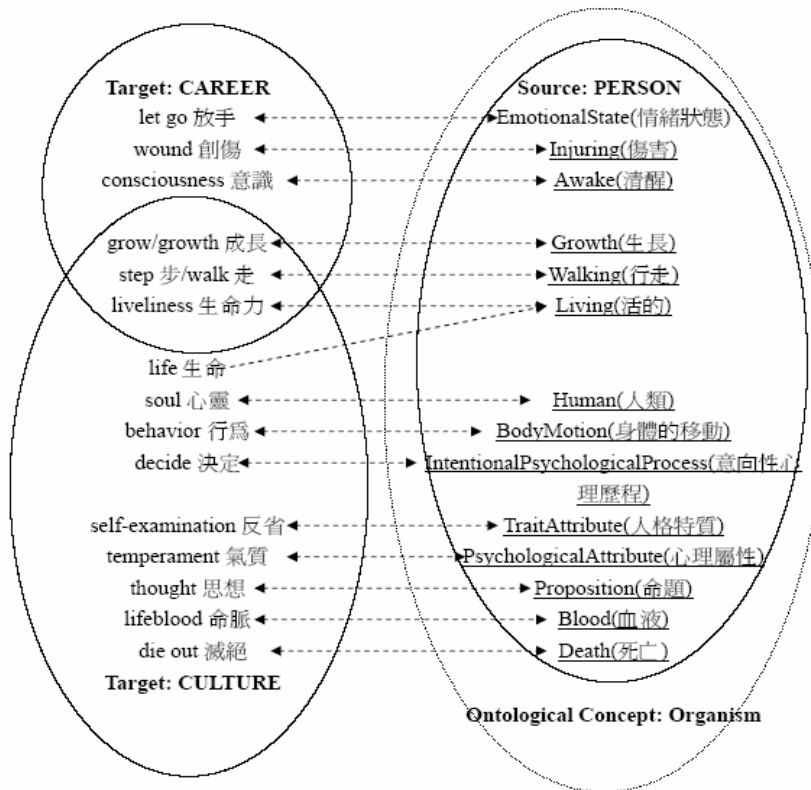

Figure 1. Categorizing the ontological nodes for CAREER and CULTURE

In this figure, the target domains CAREER and CULTURE are placed on the left side and the source domain PERSON on the right. All metaphorical instances in the target domains are related to their ontological nodes on the right side inside the circle of PERSON. Since all the SUMO nodes are related to "Organism" in one way or another, they can be subsumed under the ontological concept of "Organism," which forms the outer circle of PERSON. As mentioned previously, the metaphor CAREER IS AN ORGANISM is not selected because some nodes in "Person" (especially those related to psychological ones) cannot be accounted for by the other subsets of "Organism" such as PLANT and ANIMAL.

From Figure 1, we can see that a concept (i.e., PERSON) can be generated by looking at a cluster of lexical items (i.e., metaphorical expressions) and by looking at their SUMO nodes. The more general concept of "Organism" can be seen as the linking concept of all these lexical items. The overlapping area between CULTURE and CAREER (concepts such as "Growth" and "Walking") are linked to lexical items that are more lexicalized, as these items can apply to more target domains than the other items can. In other words, lexical items within several overlapping source domains (such as 成長 "growth" and (走)向 "walk towards") tend to be lexicalized faster than the other lexical items.

3.2 STOCK MARKET IS A PERSON in Chinese and English

The application of SUMO to two knowledge systems (Chinese and English) was discussed by Huang, Chung and Ahrens (in press). The focus of this paper is to investigate which conceptual nodes will be similar or different when a similar source domain (PERSON) is created in two different languages. For example (4), the Chinese metaphor STOCK MARKET IS A PERSON is found.

(4) 紐約　　　股市　　　復甦　　的　活力　　驚人
    neuyue　*gushi*　*fusu*　*de*　*huoli*　*jingren*
    New York　stock market　recovery DE　vitality　shock people
    "The vitality of the recovery of the New York stock market is surprising."

An English example is *the nervous stock market tumbled 67.85 points yesterday*. A comparison of the Chinese and English data for STOCK MARKET is shown in Figure 2.

Previous analysis of Chinese and English STOCK MARKET was reported by Chung, Ahrens and Sung [2003], who also re-evaluated Charteris-Black's [2001] English and Spanish data. However, neither study incorporated ontologies in their analyses.

In Figure 2, all the metaphorical instances of STOCK MARKET are linked to their

ontological nodes under PERSON. No overlapping metaphorical items that have the same meaning are found. However, the ontological nodes "BiologicalAttribute" and "OrganismProcess" overlap in the Chinese and English data. If one compares Figure 1 and 2, one finds that there are no overlapping metaphorical expressions in Chinese and that only three ontological nodes are repeated in both figures. These nodes are "IntentionalPsychologicalProcess," "TraitAttribute" and "PsychologicalAttribute."
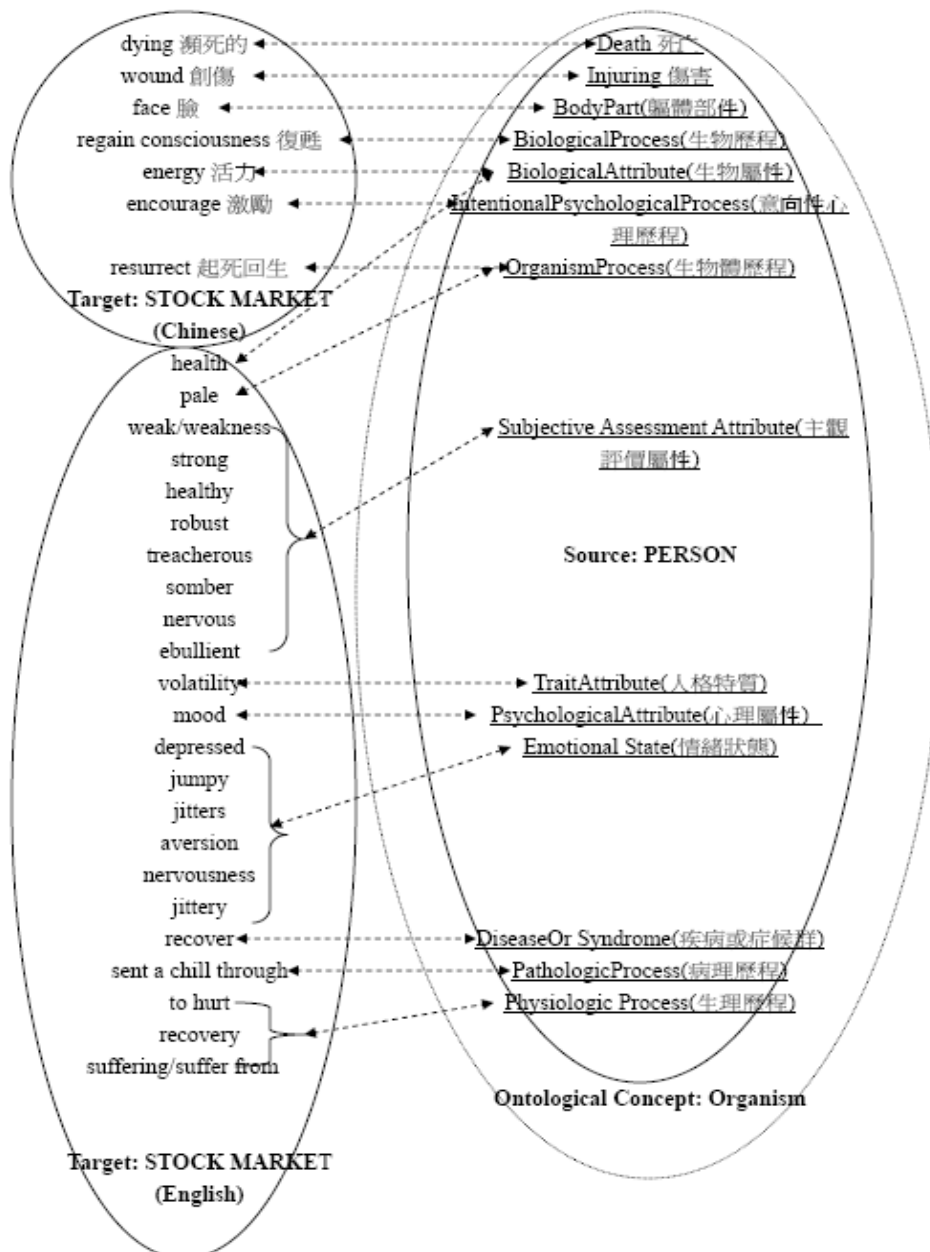

Figure 2. Categorizing the ontological nodes for STOCK MARKET

The few overlapping ontological concepts in Figures 1 and 2 suggest that the metaphorical items in CAREER and CULTURE are different from those in STOCK MARKET, even though all of them are linked to the concept PERSON. In the next section, the ontological nodes of ECONOMY will be examined.

3.3 ECONOMY IS A PERSON in Chinese and English

The example ECONOMY IS A PERSON in Chinese is shown in (5) below.

(5)	只	想	暫時	維持	不	讓	經濟	衰退
	zhi	*xiang*	*zhanshi*	*weichi*	*bu*	*rang*	*jingji*	*shuaitui*
	only	think	temporary	maintain	NEG.	let	economy	degenerate

"only want to temporarily maintain and not let the economy degenerate"

An English example is *the economy remains anemic in that period*. A comparison of the SUMO nodes for Chinese and English ECONOMY IS A PERSON is shown in Figure 3.

From Figure 3, the Chinese and English data of ECONOMY overlap with the concept "Growth" in both languages. In fact, previous works [Ahrens *et al.* 2003; Chung *et al.* 2003ab] suggested that the meaning of "growth" is mapped most frequently in both Chinese and English ECONOMY metaphors[3]. As shown in Figure 1 earlier, the concept of "growth" is also found in the target domains CAREER and CULTURE, indicating that this concept can be used to describe not only ECONOMY but also CAREER and CULTURE. This repetition of the same lexical items in several target domains may mean that this lexical item is a common concept and that its frequency of occurrence as a metaphor is high, indicating that its metaphorical meaning is strongly conventionalized.

In order to understand which aspects of PERSON are involved in all the target domains CAREER, CULTURE, STOCK MARKET and ECONOMY, a comparison of ontological nodes will be discussed in Section 4 below.

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[3] This paper only considers the types of lexical items and their related SUMO nodes (regardless of whether the items that appear many times will affect the number of times an ontological node will appear). This is so because the aim here is to extract the ontological nodes that form a concept, not their frequency.
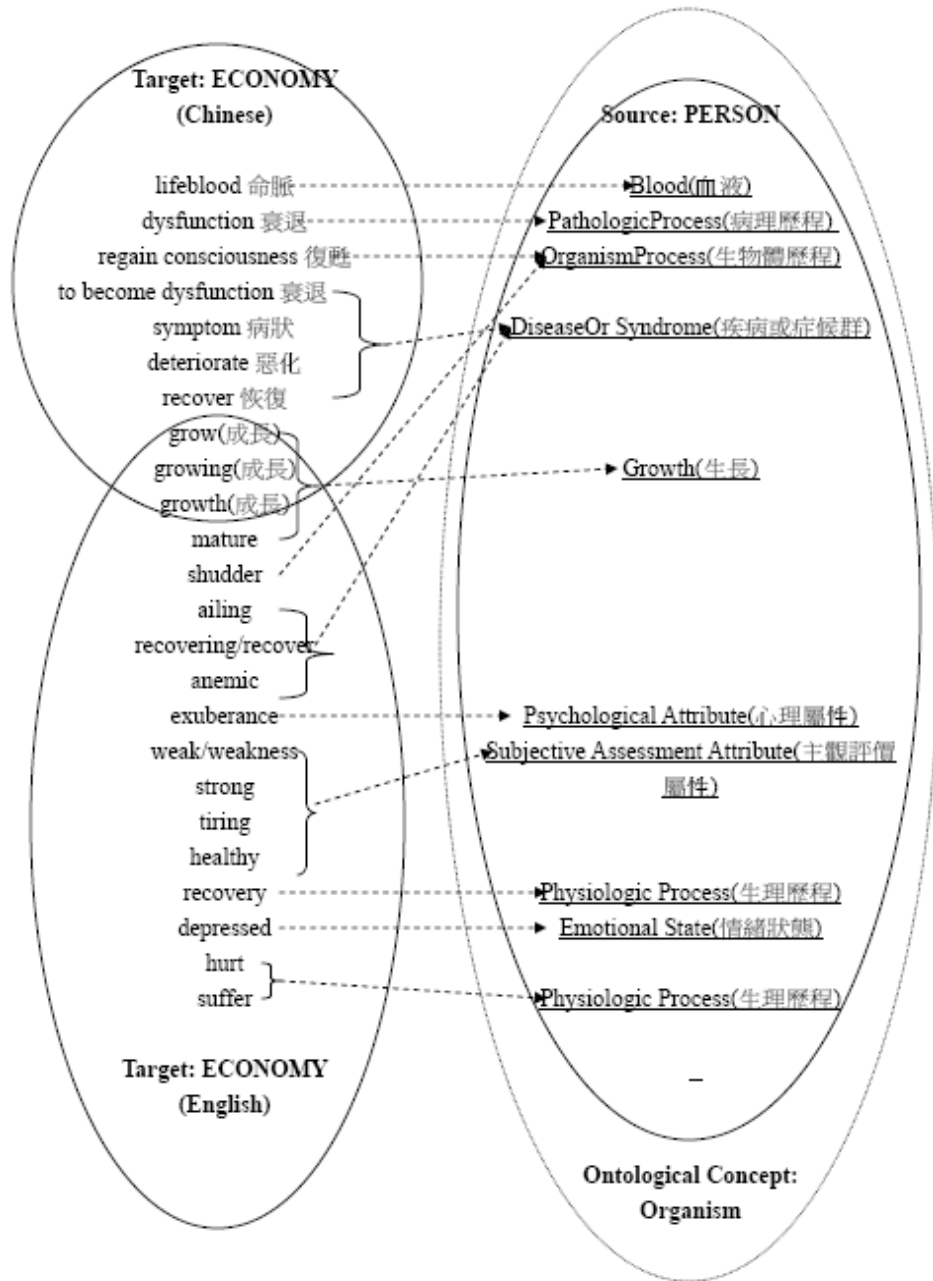
Figure 3. Categorizing the ontological nodes for ECONOMY

4. Discussion

When ontological nodes are contrasted, they are found to fall into two main types, namely, physical and psychological. This means that both the physical and psychological aspects of a person are selected when a metaphor is created.

	(6)	**Physical**		**Psychological**
	DiseaseOr Syndrome	Injuring	Subjective Assessment Attribute
	Growth	PathologicProcess	Emotional State
	Physiologic Process	TraitAttribute	Psychological Attribute
	OrganismProcess	Awake	IntentionalPsychological Process
	Walking	BiologicalProcess	Proposition
	Living	BodyMotion	
	BiologicalAttribute	BodyPart	
	Blood	Damaging	
	Death	Human	

The distribution in (6) shows that many aspects of the physical concept of human are mapped when constructing metaphors. Comparing Figures 1, 2 and 3, one finds that the node "DiseaseOrSyndrome" comes from both Chinese and English ECONOMY and STOCK MARKET only (where more lexical items in ECONOMY have this node). A similar situation is found with the ontological node of "Growth," where more types of lexical items come from the target domain ECONOMY (rather than the other three target domains). The preference for (both English and Chinese) ECONOMY for the physical aspect of PERSON shows that these two languages do not differ greatly in terms of the types of lexical items found.

On the other hand, most of the lexical items that denote the psychological aspect of a person come from STOCK MARKET (refer to "Subjective Assessment Attribute" and "Emotional State" in Figure 2). Compared with English ECONOMY, which maps onto the physical aspect of a person, STOCK MARKET seems to be described more in terms of a psychological change of a person. This finding is interesting because as Ahrens [2002] noted in her discussion of the Mapping Principle Constraint, that "a single target domain must use different source domains for different reasons." In this case, the selection of the single source domain by two different target domains in the same language occurs for different reasons. With this in mind, one can see the underlying motivation for the formulation of different

conceptual metaphors. That is, the motivation governing the selection of a source domain by a target domain is not *ad hoc*; rather, it is governed by principles. This is only reflected when the ontological nodes involved in the source domain concepts are extracted.

5. Conclusion

The results obtained from the WordNet lexical representation and SUMO searches prove two major points: First, the manual analysis performed using the CM Model in previous studies can be further automatized. Second, there is conceptual connectivity between the metaphorical expressions found within a source domain. As the philosopher Kamppinen pointed out, "representations do not operate in isolation," they are "clustered into systems of representations, cognitive schemata" [1993]. In this case, this cluster of representations is connected through the overlapping concept or "Organism" in the lexical items found. This connectivity between lexical items can be established by using computational tools such as SUMO definitions, along with a linguistic model (i.e., the CM Model) to identify conceptual metaphors in corpora.

Despite the usefulness of WordNet and SUMO for determining source domains, there are two limitations to this study. First is the process of selecting senses from WordNet, which has to be carried out manually. Second is the missing entries that are found in the Sinica Bow look-up (especially Chinese adjectives). Even though the few missing items do not affect the results of categorization as a whole, their inclusion would have made this study more complete.

Nevertheless, the incorporation of an ontology helps pinpoint at which level of knowledge conceptual metaphors occur. The discovery concerning the motivation for using conceptual metaphors contributes to identifying cognitive differences across speech communities. From the perspective of anthropology and language processing, this study has provided linguistic evidence about how humans represent concepts mentally when using metaphors. It is hoped that the line of research discussed herein will stimulate more research on how computational approaches can help set parameters for determining metaphorical senses and point the way to creating a systematic relationship between literal and figurative synsets in WordNet. In addition, it may also be possible to conduct psycholinguistic experiments to verify the metaphorical expressions that have been extracted from corpora.

Acknowledgements

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