

From Frame to Subframe: Collocational Asymmetry in Mandarin Verbs of Conversation

Mei-Chun Liu* and Chun Edison Chang[†]

Abstract

This paper examines the collocational patterns of Mandarin verbs of conversation and proposes that a finer classification scheme than the flat structure of ‘frames’ [cf. Fillmore and Atkins 1992; Baker *et al.* 2003] is needed to capture the semantic granularity of verb types. The notion of a ‘subframe’ is introduced and utilized to explain the syntactic-semantic interdependencies among different groups of verbs in the Conversation Frame. The paper aims to provide detailed linguistic motivations for distinguishing subframes within a frame as a *semantic anchor* for further defining near-synonym sets.

Keywords: Mandarin Verbs of Conversation, Semantic Frame, Subframe, Collocational Association

1. Introduction¹

As the importance of lexical semantic research has grown with the need to represent human knowledge, various lexically-based information networks have been proposed. This includes the comprehensive work on differentiating word senses and sense relations in WordNet [Miller *et al.* 1990], the ontological hierarchy in SUMO [Niles and Pease 2003], and the more linguistically-motivated model of FrameNet [Baker *et al.* 2003]. While all these databases provide valuable information regarding word senses, the first two are constructed in a more

* Graduate Institute of Foreign Literatures and linguistics, National Chiao Tung University, Taiwan
E-mail: mliu@mail.nctu.edu.tw

[†] Graduate Institute of Linguistics, National Tsing Hua University, Taiwan
E-mail: d948704@oz.nthu.edu.tw

¹ This paper is a part of a research project funded by the National Science Council (NSC 92-2411-H-009-020-ME). An earlier version was presented at the 5th Chinese Lexical Semantics Workshop at National Singapore University. We thank Chu-Ren Huang, Kathleen Ahrens, and two anonymous reviewers for their valuable comments. Of course, the authors are responsible for any possible errors.

intuitive and pre-theoretical manner without detailing the linguistic evidence for sense distinctions. FrameNet, on the other hand, is based on the theory of Frame Semantics [Fillmore and Atkins 1992] and attempts to define meaning within a set of shared knowledge or background information, that is, a *frame*. However, as pointed out by Liu and Wu [2003], if meaning is anchored in the notion of a ‘frame’, then we need independent motivations for postulating different frames. What seems to be lacking in the current framework is a cognitive linguistic explanation as to how individual ‘frames’ are distinguished and interrelated. To answer this question, we will show that within a frame, a more elaborate classification system is needed to account for the variety of verb behaviors. The notion of a ‘subframe’ is introduced and utilized to capture the syntactic-semantic interdependencies observed in corpus data².

2. Defining the Conversation Frame

Compared with the other communication frames³, the conversation frame is unique in that it profiles the property of *reciprocity* or two-way communication. Mandarin verbs in the conversation frame encode reciprocal communicative events, where participants are involved as Interlocutors, such as *tan* 談 ‘talk’, *taolun* 討論 ‘discuss’, *xietiao* 協調 ‘negotiate’, *chaojia* 吵架 ‘quarrel’, *xianliao* 閒聊 ‘chat’, etc⁴. These conversation events highlight a particular subpart of the communication schema with its core being frame elements, as proposed in Liu and Wu’s conceptual schema for the conversation frame [2003]. We can further characterize the conversation frame as follows:

- (1) The conversation frame:
 - a) Cognitive Schema (grayed and bolded area):
 - b) Domain: communication;
 - c) Definition: a two-way communicative process between Interlocutors (Int1, Int2, or Intls) via a certain Medium, on a given Topic;
 - d) Semantic profile: reciprocity between Interlocutors;
 - e) Core frame elements (FEs): Int1/Int2 or Intls, Medium, Topic;

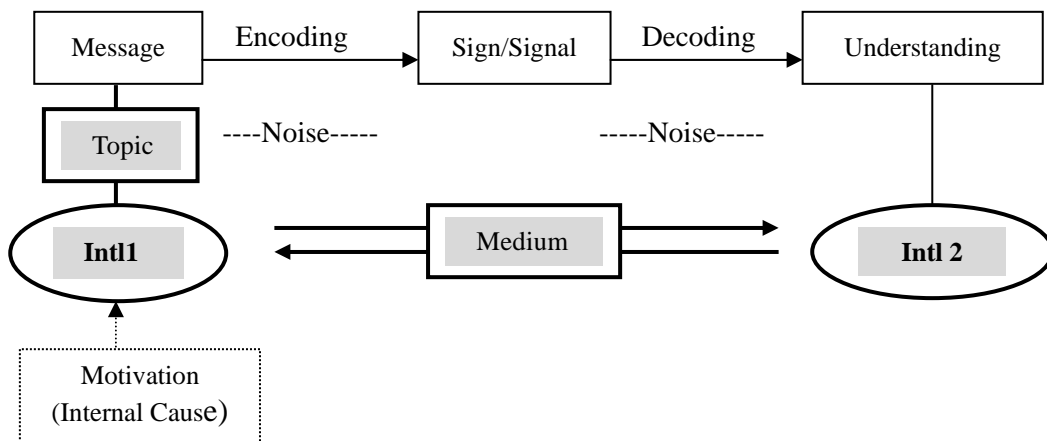
² A preliminary model of the Mandarin VerbNet (<http://140.114.75.18/verbnet/webform1.aspx/>) has been constructed by researchers from National Chiao Tung University and National Tsing Hua University.

³ For details, please see [Liu *et al.* 2004], where the communication domain is divided into 14 frames and provides conceptual motivations for the cognitive bases of individual frames.

⁴ The lemmas discussed in this paper are high-frequency words of the conversation frame used in Taiwan.

Collocational Asymmetry in Mandarin Verbs of Conversation

- f) Basic syntactic patterns: 他們[Intls]面對面[Medium]談政治[Topic].
我[Intl1]和/與/跟他[Intl2]談政治[Topic].



By specifying its cognitive schema, definitional description, semantic profile, a distinct set of frame elements, and the basic syntactic patterns, the conversation frame can be uniquely defined and proved to be well-motivated in relation to other communication frames. However, given the diverse range of lemmas included in the frame, there is a fundamental question to be answered: within the conversation frame, are there semantic subtypes that need to be captured? This paper aims to show that corpus-based analyses of verb behavior render clear evidence for further distinguishing ‘subframes’⁵.

3. Motivations for Distinguishing Subframes

As mentioned above, verbs of conversation share a set of core frame elements: Interlocutor 1, Interlocutor 2 (or combined as Interlocutors), Topic, and Medium. However, a wide range of verbs are found in the conversation frame, such as *tan/tanlun* 談/談論 ‘converse, talk’, 討論/商量 ‘discuss’, *xietiao/goutong* 協調/溝通 ‘negotiate’, *chao/chaojia* 吵/吵架 ‘quarrel’, and *lia/liaotian* 聊/聊天 ‘chat’. One inevitably wonders how these verbs differ from each other. Although sharing the same basic pattern, these lemmas differ obviously in terms of manner, register, and purpose. Consider (2):

⁵ Although Fillmore *et al.* [2005] put the label ‘subframe’ under the description of frames in the new version of FrameNet (<http://www.icsi.berkeley.edu/~framenet>), they did not explicitly discuss how to distinguish *subframes*, that is, what the linguistic motivations for distinguishing and defining *subframes* are.

- (2) 他們在 談/討論/溝通/吵/聊 人生的意義。

The five verbs in (2) may share the same topic, but encode distinct types of conversational events. We would like to know: what exactly are the distinctions in their lexical meanings and what grammatical correlations can be found to such lexical semantic distinctions? In the following, a detailed discussion regarding the coding of their core frame elements (FEs) and the various collocational associations will be given to capture the grammatical motivations for distinguishing subframes.

3.1 Realization and Profiling of Core Frame Elements

As mentioned before, a frame is distinguished according to syntactically expressed core frame elements (FEs). Subgroups of a frame may be further distinguished based on frequent foregrounding or backgrounding of certain frame elements observed in the corpus data. Among the core frame elements of the conversation frame, *Int1/Int2*, *Intls*, *Medium*, and *Topic*, the first two are commonly shared by all conversation verbs, but *Medium* is most frequently found with the ‘converse’ verbs, *tan/tanlun* 談/談論 (4.3%) but not common with other verbs (less than 1.2%):

- (3) 大家[Interlocutors]面對面[Medium_Means]談[Conversation-Converse]，可直接爭取訂單。

Although *Topic* is a default FE for conversation events, only the ‘discuss’ verbs occur most frequently with a topic (73%) and allow a *Topic* to be preposed, as in (4):

- (4) 宣傳的事[Topic]你們[Interlocutors]再討論[Conversation-Discuss]。

In addition, *Topic* tends to be absent in a chatting event. In the Sinica Corpus, *Topic* is simply not found with the verbs *liaotian* 聊天 and *xianliao* 閒聊 ‘chat’ (0%). The suppression of *Topic* indicates that *Topic* may not be important in ‘chat’ events and, thus, tends to be backgrounded:

- (5) 旅行回來...毛空去看望他，兩人[Interlocutors]就閒聊[Conversation-Chat]起來。

Collocational Asymmetry in Mandarin Verbs of Conversation

Another interesting observation regarding the coding of Topic is that it may overlap with the marking of Cause; the ‘quarrel’ verbs tend to take a Topic-Cause as one important role:

- (6) 他們 爲/因爲 錢/感情[Topic_Cause]吵架[Conversation-Quarrel]。

The overt marking of Topic-Cause with the marker *wei/yinwei* ‘because of’ (6% with *chaojia/zhenglun* 吵架/爭論) seems to indicate that the ‘quarrel’ events, coding a highly marked manner of communication, require an explanation for their occurrence. The overt Cause in the above examples also fulfills the role of Topic, since what is being argued about has to do with the cause of the argument.

Finally, a unique pattern is observed regarding the coding of interlocutors: with the ‘negotiate’ verbs, *xietiao/goutong* 協調/溝通, there may be a third participant, Interlocutor 3, since a negotiating event is often conducted between Interlocutor 2 and Interlocutor 3 with a Mediator, Interlocutor 1. Syntactically, Int12 and Int13 may be foregrounded as the Direct Object, as exemplified below:

- (7) 中東戰爭爆發，省府[Interlocutor_1]已協調[Conversation-Negotiate]台汽 [Interlocutor_2]和台鐵[Interlocutor_3]，完成預期中東供油減少時的各項因應措施。

The additional participant, Interlocutor 3, is only found in the ‘negotiate’ events (3.1%) but completely absent with other verbs. Although most verbs only take the Topic as the direct object, the ‘negotiate’ verbs may encode Interlocutor 2 (or with Interlocutor 3) as the direct object without adding the associative marker *han/yu/gen* 和/與/跟 ‘and’, as further exemplified below:

- (8) a. [執行秘書]_{Int1} 已協調 [相關單位]_{Int2}， b. 由[他]_{Int1} 負責溝通 [校方]_{Int2}。

This observation suggests that with the ‘negotiate’ verbs, the co-participant, i.e., Interlocutor2 (or/and Interlocutor 3) may be viewed as the undergoer or the affected target of the event, which is a unique pattern that sets the ‘negotiate’ verbs apart from other conversation verbs.

The distribution of core frame elements across different conversation verb types is summarized in the following table:

(9) Distribution of Core Frame Elements among Conversation Verbs:

FEs Verbs	Intls	Intl1/Intl2	Intl3	Intl2/Intl3 as DO	Topic	Topic as Cause	Medium
Converse 談/談論	40% (441/1103)	14 % (156/1103)	0% (0/1103)	0% (0/1103)	17.3% (191/1103)	0% (0/1103)	4.3% (47/1103)
Discuss 討論/商量	62% (129/208)	29% (60/208)	0% (0/208)	0% (0/208)	73% (152/208)	0% (0/208)	0% (0/208)
Negotiate 協調/溝通	15 % (74/485)	29.5% (143/485)	3.1% (15/485)	7% (33/485)	16.7% (81/485)	0% (0/485)	0.9% (4/485)
Quarrel 吵架/爭論	48% (101/211)	11.4% (24/211)	0% (0/211)	0% (0/211)	10.4% (22/211)	6% (13/211)	0% (0/211)
Chat 聊天/閒聊	38% (66/174)	46 % (81/174)	0% (0/174)	0% (0/174)	0% (0/174)	0% (0/174)	1.1% (2/174)

It is clear from the table that each verb type displays a distinct pattern in coding the core frame elements through either the foregrounding or backgrounding of certain participant roles.

3.2 Lexical Collocations and Grammatical Functions

Besides the realization of core frame elements, conversation verbs also differ in terms of lexical collocation and grammatical function. Looking closely at their collocational associations in the Sinica Corpus, we found that there are asymmetrical distributions in four respects: 1) V+V pattern: some verbs may occur with a preceding light verb, such as *jinxing* 進行 ‘proceed’ or *dacheng* 達成 ‘achieve’; 2) metonymic subject: the subject of some, but not all, verbs of conversation may be inanimate entities taking the role of Interlocutor based on the principle of metonymy; 3) V+ Complement pattern: some verbs take a postverbal complement or adverbial adjunct denoting ‘result evaluation’, such as *chenggong* 成功 ‘successful’ or *shibai* 失敗 ‘failing’; 4) in terms of the distribution of grammatical functions, conversation verbs exhibit different frequencies of nominalization. Based on the above four criteria, verbs of conversation can be further divided into 5 subgroups with a corresponding set of unique behaviors. We will address the syntactic-semantic interdependencies manifested by each association pattern in the following sections.

3.2.1 V+V Pattern: with Light Verbs *Jinxing* 進行 or *Dacheng* 達成

The use of the light verb *jinxing* 進行 ‘proceed’ entails a formal register and encodes a procedural process or *atelic* event, according to Huang *et al.* [1995]⁶. It tends to occur with an activity verb that is compatible with the formal register and involves a durative process, as shown in (10):

⁶ Huang *et al.* [1995] claimed that *jinxing* ‘to proceed’ takes a processed type argument, which denotes the process of an event. In other words, the verb *jinxing* implies a non-punctual and non-telic event.

Collocational Asymmetry in Mandarin Verbs of Conversation

- (10) a. 研究小組[Intls]針對口訪前置作業階段之相關事宜進行討論
[Conversation-Discuss] ◦
b. *進行 談論/吵架/聊天 ◦

Below is the distributional tendency of *jingxing* in the Sinica Corpus:

(11) Distribution with *jingxing* 進行 ‘proceed’

V1 \ V2	<i>taolun</i> 討論	<i>goutong</i> 溝通	Other Verb Types <i>tanlun/chaojia/liaotian</i> 談論/吵架/聊天
<i>Jingxing</i> 進行	4% (3/83)	11% (25/231)	0%

Another verb, *dacheng* 達成 ‘achieve’, is also found with some conversation verbs; it requires a formal register but encodes a *telic* event. Denoting goal-orientation, *dacheng* 達成 is compatible with activity verbs entailing a semantic endpoint with an incremental theme, and it occurs mostly with the nominalized forms of ‘negotiate’ verbs, such as *goutong/xietiao/xieyi* 溝通/協調/協議, as in (12-13):

- (12) a. 雙方最後達成協議[conversation-negotiate] ◦
b. *達成 談/談論/討論/吵架/爭論/聊天/閒聊 ◦

Additional examples are found with *goutong* 溝通 and *xietiao* 協調 at the Kimo website:

- (13) a. 要耗費相當長的時間來達成溝通[conversation-negotiate] (yahoo 2005/07/01) ◦
b. 各方股東達成協議[conversation-negotiate] (yahoo 2005/06/13) ◦

(14) Distribution with *dacheng* 達成

V1 \ V2	<i>xieyi</i> 協議	Other Verb Types <i>tanlun/taolun/chaojia/liaotian</i> 談論/討論/吵架/聊天
<i>Dacheng</i> 達成	23% (36/154)	0%

The co-occurrence with the preceding verb *jinxing* 進行 ‘proceed’ or *dacheng* 達成 ‘achieve’ serves to distinguish a conversation event in terms of its pragmatic mode (formal vs. informal) and event type (*telic* vs. *atelic*).

3.2.2 Use of an Inanimate Subject

Interlocutors in conversation events are, by default, human participants. However, unlike the ‘chat’ verbs, other verbs may all take inanimate subjects (place or institute names) as Interlocutors via metonymic extension from institute/building to human organization:

- (15) a. 台北和北京 [Intl1 and Intl2] 談/談論/討論/溝通 了很久。
 b. 台北和北京 *聊天/*閒聊 了很久。

Metonymy tends to be associated with verbs that are formal in register and also require an official or non-personal topic (e.g., public affairs). The Sinica Corpus shows that verbs encoding informal events, such as the ‘chat’ verbs, seldom occur with metonymic non-human subjects:

(16) Distribution with inanimate subjects

Subj. type \ V	<i>tanlun</i> 談論	<i>taolun</i> 討論	<i>goutong</i> 溝通	Other Verbs <i>Liaotian/xianliao</i> 聊天/閒聊
Inanimate Subject	3% (8/262)	6% (5/83)	9% (21/231)	0%

3.2.3 Postverbal Complement with Result Evaluation

Among the conversation verbs, only the ‘negotiate’ verbs (e.g., *xietiao* 協調 and *goutong* 溝通) may collocate with result-evaluating complements, such as *chenggong* 成功 ‘successfully’ and *shibai* 失敗 ‘failingly’, as shown below with examples and percentage rates for the Sinica Corpus:

- (17) a. 國防部和兩廳院已初步協調成功。
 b. 在協調失敗後，水公司終於昨天宣布放棄。

(18) Distribution of result evaluating complements

Result Comp. \ V	<i>xietiao</i> 協調	Other Verb Types <i>tanlun/taolun/chaojia/liaotian</i> 談論/討論/吵架/聊天
<i>chenggong/shibai</i> 成功/失敗	4 % (3/66)	0%

Additional data obtained from the internet show that the verb *goutong* 溝通 behaves in the same way:

Collocational Asymmetry in Mandarin Verbs of Conversation

- (19) a. 黨團也隨即召開記者會，強調有信心溝通成功 (yahoo 2005/03/20)。
 b. 雙方溝通失敗，因此反目成仇 (yahoo 2005/03/17)。

The co-occurrence with effect-evaluating complements indicates that the two-way communicative events with *xietiao* ‘negotiate’ or *goutong* ‘communicate’ involve a solution-seeking process, which is semantically bounded and may be *evaluated* as to whether the solution has been achieved.

3.2.4 Frequency of Nominalization

With regard to grammatical functions, some groups of verbs tend to be nominalized more frequently than the others. Comparing high-frequency verbs and their distributions over grammatical functions, we see clear skewing in nominal uses based on the Sinica Corpus:

(20) Distribution of predicate vs. nominal uses

Function \ V	<i>tanlun</i> 談論	<i>taolun</i> 討論	<i>goutong</i> 溝通	<i>chaojia</i> 吵架	<i>liaotian</i> 聊天
Predicate	77% (202/262)	52% (83/161)	55% (231/419)	76% (123/162)	94% (134/142)
Nominalization	23% (60/262)	48% (78/161)	45% (188/419)	24% (39/162)	6% (8/142)

Nominalization serves to mark activities as event nominals that may be referred to as quantifiable entities and nominalization is also highly correlated with written texts that are formal in register.

The following table summaries the collocational patterns discussed above:

(21) Distribution of collocational variations

Subtype \ Collocational Variation	進行+V	達成+V	V+Result [成功/失敗]	[+Nom]
Converse 談/談論	No	No	No	Low
Discuss 討論/商量	Yes	No	No	High (with 討論)
Negotiate 協調/溝通	Yes	Yes	Yes	High
Quarrel 吵架/爭論	No	No	No	Mid
Chat 聊天/閒聊	No	No	No	Low

The syntactic patterns of coding frame elements and collocational variations discussed above provide crucial evidence and support for categorizing conversation verbs into syntactically motivated subgroups, termed ‘subframes’. The division of subframes serves to provide the semantic ground for further distinguishing near-synonyms, as one important layer in the hierarchical structure of frame-based semantic classification.

4. Subframes: A Semantic Anchor for Near-synonyms

4.1 Defining Conversation Subframes

As mentioned above, the asymmetrical distributions of conversation verbs over different collocational associations clearly suggest that verbs can be further divided into subtypes. These subtypes may be viewed as different *subframes* as they further characterize the semantic distinctions within a *frame*. Each subframe displays unique patterns of its basic structure (Basic Patterns) and collocational skewings (Collocational Associations) that manifest its unique semantic properties.

The table shown below recaptures all the crucial syntactic distinctions for the 5 subframes:

(22) Collocational patterns associated with conversation subframes

CP Subframe	Intl2 as DO	Inanimate Subj.	Topic as Cause	Absence of Topic	進行+V	達成+V	V-R 成功/失敗	[+Nom]
1. Converse 談/談論	No	Yes	No	No	No	No	No	Low
2. Discuss 討論/商量	No	Yes	No	No	Yes	No	No	High
3. Negotiate 協調/溝通	Yes	Yes	No	No	Yes	Yes	Yes	High
4. Quarrel 吵架/爭論	No	Yes	Yes	No	No	No	No	Mid
5. Chat 聊天/閒聊	No	No	No	Yes	No	No	No	Low

Based on the above syntactic behaviors, we attempt to differentiate and define five subframes within the conversation frame, each with a clear definition, a set of foregrounded or backgrounded FEs, a unique set of semantic features, and representative lemmas.

Collocational Asymmetry in Mandarin Verbs of Conversation

(23) Conversation Subframes: definition, FEs, semantic attributes and lemmas

a) Subframe 1_Converse

Definition: Interlocutors exchange ideas on a given Topic, via a Medium (including a means or language) -- the most generic subtype of conversation;

FEs: (the default set) Interlocutors, Topic, Medium;

Semantic attributes: [event type: process], [register: unmarked], [manner: unmarked], [purpose: underspecified];

Lemmas: *tan/tanlun/jiaotan/jiaoliu* 談/談論/交談/交流, etc.

b) Subframe 2_Discuss

Definition: Interlocutors exchange opinions on a given Topic to establish pros and cons in a serious manner;

Foregrounded FE: Topic;

Semantic attributes: [event type: procedural process], [register: formal], [manner: serious], [purpose: establish pros and cons];

Lemmas: *taolun/shangliang/shangtao/shangtan* 討論/商量/商討/商談, etc.

c) Subframe 3_Negotiate

Definition: Interlocutors confer and negotiate on a certain Topic-Purpose (Topic may overlap with Purpose) in order to reach a consensus or settlement;

Foregrounded FE: Topic-Purpose;

Semantic attributes: [event type: procedural process], [register: formal], [manner: serious], [purpose: achieve consensus];

Lemmas: *xietiao/xieyi/goutong/xieshang* 協調/協議/溝通/協商, etc.

d) Subframe 4_Qarrel

Definition: Interlocutors dispute actively or vehemently exchange different opinions on a certain Topic-Cause in a heated manner;

Foregrounded FE: Topic-Cause;

Semantic attributes: [event type: process], [register: underspecified], [manner: marked_disagreeable], [purpose: pertaining to the Cause];

Lemmas: *chaojia/zhenglun/zhengcha/zhengzhi* 吵架/爭論/爭吵/爭執, etc.

e) Subframe 5_Chat

Definition: Interlocutors engage in an informal verbal activity in a rather casual and entertaining manner;

Backgrounded FE: Topic;

Semantic attributes: [event type: process], [register: informal], [manner: casual], [purpose: underspecified];

Lemmas: *xianliao/liaotain/xiantan/tantian* 閒聊/聊天/閒談/談天, etc.

The five subframes as defined above may serve as semantic anchors for further exploring near-synonym sets, such as 交談 *jiatān* vs. 交流 *jiāoliú* ‘converse, exchange’; 討論 *tāolun* vs. 商量 *shāngliang* ‘discuss, talk about’; or 協調 *xiétiao* vs. 溝通 *gōutong* ‘negotiate’, etc. It is at the level of subframes that we may find the most relevant information for fine-tuning lexical distinctions among near-synonyms (For further discussion, see [Liu *et al.* 2004]).

4.2 Semantic Inheritance

The layered structure of frame-based classification entails semantic inheritance from top to bottom in a hierarchical structure. At the subframe level, multiple inheritances may happen; i.e., a given subframe may inherit features from two or more different frames. For example, as mentioned above, verbs belonging to the ‘Quarrel’-subframe highlight Topic-Cause for the marked Manner. This is a result of multiple inheritance. The ‘quarrel’ verbs inherit the element Topic from the Conversation frame, and the element Cause from the Hostile_encounter Frame, where a Cause is normally specified.

5. Conclusion: Frame-based Hierarchy of Verbal Information

To fully represent the semantic relations among verbs, a multi-layered classificational structure is needed, which helps to manifest different levels of semantic generalization. In this paper, the syntactically well-motivated level of subframes is proposed, rendering a 5-layered hierarchical structure of lexical semantic representation: *Domain > Frame > Subframe > Near-synonym sets > Lemma*. This model is also adopted in building the lexical network of Mandarin VerbNet [Liu *et al.* 2004]. With the proposal of subframes within the theoretical constructs of frame semantics, verb meanings may be defined with finer semantic distinctions that are syntactically motivated. The next task is to show that further fine-grained lexical distinctions are needed to differentiate near-synonyms within each subframe. The postulation of subframes is a necessary refinement of the frame-based approach to lexical semantics. With its detailed lexical information, subframes provide the most relevant semantic anchor for further disambiguating near-synonyms as well as individual lemmas.

References

- Baker, C. F., C. J. Fillmore, and B. Cronin, “The Structure of the Framenet Database,” *International Journal of Lexicography*, 16(3), 2003, pp. 281-296.

Collocational Asymmetry in Mandarin Verbs of Conversation

- Fillmore, C. J., and B. T. S. Atkins, "Toward a Frame-Based Lexicon: The Semantics of RISK and Its Neighbors," *Frames, Fields, and Contrasts*, ed. by Lehrer, A. and E. Kittay, Hillsdale: Lawrence Erlbaum Associates, 1992, pp. 75-102.
- Fillmore, C. J. *et al.*, FrameNet, version 2.0, <http://framenet.icsi.berkeley.edu/>, 2005.
- Huang, C. R., M. Yeh, and L.P. Chang, "A Corpus-based Study of Nominalization and Verbal Semantics: Two Light Verbs in Mandarin Chinese," In *Proceedings of the Sixth North American Conference on Chinese Linguistics*, 1995, Los Angeles: GSIL, USC.
- Liu, M. C., T. Y. Chiang, and C. Chang, "The construction of Mandarin VerbNet: A frame-based corpus approach". Paper presented at the Symposium of Current trends and development of Chinese Lexical Semantics, 2004, Beijing University, Beijing, China.
- Liu, M. C., and Y. C. Wu, "Beyond Frame Semantics: Insight from Mandarin Verbs of Communication," Paper presented at the 4th Chinese Lexical Semantics Workshop, 2003, City University of Hong Kong.
- Liu, M. C., and C. R. Huang et al., "Sense and Sense-ability Series V: Mandarin VerbNet (I)--General Introduction and Communication Frames," Technical Report No. 04-01, Center for Knowledge-based Corpus Studies, Department of Foreign Languages and Literatures, National Chiao Tung University, Hsinchu, and Corpus Linguistics Research Group, Institute of Linguistics Academia Sinica, Taipei, 2004.
- Miller, A., R. Beckwith, C. Fellbaum, D. Gross, and K.J. Miller, "Introduction to WordNet: An on-line Lexical Database," *International Journal of Lexicography*, 3(4), 1990, pp. 235-244.
- Niles, I., and A. Pease, "Linking Lexicons and Ontologies: Mapping WordNet to the Suggested Upper Merged Ontology," In *Proceedings of the 2003 International Conference on Information and Knowledge Engineering (IKE'03)*, Las Vegas, Nevada, June 23-26, 2003.

