

## The Polysemy of *Da3*: An ontology-based study

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**Abstract:** *In this study, we explore all possible concepts for physical activity senses and metaphorical event senses of da3 through the SUMO ontological concept system. We use SUMO to find out their concepts in order to group and cluster these same concept words. For that reason, we can get different concept groups for the physical activity senses or metaphorical event senses of da3. We also compare our analysis with Gao's study (2001) and find our results are very similar. This leads us to propose that a concept-base approach is a viable one when exploring the sense of polysemous verbs in Chinese.*

**Keywords:** *Concept, SUMO, Da3, Polysemy*

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### 1. Introduction

In this study, we explore all possible concepts for physical activity and metaphorical event senses (excluding other idiomatic senses and extension senses) of *da3* through the Suggested Upper Merged Ontology (SUMO) ontological concept system (Huang et al. 2004). According to previous work (Gao 2001), *da3* is a basic verb in the domain of physical action verbs in Chinese, as 1) it refers to the most basic action of the hand; and 2) at the same time it can refer to a wide-range of actions or events that involve physical contact of one kind or another. Also *da3* is polysemous to a very high degree. Its

prototypical meaning reaches a high frequency of occurrence in the empirical corpus data. In this paper, we will compare Gao's (2001) analysis with the analysis we provide based on SUMO.

First, we will collect data from Sinica Corpus and check senses from Chinese Wordnet. Next, we analyze these physical activity and metaphorical event senses of *da3* in SUMO (Huang et al. 2004) to find all possible concepts and categorize them. Finally, we analyze these concepts for semantic features in order to compare our analysis with the analysis in Gao's study (2001).

## 2. Previous research

Regarding verb studies, previous research has focused on VV compound verbs in Modern Chinese (Hong and Huang, 2004; Li, 1990), or on near synonyms in Modern Chinese (Chief et al, 2000; Huang et al. 2000; Liu 2002; Tsai, 2002; Huang and Hong, 2005). These studies focused on the semantic relations between lemmas. However, some studies were focused on different senses or relations in the same lemma. Also, some scholars have worked on *da3* polysemy analyses. *Da3* is one of the most frequently used verbs, as it is ranked 16 in the list of most frequently used verbs in Chinese (Bei and Zhang, 1988). Gao (2001) explored the semantic properties of *da3* and its prototypical meaning and categorized its semantic representations to show the systematic patterning of its meaning extensions.

## 3. Motivation and Goals

Language knowledge representation is a manifestation of the systematic contrasts found in human communication, which defies conventional description. Take modal verbs as an example. Modal verbs have similar semantic functions and cannot be easily distinguished in terms of their lexical senses. Therefore, they are considered to be interchangeable. Nevertheless, it is not uncommon that this kind of polysemy always has contrasts in usage, as we can see the contrast between *hui4* (know) and *hui4* (can) below:

(1a) 臺灣廠商到德國開商展時，非常需要會德語和中文的人，做為溝通橋樑。

Tai2 wan1 chang3 shang1 dao4 de2 guo2 kail shang1 zhan3 shi2,  
 Taiwan factory to Germany exhibit time,

fei1 chang2 xu1 yao4 hui4/ \* neng2 de2 yu3 han4 zhong1 wen2 de5  
 readily need could German and Chinese MOD

ren2, zuo4 wei2 gou1 tong1 qiao2 liang1.  
persons, to communicate bridge.

“When Taiwan factories exhibit in Germany, they really need people who could speak German and Chinese to communicate with other persons.”

(1b) 在上課的時候，他不會講德語或中文和學生溝通，因為他怕自己沒辦法完整表達意思。

Zai4 shang4 ke4 de5 shi2 hou4, ta1 bu2 hui4 jiang3 de2 yu3  
In class MOD time, he will not speak German

huo4 zhong1 wen2 han4 xue2 sheng1 gou1 tong1, yin1 wei4 ta1 pa4  
or Chinese with student communicate, because he worry

zi4ji3 mei2 ban4 fa3 wan2 zheng3 biao3 da2 yi4 si1.  
himself no way complete express meaning.

“In class, he can’t communicate with his students in German or Chinese, because he worries that he can’t completely express his meaning (in these languages).”

Considering the lexical sense of modal verb polysemy and its natural language use, *hui4* means both “know” or “can”. As defined, we notice that they differ from each other, even though they share similar concepts.

This paper will investigate the lexical semantic relations between each sense of *da3* polysemy (excluding idiomatic senses and extended senses) by studying its sense distinctions, word formation collocation, and distribution pattern.

#### 4. SUMO

In this study, we use Suggested Upper Merged Ontology (SUMO) to analyze all concepts for *da3*. We find out all possible concepts and divide different them into different categories.

WordNet is inspired by current psycholinguistic and computational theories of human lexical memory (Fellbaum (1998), Miller et al. (1993)). English nouns, verbs, adjectives, and adverbs are organized into synonym sets, each representing one underlying lexicalized

concept. Different semantic relations link the synonym sets (synsets). The version of WordNet that Sinica BOW implemented is version 1.6, with nearly 100,000 synsets.

In Sinica BOW, each English synset was given up to the 3 most appropriate Chinese translation equivalents. In cases where the translation pairs are not synonyms, their semantic relations are marked (Huang et al. 2003). The bilingual WordNet is further linked to the SUMO ontology. We use the semantic relations in bilingual resource to expand and predict domain classification when it cannot be judged directly from a lexical lemma.

### 5. Data collection

From Sinica Corpus and Gigaword Corpus, we find several patterns for *da3*. According to the Chinese Wordnet Group analysis (Huang et al., 2003), there are 114 senses which include physical activity senses, metaphorical events, idiomatic senses and extended senses. In this study, we would like focus on physical activity senses, and metaphorical event senses, but not on idiomatic senses and extended senses. The sense number distribution of *da3* was shown as below Table 1.

Category			Total
Physical sense	Metaphorical sense	Additional sense	
41 (35.96%)	33 (28.95%)	40 (35.09%)	114

Table 1: The sense number distribution of *da3* in Chinese Wordnet

Also, we take the analysis result of *da3* from Chinese Wordnet to check manually the sense distribution in Sinica Corpus and GigaWord Corpus. Therefore, we can observe the empirical presentations of *da3* in the context. Table 2 shows the sense distribution in Sinica Corpus and GigaWord Corpus.

Resource	Physical Sense	Metaphorical Sense	Additional Sense	Total
Sinica Corpus	941 (63.97%)	205 (13.94%)	325 (22.09%)	1,471
GigaWord Corpus	37,098 (48%)	12,366 (16%)	27,824 (36%)	77,288

Table 2: The sense distribution in Sinica Corpus and GigaWord Corpus

### 6. Data analysis

The analysis, given in Chinese Wordnet (Table 3 and Table 4), is based on the Sinica

Corpus, Gigaword Corpus and the criteria proposed by Huang et al. (2003) to differentiate the lexical meanings, presents several different senses for *da3*.

打 1 *da3* ㄉㄚˇ

詞義 1: 【及物動詞, VC】以手施力使手或手持物撞擊特定對象。{tap, 01496422V}

例句: 男子說完用力的<打>一下桌子, 整個桌子馬上變成木屑一片。

例句: 他用扇骨用力<打>門板好幾下, 然後說: 我是如此的人嗎? 專程來抓你的小辮子?

詞義 2: 【及物動詞, VC; 名詞, nom】用手或手持物打後述對象, 使其感到疼痛或受到傷害。{hit, 00960484V}

義面 1: 【及物動詞, VC】用手或手持物打攻擊後述對象, 使其感到疼痛或受到傷害。{hit, 00960484V}

例句: 因為他<打>人也是為了完成國家任務, 說清楚群眾是會諒解的。

例句: 母親忽然沉下臉<打>他一下手背, 並告誡他不能指月亮娘娘, 會爛耳朵的。

義面 2: 【名詞, nom】用手或手持物打攻擊後述對象, 使其感到疼痛或受到傷害。{hit, 00960484V}

例句: 說謊一臉狡猾, 輕輕的對我耳語道: 主人, 你如果認錯, 至少要挨一頓<打>。

例句: 這兒的老師也常在學生不乖或考試成績不好時祭出「班法」, 給學生一頓好<打>, 這一點也令我難以接受。

詞義 3: 【及物動詞, VC】易碎物品因受到撞擊使破碎。{break, 00231588V}

例句: 在高速公路不知哪裏天上飛來一石, 把擋風玻璃<打>成一個小凹洞。

例句: 廟裏的人把碗<打>了, 他心裏都過不去, 因為一旦它被破壞掉的時候, 那個生命體要釋放出來, 它沒有完成它的生命里程, 就無處可去。

Table 3: The analysis of physical activity senses of *da3* from Chinese Wornet

**詞義 11: 【及物動詞, VC】** 比喻建立基礎, 常與「基礎」、「基石」連用。同義詞「打下(0600)」。{establish, 00430666V}

例句: 英國球隊在這方面因為基礎<打>得很好, 後面的訓練比賽也就有了更好的體能保證。

例句: 這一群功夫底子<打>很深的訓練員, 在正式表演的時候, 都會有很好的表現, 不需要擔心。

**詞義 12: 【及物動詞, VC】** 比喻建立, 常與「名聲」、「成果」連用。同義詞「打下(0700)」。{build, 01136879V}

例句: 全市警察機關和全體民警要充分認識這次活動的重大意義, 統一思想, 全警動員, <打>出一番成果, <打>出一片聲威。

例句: 南方網訊綜藝大哥大胡瓜又要出唱片了, 不過這回卻是鎖定要在大陸發行, 胡瓜笑說, 唱片賣得好不好不重要, 最重要是藉機大<打>在大陸的知名度。

**詞義 13: 【及物動詞, VC】** 比喻在商業上針對特定對象或管道經營。同義詞「建立」、「立 1(1210)」、「樹 1(0210)」。{build, 01136879V, establish}

例句: Vitria 的氣夜應用系統整合軟體在業界已經是領導品牌, 張若玫先在歐美<打>市場, 近半年才積極進軍亞洲。

例句: 明基電通認為未來市場須雙元化, 在開發中國家<打>年輕人市場, 因為年輕人口充沛, 在已開發國家也要<打>銀髮族。

Table 4: The analysis of metaphorical event senses of *da3* from Chinese Wornet

Among these 41 physical activity senses of *da3*, we divide them into two main physical activity senses for *da3*: 1) hit and 2) pump such as below:

(2)a. 母親忽然沉下臉<打>他一下手背, 並告誡他不能指月亮娘娘, 會爛耳朵的。

Mu3 qin1 hu1 ran2 chen2 xia4 lian3 da3 tai yi2 xia4 shou3 bei4,  
Mother suddenly sink down face hit he one time hand,

bing4 gao4 jie4 tai bu4 neng2 zhi3 yue4 liang4 niang2 niang5,  
and warn he can't point moon queen,

hui4 lan4 er3 duo1 de5  
will decayed ear MOD

“His mother suddenly becomes long-faced and hits him on the back of his hand, then warned him that he will get rotting ears if he points to the moon.”

b. 這時每一鞭都如<打>在她的身上一般痛楚。

Zhe4 shi2 mei3 yi1 bian1 dou1 ru2 da3 zai4 tai de5  
This time every whipped all like whip she MOD

shen1 shang4 yil bai tong4 chu3  
body general pain

“At this moment, every whipped whip pains her like she is being whipped.”

(3) 為了防止車輛陷進沙地，不要把輪胎氣<打>得太足。

Wei4 le5 fang4 zhi3 che1 liang4 jin4 sha1 di4, bu2 yao4 ba3  
For prevent cars tuck into sand, don't let

lun4 tai1 qi4 da3 de2 tai4 zu2  
tires gas pump too full

“Do not pump the tires too full to avoid the cars being stuck in the sand.”

Moreover, in “hit” sense of *da3*, we also can divide this sense into two different categories: 1) hand and hand holdings and 2) force and impact. Then, in the second category, we can divide force and impact in additional sub-categories: 1) direct contact and 2) contact by injection.

(4) 他用力<打>門板好幾下，然後說：我是如此的人嗎？

Ta1 yong4 li4 da3 men2 ban3 hao3 ji3 xia4, ran2 hou4 shuo1:wo3  
He use force beat door plank several times, then say: I

shi4 ru3 ci3 de5 ren2 ma5?  
is this MOD man

“He beat forcefully the door plank several times and then said: Am I a person like this?”

(5) 當靜脈注射毒癮者<打>毒品時，通常是不會馬上把毒品立刻注射進去，而是將針頭插在血管上。

Dang1 jing4 mai4 zhu4 she4 du2 yin3 zhe3 da3 du2 pin3 shi2,  
When intravenous injection drug addiction person inject drugs time,

tong1 chang2 shi4 bu2 hui4 ma3 shang4 ba3 du2 pin3 li4 ke4  
usually will not at once let drugs immediately

zhu4 she4 jin4 qu4, er2 shi4 jiang1 zhen1 tou2 cha1 zai4  
inject into, instead use needle head insert in

xie3 guan3 shang4  
blood vessel above

“When drug addicts take drugs, they usually rest the needle in the vein instead of injecting the drug directly.”

(6) 一個滿眼夢想的快樂女孩，因為受傷開刀，要<打>釘子進脊椎，像副衣架一般把彎彎的骨頭撐直。

Yi2 ge4 man3 yan3 meng4 xiang3 de5 kuai4 le4 nyu3 hai2,  
One full eyes dream MOD happy girl,

yin1 wei4 shou4 shang1 kai1 dao1, yao4 da3 ding1 zi5 jin4  
because hurt operate, will put nail to

ji2 zhui1, xiang4 fu4 yi1 jia4 yi1 ban1 ba3 wan1 wan1 de5  
spine, like set clothes stand in general let bend MOD

gu3 tou2 cheng1 zhi2  
bone prop straight

“A happy girl full of dreams due to an injury has to undergo an operation that puts nails into her spine to straighten up the wiggled spine, which is very similar to clothing being hanged on hangers.”

Among these 33 metaphorical event senses of da3, we find two main metaphorical event senses for da3: 1) hand action extension and 2) hand action unextension such as below:

(7) 我從北京坐車去太原，6 個小時的車程，就有 400 餘個電話<打>到我的手機上。

Wo3 cong2 bei3 jing1 zuo4 ch3 qu4 tai4 yuan2, 6 ge4 xiao3 shi2  
I from Beijing by bus to Taiyuan, six hours

de5 che1 cheng2, jiu4 you3 400 yu2 ge4 dian4 hua4 da3 dao4 wo3  
MOD drive, have 400 more telephone call to I

de5 shou3 ji1 shang4.  
MOD cell phone above.

“I took the bus from Beijing to Taiyuan. In these six hours, there were more than 400 calls made to my cell phone.”

(8)飛利浦的算盤<打>得很好，希望能夠透過這種新的制度，多收點錢。

Fei1 li4 pu3 de5 suan4 pan2 da3 de2 hen3 hao3, xil wang4  
Philips MOD abacus operate MOD very good, hope

neng2 gou4 tou4 guo4 zhe4 zhong3 xin1 de5 zhi1 du4, duo1  
be able through this kind new MOD system, more

shou1 dian3 qian.  
receive money.

“Philips is taking advantages from the new system developed to raise their profit.”

(9)她忽然對他說：我們來<打>個交道，你家的女兒和我家女兒交換。

Ta1 hul ran2 dui4 ta1 shuo1: wo3 men2 lai2 da3 ge4 jiao1 dao4,  
She suddenly face he say: we come into contact with,

ni3 jia1 de5 nyu3 er2 han4 wo3 jia1 nyu3 er2 jiao1 huan4.  
you family MOD daughter and our family daughter exchange.

“She had a sudden idea and said “Let’s make a deal and swap our daughters around.”

We follow these categories to explore the common semantic features for these metaphorical event senses of *da3* in the SUMO concept system.

## 7. Concept analysis

According to Gao’s study (2001), she used a sense division principle to analyze *da3*, generalize the patterns and features of the polysemy of *da3*, and thus obtained five major categories.

Gao (2001) mentioned the prototypical meaning of *da3*. She talked about in the

prototypical case the most central part of the meaning of *da3* is the physical contact between an agent's hands and a concrete item. In her paper, she also mentioned that there were three different semantic elements for *da3* such as 1) *hand, hand holdings or instrument*; 2) *force direction* and 3) *impact*.

From all our senses of *da3*, we can divide three main categories: 1) physical activity senses such as *da3 zhuo1 zi5* (to tap the table), *da3 shou3 bei4* (to hit the back of a hand), *ba3 wan3 da3 po4* (to break a bowl)... and so on; 2) metaphorical event senses such as *da3 jiao1 dao4* (to develop the interpersonal relationship/ to come into contact with), *da3 dian4 hua4* (to call), *da3 ru2 yi4 suan4 pan2* (to expect things to turn out as one wishes)... and so forth and 3) additional senses include idiomatic senses and extended senses such as *da3 zhe2 kou4* (to give a discount), *da3 ke1 shui4* (to nod), and *da3 jian1* (to stop for refreshments when traveling). However, in this study, we just focus on physical activity senses and metaphorical event senses. Based on Gao's analysis (2001), we know that physical activity senses of *da3* include these features such as hand, hand holdings, instrument; force and impact, so we thoroughly examine our physical activity senses by SUMO concept system. In here, we can observe that there are several concept of SUMO for physical activity senses of *da3* such as below Table 5:

The phrase of <i>da3</i> in Chinese	Translation in English	SUMO concept
<i>da3 shou3 bei4</i>	to <i>hit</i> the back of a hand	impacting
<i>da3 zhuo1 zi5</i>	to <i>tap</i> the table	touching
<i>ba3 wan3 da3 po4</i>	to <i>break</i> a bowl	impacting
<i>lun4 tai1 da3 qi4</i>	to <i>pump</i> gas into tire	putting
<i>da3 shi1 li4 kang1</i>	to <i>inject</i> silicon	putting

Table 5: SUMO concept for physical activity senses of *da3*

Also based on Gao's study (2001), metaphorical event senses of *da3* include these features such as bodypart and instrument, so we could explore our metaphorical event senses by SUMO concept system again. Therefore, we would obtain that there are several kinds of concepts in SUMO ontological concept system for metaphorical event senses of *da3* such as below Table 6:

The phrase of <i>da3</i> in Chinese	Translation in English	SUMO concept
<i>da3 dian4 hua4</i>	to <i>call</i>	communication
<i>da3 zhi1 ming2 du4</i>	to <i>build</i> the well-known	intentional process
<i>da3 ru2 yi4 suan4 pan2</i>	to <i>scheme</i> the wishful thinking	intentional process
<i>da3 zhao4 mian4</i>	to <i>greet</i>	communication
<i>da3 jiao1 dao4</i>	to <i>develop</i> the interpersonal relationship	intentional psychological process

Table 6: SUMO concept for metaphorical event senses of *da3*

We follow SUMO concept system to obtain these concepts of physical activity senses and metaphorical senses of *da3*. These physical activity concepts are such as impacting, touching, putting. We also know that the SUMO concept identifications correspond with the divisions and definitions in WordNet. For this reason, we need make sure the WordNet definitions of these concepts for physical event senses of *da3*.

The phrase of <i>da3</i> in Chinese	The English lemma of <i>da3</i>	WordNet definition	SUMO concept
<i>da3</i> shou3 bei4	<i>hit</i>	deal a blow to, either with the hand or with an instrument	impacting
<i>da3</i> zhuo1 zi5 <i>ba3</i> wan3 <i>da3</i> po4	<i>tap</i> <i>break</i>	a light touch or stroke destroy the integrity of; usually by force; cause to separate into pieces or fragments	touching impacting
lun4 tai1 <i>da3</i> qi4 <i>da3</i> shil li4 kang1	<i>pump</i> <i>inject</i>	deliver forth force or drive (a fluid or gas) into by piercing	putting putting

Table 7: WordNet definition and SUMO concept for physical activity senses of *da3*

In this same way , we also follow SUMO concept system to obtain these metaphorical event concepts are such as communication, intentional process and intentional psychological process. We also make sure the WordNet definitions of these concepts for metaphoric event senses of *da3*.

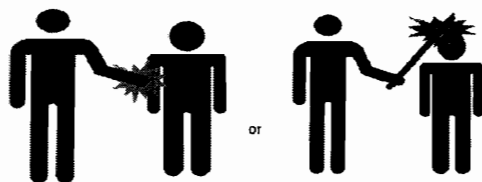
The phrase of <i>da3</i> in Chinese	The English lemma of <i>da3</i>	WordNet definition	SUMO concept
<i>da3</i> dian4 hua4	<i>call</i>	get or try to get into communication by telephone	communication
<i>da3</i> zhi1 ming2 du4	<i>build</i>	build or establish something abstract	intentional process
<i>da3</i> ru2 yi4 suan4 pan2	<i>scheme</i>	form intrigues (for) in an underhand manner	intentional process
<i>da3</i> zhao4 mian4	<i>greet</i>	express greetings upon meeting someone	communication
<i>da3</i> jiao1 dao4	<i>develop</i>	generate gradually	intentional psychological process

Table 8: WordNet definition and SUMO concept for metaphorical event senses of *da3*

In this way, we obtain the common semantic elements from SUMO concepts for physical activity senses of *da3*. The semantic features are hand, instrument, and force. In addition, we can detect when we do these actions, the manners are impact, direct contact or contact by injection. We may visual this as:

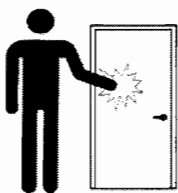
(1) Agent + hand, hand holding or instrument

--> Patient (person or physical object)



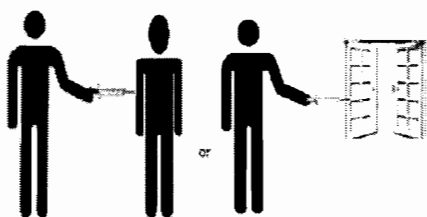
(2) Agent --> impact (direct contact)

--> Physical object



(3) Agent with an instrument --> force (contact by injection)

--> Patient (person or physical object)



From the SUMO concept system for the physical activity senses of *da3*, we see these concepts imply the following semantic features: hand, hand holdings, instrument; force and impact (direct contact or contact by injection). Also, we would like use the same way---taking SUMO concept system in order to explore the semantic elements from their concepts of the metaphorical event senses of *da3*. From these concept of the metaphorical event senses of *da3* --- communication, intentional process and intentional psychological process, their concepts connote several semantic elements such as bodypart, instrument and mentation. For example, in “*da3 dian4 hua4* (to call)”, agent need use his hand to finish this event, therefore, this event would imply the bodypart element. Moreover, in “*da3 shui3* (to take some water)”, we know that we need use pails or some containers to obtain some water. From “*da3 shui3*”, we would expect the instrument element in this event. Finally, in “*da3 ru2 yi4 suan4 pan2* (to expect things to turn out as one wishes)”, the concept would connote the mentation element in this event. Last but not least, when we precede these events, the manners are two different contacts as hand action and visual action.

We use SUMO ontological concept system to find out all possible concepts for the physical activity senses and metaphorical event senses of *da3*, while Gao (2001) used semantic features to analyze and explain physical actions of *da3*. Following our analyses, explanations, comparison and demonstrations, we discover that our analyses and main categories correspond with Gao's study result for the physical activity senses and metaphorical event senses of *da3*.

## 8. Conclusion

In this study, we explore all possible concepts for physical activity senses and metaphorical event senses of *da3* through the SUMO ontological concept system. These physical activity concepts imply the semantic features: hand, hand holdings, instrument; force and impact, while these metaphorical event concepts connote the features: bodypart, instrument, mentation and contact.

We use the concept-based approach in this study, while Gao (2001) took a semantic-feature-based approach to examine the physical activity senses and metaphorical event senses of *da3*. We use SUMO to find out their concepts in order to group and cluster these the same concept words. For that reason, we can get different concept groups for the physical activity senses or metaphorical event senses of *da3*.

In this study, we attempt to use concept-based approach to analyze Polysemy in Chinese. Therefore, this leads us to propose that a concept-based approach is a viable one when exploring the sense of polysemous verbs in Chinese.

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### Website Resources

Chinese Word Sketch Engine: <http://wordsketch.ling.sinica.edu.tw/>

English Word Sketch Engine: <http://www.sketchengine.co.uk/>

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