

# Dynamic Semantics for Intensification and Epistemic Necessity: The Case of *Yídìng* and *Shìbì* in Mandarin Chinese

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## Abstract

Functioning as adverbials, *yídìng* and *shìbì* in Mandarin Chinese can either express intensification or (strong) epistemic necessity. In addition, context influences their semantics. Hence, dynamic semantics are proposed for them. An information state  $\sigma$  is a pair  $\langle \mathcal{A}, s \rangle$ , where  $s$  is a proposition and  $\mathcal{A}$  is an affirmative ordering. *Yídìng*( $\phi$ ) performs update on an information state:  $\mathcal{A}$  is updated with  $\phi$  and  $s$  is specified to be a subset of or equal of  $\phi$ , as long as  $\phi$  is true in one of the absolutely affirmative worlds. Otherwise, uttering *yídìng*( $\phi$ ) leads to an absurd state. This is how a strong epistemic necessity reading is derived. To yield an intensification reading, *yídìng*( $\phi$ ) performs a test on the information state. *Yídìng*( $\phi$ ) gives back the original information state as long as  $\phi$  is true in all of the absolutely affirmative worlds. Otherwise, an absurd state is produced. As for *shìbì*, its semantics is identical to that of *yídìng*, except for that the  $s$  in an information state  $\sigma$  for *shìbì* is underspecified and needs resolving before a proposition gets an appropriate interpretation. The information needed to resolve the underspecified  $s$  for *shìbì* must be inferred from the context.

## 1 Introduction

In Mandarin Chinese (henceforth, Chinese), intensification and modal necessity can be expressed by the same lexical item. Adverbial *yídìng* is one of

such lexical items.<sup>1</sup> Please refer to the following examples.

- (1) A: Zhāngsān xǐhuān Xiǎoměi ma?  
Zhangsan like Xiaomei Q<sup>2</sup>  
'Does Zhangsan like Xiaomei?'
- B: Zhāngsān yídìng xǐhuān Xiǎoměi  
Zhangsan YÍDÌNG like Xiaomei  
Tā hěn zhùyì Xiǎoměi-de  
He very pay.attention.to Xiaomei-ASSO  
yìjùyídòng. Zhè shì hěn hélǐde  
move this be very reasonable  
tuīcè.  
conjecture  
'It must be the case that Zhangsan likes Xiaomei. He pays much attention to every move of Xiaomei. This is a reasonable conjecture.'
- B': Zhāngsān yídìng xǐhuān Xiǎoměi.  
Zhangsan YÍDÌNG like Xiaomei  
Zhè shì zhòngsuǒzhōngzhīde shìshí.  
This be widely-known fact  
'Zhangsan definitely likes Xiaomei. This is a widely-known fact.'

<sup>1</sup> Please note that *yídìng* can function either as a nominal modifier or a propositional modifier. The former is referred to as adjectival *yídìng* and the latter adverbial *yídìng*. This paper discusses adverbial *yídìng* only because the semantics of adjectival *yídìng* is simple and not as rich as adverbial *yídìng*.

<sup>2</sup> The abbreviations used in this paper include: ASSO for an associative marker, DEON for a deontic modal expression, DYN for a dynamic modal expression, EPI for an epistemic modal expression, Prc for a sentence-final particle, Prg for a progressive marker, Q for an interrogative particle.

(1) contains two conversations: one between A and B, and the other between A and B'. In the two conversations, A asks whether Zhangsan likes Xiaomei. Although the same sentence *Zhāngsān yídìng xīhuān Xiǎoměi* 'Zhangsan YÍDÌNG like Xiaomei' is uttered as a response to A's question, *yídìng* has different semantic functions. In the utterance of B, *yídìng* expresses epistemic necessity because B says that the proposition *Zhāngsān yídìng xīhuān Xiǎoměi* 'Zhangsan YÍDÌNG like Xiaomei' is a reasonable conjecture. *Yídìng* of this usage is translated as *it must be the case that...*

Moreover, when expressing epistemic necessity, *yídìng* expresses 'strong' epistemic necessity. The following examples demonstrate the difference between epistemic necessity and 'strong' epistemic necessity.

- (2) a. Ruóguǒ zài kǎo bù jǐgé, nǐ  
If again take.exam not pass you  
māma yídìng hěn shēngqì.  
Mom YÍDÌNG very angry  
'If you fail the exam again, it must be the case that you mom will be very angry.'
- b. Ruóguǒ zài kǎo bù jǐgé, nǐ  
If again take.exam not pass you  
māma huì hěn shēngqì.  
Mom will very angry  
'If you fail the exam again, you mom will be very angry.'

The difference between (2a) and (2b) lies in that (2a) contains *yídìng*, while (2b) uses *huì*. *Huì* has several meanings and one of them is inference, e.g. Chang (2000), Liu (1997), etc. In (2b), *huì* is used to express an inference about a future situation based on the antecedent led by *rúguǒ* 'if'. Although *yídìng* in (2a) has a similar function, (2a) and (2b) have a subtle semantic difference: (2a) shows a stronger certainty of the speaker's regarding the truth of the proposition *your Mom will be angry*, compared to (2b). Hence, when used to indicate an inference, *yídìng* is said to express 'strong' epistemic necessity.

On the other hand, *yídìng* in the utterance of B' has a different semantic function. In this utterance, *yídìng* is used to intensify the speaker's affirmativeness toward the proposition *your Mom will be angry*, instead of expressing the proposition as an inference. The intensification function of *yídìng* in this example is made explicit because of B' claims

that the proposition (= *Zhāngsān yídìng xīhuān Xiǎoměi* 'Zhangsan YÍDÌNG like Xiaomei') is a widely-known fact. This usage of *yídìng* is translated as *definitely* in English and is referred to as an intensification reading.

*Shìbì* has a semantic function similar to *yídìng* and they are interchangeable in some examples, but not in others. See below.

- (3) a. Yīnwèi zhùzi tài xì, yòng zhè zhǒng  
Because pillar too thin, use this kind  
wūdǐng yídìng/shìbì yǒu kěnéng  
roof YÍDÌNG/SHÌBÌ have possibility  
tāxiàlái.  
collapse  
'Because the pillars are too thin, if this type of roof is used, it is definitely possible that the roof will collapse.'
- b. Rúgǒu nǐ chuān hòu yīfú, nǐde  
if you wear thick clothes your  
shāng yídìng/shìbì jiào qīng.  
wound YÍDÌNG/SHÌBÌ relatively minor  
'If you wear thick clothes, it must be the case that your wound is relative minor.'
- (4) a. Zhè-ge shíhòu, Xiǎomíng yídìng/\*shìbì  
This-CL time Xiaoming YÍDÌNG/\*SHÌBÌ  
zài jiā.  
at home  
'At this moment, it must be the case that Xiaoming is at home.'
- b. Hūn hòu, rúguǒ zhù Yìnní, wǒ  
married after if live Indonesia I  
\*yídìng/shìbì cídiào gōngzuò.  
\*YÍDÌNG/SHÌBÌ resign job  
'After getting married, if we live in Indonesia, I definitely have to quit my job.'

In (3a, b), *yídìng* and *shìbì* are interchangeable and these two sentences are pretty much synonymous. However, in (4a, b), they are not interchangeable. In (4a), only *yídìng* is allowed, whereas in (4b) only *shìbì* is permissible.

In this paper, I would like to address the following questions. First, is it possible to provide a unified semantics for *yídìng* and *shìbì*? Second, how can the unified semantics account for the semantic similarity and difference between *yídìng* and *shìbì* as demonstrated in (3) and (4)? Finally, how can the unified semantics take care of contextual influence on the semantics of *yídìng* and *shìbì* illustrated by the utterances of B and of B' in (1)?

This paper is organized as follows. In Section Two, I critically review literature on *yídìng* and *shìbì*. In Section Three, I present more data and provide dynamic semantics for *yídìng* and *shìbì*. Section Four concludes this paper.

## 2 Review of Previous Studies

The literature on *yídìng* and/or *shìbì* include Chen (2011), Ding (2008a, b), C. Li (2005), S. Li (2009), Wang (2007), Xu (1995), Zhou (2014), etc. Xu (1995) is on the English translations of *yídìng* and two other adverbs and is not reviewed here. I critically review the other seven studies.

I start with the literature on *yídìng* and conduct the review in chronological order. Li (2005) distinguishes two variants of *yídìng*, labeled as *yídìng*<sub>1</sub> and *yídìng*<sub>2</sub>. He suggests that the former expresses strong volition, either the subject's or the speaker's strong volition (for another person) to do something, while the latter denotes stipulation or judgment. He further claims that *yídìng*<sub>1</sub> often goes with *yào*, which expresses a deontic reading here, or with *děi*, which also has a deontic reading, and that *yídìng*<sub>2</sub> often goes with *shì* 'be' or *hui*, which denotes epistemic necessity.

A major problem with Li (2005) is that he does not take the intensification reading into consideration, such as the utterance of B' in (1). Another problem is that the semantic contribution of *yídìng* is blurred when it goes with another modal expression. For example, he suggests that *yídìng děi* 'YÍDÌNG DEON' expresses a deontic reading. Then, a reasonable question to ask is what semantic contribution *yídìng* has here. The same problem occurs to *yídìng huì* 'YÍDÌNG EPI'.

Ding (2008a, b) also discusses the semantics of *yídìng*. These two studies distinguish *yídìng*<sub>1</sub> from *yídìng*<sub>2</sub> as well. Similar to Li (2005), Ding (2008a, b) claims that *yídìng*<sub>1</sub> expresses strong volition and *yídìng*<sub>2</sub> denotes emphasis on the truth of an inference/judgment. Ding's (2008a, b) conclusion is similar to Li (2005) and hence suffers from the same problems.

Chen (2011) is mostly on the grammaticalization of *yídìng*. As for the semantics of *yídìng*, he claims that *yídìng* expresses strong volition or stipulation/inference. Since Chen's (2011) conclusion is identical to Li (2005) and Ding (2008a, b), and therefore is vulnerable to the same problems.

Two major problems shared by Chen (2011), Ding (2008a, b) and Li (2005) are the following. First, they do not discuss whether it is possible to provide a unified semantics for *yídìng*, and second, they do not discuss how the contextual influence on the semantics of *yídìng* as demonstrated in the two conversations in (1) should be dealt with.

S. Li (2009), Wang (2007) and Zhou (2014) focus on *shìbì*. These three studies are also reviewed in chronological order. Wang (2007) is on the lexicalization of *shìbì*. This paper suggests that *shìbì* describes an inference made based on a current situation. S. Li (2009) is about the historical development of *shìbì*. This study states that *shìbì* expresses an inference that some situation is certain to take place in the future, based on the current status of some other situation. Zhou (2014) provides a relatively detailed discussion on the semantic features of *shìbì*, but basically says the same thing as S. Li (2009) and Wang (2007). While epistemic necessity is one of the readings expressed by *shìbì*, these studies cannot explain why *shìbì* is not good in (4a), which also has an epistemic necessity reading, and neither do they take the intensification reading, such as (3a), into consideration.

Since the above reviewed papers do not provide a comprehensive picture for the semantics of *yídìng* and *shìbì*, further study is called for so that the unanswered questions can be addressed.

## 3 Semantics of *Yídìng* and *Shìbì*

### 3.1 The Data

*Yídìng* can either present a proposition without a modal expression or one with a modal expression. The utterances of B and of B' in (1), and the sentence (2a) are typical examples where *yídìng* presents a proposition not containing a modal expression. (3a) is an example where *yídìng* presents a modal containing a modal expression. Either case, *yídìng* is ambiguous between a strong epistemic reading and an intensification reading. Let's look at a few more examples.

- (5) a. Lǐsì yídìng zài jiā.  
Lisi YÍDÌNG at home  
'It must be the case that Lisi is at home.'  
Or, 'Lisi is definite at home.'

- b. Wángwǔ yídìng yǐjīng xiěwán  
Wangwu YÍDÌNG already write.finish  
gōngkè le.  
homework Prc  
'It must be the case that Wangwu has already finished his homework.' Or,  
'Wangwu definitely has finished his homework.'
- c. Zài xià jǐ tiān dà yǔ,  
Again rain several day heavy rain  
zhèlǐ yídìng fānshēng tǔshīliú.  
here YÍDÌNG happen mud.slide  
'If it rains heavily a few more days, it must be the case that mud slide will happen here.' Or,  
'If it rains heavily a few more days, mud slide definitely will happen here.'
- (6) a. Zhàoliù yídìng huì qí jiāotàchē.  
Zhaoliu YÍDÌNG DYN ride bike  
'It must be the case that Zhaoliu can ride a bike.' Or,  
'Zhaoliu definitely can ride a bike.'
- b. Sūnqī yídìng děi dǎsǎo fángjiān le.  
Sunqi YÍDÌNG DEON clean room Prc  
'It must be the case that Sunqi has to clean his room.' Or,  
'Sunqi definitely has to clean his room.'

Some native speakers I consult point out to me that, standing alone, (6b) preferably has an intensification reading, rather than a strong epistemic necessity reading. However, if we provide a context for the sentence, the strong epistemic necessity reading can be brought out. For example,

- (7) Sūnqī yídìng děi dǎsǎo fángjiān le.  
Sunqi YÍDÌNG DEON clean room Prc  
Zhè shì wǒ-de tuīcè. Tā-de fùmǔ  
this be my conjecture his parents  
yǐjīng shòubǔliǎo le.  
already tolerate.not Prc  
'It must be the case that Sunqi has to clean his room. This is my guess. His parents cannot tolerate it anymore.'

So, can a unified semantics be proposed for *yídìng*? I believe so. The examples presented in this section and previous sections tell us that the semantics of *yídìng* contains two parts. The first part provides an epistemic necessity reading, just

like *must* in English. The other part provides an intensification reading.

If we put aside the contextual influence on the semantics of *yídìng* for the moment, the semantics of *yídìng* can be modeled using Kratzer's (2012[1981], 1991) semantics of modal expressions. See (8).

- (8) Modal semantics for *yídìng*  
Modal base: Epistemic  
Modal force: Necessity  
Ordering sources: (a) doxastic or stereotypical, (b) affirmative

In (8), the modal base, modal force and one of the ordering sources in (a) together are actually the typical semantics for an epistemic necessary modal expression. The new idea here is the second ordering source, the affirmative ordering source. von Stechow and Iatridou (2008) propose that weak necessity modals such as *should* in English need two ordering sources for their semantics. The idea of two ordering sources is adopted here.

What is an affirmative ordering source? An affirmative ordering source orders possible worlds in terms of the speaker's affirmativeness toward a proposition.  $\leq_A$  represents an affirmative ordering source. Then, the ordering of two possible worlds based on an affirmative ordering source is defined as below.

- (9)  $v, w$  are possible worlds.  $p$  is a proposition.  
 $w \leq_A v$  iff  $\{p: p \text{ is affirmed in } v\} \subseteq \{p: p \text{ is affirmed in } w\}$   
(cf. Kratzer 2012[1981]: 39)

How about *shìbì*? I show that *yídìng* and *shìbì* are interchangeable in some cases, but not in others. For the purpose of discussion, I repeat the relevant examples in (10).

- (10) a. Zhè-ge shíhòu, Xiǎomíng yídìng/  
This-CL time Xiaoming YÍDÌNG/  
\*shìbì zài jiā.  
\*SHÌBÌ at home  
'At this moment, it must be the case that Xiaoming is at home.'

- b. Hūn hòu, rúguǒ zhù Yīnní, wǒ  
 married after if live Indonesia I  
 \*yídìng/shìbì cídào gōngzuò.  
 \*YÍDÌNG/SHÌBÌ resign job  
 ‘After getting married, if we live in In-  
 donesia, I definitely have to quit my  
 job.’
- (11) a. Rúguǒ wǒ bù néng chōngfèn  
 If I not can sufficient  
 gōngyìng shìchāng dehuà, wǒ-de  
 provide market Prc my  
 gùkè shìbì/yídìng huì cóng  
 customer SHÌBÌ/YÍDÌNG will from  
 bié chù gòu huò.  
 other place purchase goods  
 ‘If I cannot provide sufficiently in the  
 market, my customers definitely pur-  
 chase goods from somewhere else.’
- b. Yào jiàngdī chéngběn, zhōngyóu  
 want decrease cost CPC  
 yídìng/shìbì yào zēng  
 YÍDÌNG/SHÌBÌ DEON increase  
 chǎn  
 production  
 ‘If it wants to decrease cost, CPC defi-  
 nitely has to increase production.’

In (10a), *yídìng* is good, but *shìbì* is not. 331 examples of *shìbì* are retrieved from the online version of the Sinica Corpus. Examining these examples carefully, I find that, whenever *shìbì* is used, additional information must be present so that the sentence with *shìbì* can be inferred. For example, in (10b), moving to Indonesia after getting married leads to the event that the speaker has to quit his/her current job. The same reasoning applies to (11a, b).

Therefore, the first difference between *yídìng* and *shìbì* is that the former does not need the context to explicitly provide information based on which the proposition presented by *yídìng* can be inferred, whereas the latter does. In (10a), *shìbì* is not good because of lack of such information.

What happens if another modal expression, other than *yídìng* and *shìbì*, occurs in the sentences, such as (11a, b)? In these cases, *yídìng* and *shìbì* are interchangeable, and they are ambiguous as discussed above.

So, what is the semantics of *shìbì* and how is it related to that of *yídìng*? (10) sheds some light on this question. Again, putting contextual influence

aside, I propose that the modal base of *shìbì* and the ordering source related to the modal base are both underspecified, while the affirmative ordering source is always there for *shìbì*. *Shìbì* cannot be used in (10a) because information required to infer the proposition presented by *shìbì* does not exist. The lack of such information makes it impossible to resolve the underspecified modal base (and the underspecified ordering source) of *shìbì*.

On the other hand, in (10b), if one moves out of town, then it is most likely required for him/her to quit his/her current job in town. That is, the relation between the two clauses in (10b) indicates a deontic reading and the underspecified modal base of *shìbì* is resolved to circumstantial and the ordering source is related to a physical law: if one is not at a place, he cannot hold a job at that place.<sup>3</sup>

In sum, putting contextual influence aside, I propose the following. *Yídìng* has an epistemic modal base and two ordering sources. One is doxastic or stereotypical and the other is affirmative. An affirmative ordering source orders possible worlds in terms of the degree of speaker’s affirmativeness concerning a proposition. *Shìbì* has an underspecified modal base and two ordering sources. One of the ordering sources is underspecified as well because it needs to be compatible with the modal base. The other is an affirmative one.

### 3.2 Dynamic Semantics for *Yídìng* and *Shìbì*

Although, in Section 3.1, semantics are proposed, along the lines of Kratzer (2012[1981], 1991), for *yídìng* and *shìbì*, Kratzer’s semantics of modality cannot take care of contextual influence, which is demonstrated in the two conversations in (1). There is no mechanism in Kratzer’s semantics of modality (and in truth-conditional semantics as well) to deal with contextual effects.

Instead, I would like to propose dynamic semantics (Groenendijk and Stokhof 1991, Chierchia 1995, etc.)<sup>4</sup> for *yídìng* and *shìbì* so that contextual effects can be taken care of. Yalcin (2007) discusses why sentences such as *suppose that it is raining but it might not be* is infelicitous. In order to take care of embedded epistemic modals, a clause embedded under *suppose* must be interpreted accord-

<sup>3</sup> Let’s not consider, for the moment, work at home through internet or other special situations.

<sup>4</sup> For an excellent introduction to dynamic (modal) logic, please refer to Section 3.2, Portner (2008).

ing to what the subject supposes. Hence, one version of Yalcin’s (2007) proposal is as follows:

- (12) a.  $S_{w,x}$  is defined as  $\{w': w' \text{ is compatible with what } x \text{ supposes in } w\}$   
 b.  $\|x \text{ suppose } \phi\|^{c,s,w} = \{w: S_x^w \subseteq \|\phi\|^{c,S_w,x,w'}\}$   
 c.  $\|\text{Suppose that it is raining but it might not be}\| = \forall w' \in S_{w,x}: \|\phi\|^{c,S_w,x,w'} \text{ is true} \wedge \exists w' \in S_{w,x}: \|\neg\phi\|^{c,S_w,x,w'} \text{ is true}$

(12c) is a contradiction because it is not plausible that  $S_{w,x}$  contains a possible world where  $\phi$  and  $\neg\phi$  are both true at the same time. Yalcin’s (2007) idea applies to *yídìng* and *shìbì* as well because of the infelicity of the following example:

- (13) *tiān zhème hēi, xiànzài yídìng/shìbì*  
 sky so dark now YÍDÌNG/SHÌBÌ  
*zài xiàyù. #dànshì, yě yǒu kěnéng*  
 Prg rain #but also have possibility  
*méiyǒu*  
 not  
 ‘It is so dark. Now, it must be the case that it is raining, #but it may not be.’

But, Yalcin’s (2007) idea alone is not adequate for *yídìng* and *shìbì* because they denote a ‘strong’ epistemic necessity reading, rather than simple epistemic necessity. Is it possible to incorporate the affirmative ordering source as defined in Section 3.1 into an information state, i.e. what Yalcin (2007) refers to as *s*? Veltman’s (1996) proposal can help us here.

In order to account for the semantics of *normally* and *presumably*, Veltman (1996) propose that an information state is a pair  $\sigma = \langle \varepsilon, s \rangle$ . *s* is a proposition and Yalcin’s (2007) *s* or  $S_{w,x}$  is one type of Veltman’s (1996) *s*.  $\varepsilon$  is an expectation pattern, i.e. an ordering of possible worlds, where  $w \leq_\varepsilon v$  iff every expectation which is met by *v* is also met by *w* (Veltman 1996: 13).

Combining Veltman (1996) and Yalcin (2007), I propose that for *yídìng* and *shìbì* the information state  $\sigma$  is also a pair and that  $\sigma = \langle \mathcal{A}, s \rangle$ . *s* is a proposition, as in Veltman (1996) and Yalcin (2007).  $\mathcal{A}$  is an affirmative ordering, where  $w \leq_{\mathcal{A}} v$  if and only if every proposition which is affirmed to be true in *v* is also affirmed to be true in *w*.

In addition, in order to account for the high degree of affirmativeness in the semantics of *yídìng* and *shìbì*, we define absolutely affirmative words as (14a). We also need to update the affirmative ordering with a proposition, so that the proposition is true in the worlds where more propositions are affirmed to be true, as defined in (14b):

- (14) a. Absolutely affirmative worlds (cf.  $n_{\langle \varepsilon, s \rangle}$  in Veltman 1996: 14)  
 $\text{Aff}_{\mathcal{A}} = \{w \in W: \forall v \in W, w \leq_{\mathcal{A}} v\}$ , where *W* is the set of all possible worlds.  
 b. Updating an affirmative ordering  
 $\mathcal{A} \bullet \phi = \{ \langle w, v \rangle: w \leq_{\mathcal{A}} v \text{ if } v \in \phi, \text{ then } w \in \phi \}$

(14a) says the following:  $\text{Aff}_{\mathcal{A}}$  is a set of possible worlds each of whose members has more propositions affirmed to be true than one of the other possible worlds in *W*.  $\text{Aff}_{\mathcal{A}}$  is referred to as the absolutely affirmative worlds because all the worlds in this set contain only propositions affirmed to be true.

(14b) is the definition of updating  $\mathcal{A}$  with  $\phi$ :  $\mathcal{A} \bullet \phi$  is a pair  $\langle w, v \rangle$ , where, if  $\phi$  is true in *v*, then  $\phi$  is also true in *w*, that is, the affirmative ordering takes  $\phi$  into consideration. In this way, we can relate a proposition  $\phi$  to an affirmative ordering  $\mathcal{A}$ .

- (15) a. strong epistemic necessity reading  
 $\sigma \|yídìng(\phi)\|^M$   
 $= \langle \mathcal{A} \bullet \phi, s \subseteq \phi \rangle$  if  $\text{Aff}_{\mathcal{A}} \cap \{w: \|\phi\|^{w,M} = 1\} \neq \emptyset$  and *s* represents the speaker’s knowledge in *w*; or  
 $=$  absurd state, otherwise  
 b. intensification reading  
 $\sigma \|yídìng(\phi)\|^M$   
 $= \sigma$  if  $\text{Aff}_{\mathcal{A}} \cap \{w: \|\phi\|^{w,M} = 1\} = \text{Aff}_{\mathcal{A}}$  and *s*  $\neq$  the speaker’s knowledge in *w*; or  
 $=$  absurd state, otherwise.

(15a) accounts for the strong epistemic necessity reading *yídìng* can denote. The ordering source  $\mathcal{A}$  is updated with the proposition  $\phi$ . This update relates  $\phi$  to the order  $\mathcal{A}$  so that the affirmative ordering takes  $\phi$  into consideration. Just like Yalcin (2007),  $s \subseteq \phi$  says that  $\phi$  is interpreted with respect to *s*, the speaker’s knowledge. There is a condition for the new information state  $\langle \mathcal{A} \bullet \phi, s \subseteq \phi \rangle$  to hold:

$\phi$  must be true in one of the absolutely affirmative worlds. This condition is stated as  $\text{Aff}_A \cap \{w: \|\phi\|^{w, M} = 1\} \neq \emptyset$ . If the condition does not hold, then  $A \bullet \phi$  fails and uttering the  $\|\text{yídìng}(\phi)\|^M$  produces an absurd state.

As for the intensification reading, since this is not an inference or judgment,  $s$  does not equal to the speaker's knowledge in  $w$ . Instead of updating the information state, an intensification reading simply performs a test, as stated in (15b). As long as  $\phi$  is true in all of the absolutely affirmative worlds, then  $\|\text{yídìng}(\phi)\|^M$  gives back the original information state. If the condition does not hold, then an absurd state is yielded.

How about *shìbì*? As pointed out in Section 3.1, the difference between *yídìng* and *shìbì* lies in that the modal base of *shìbì* is underspecified. If we examine the information state  $\sigma$  carefully, we can find that  $s$  in  $\sigma$  functions in a way similar to a modal base. Hence, I propose that the  $s$  in the information state for *shìbì* is underspecified and must be resolved before a sentence containing *shìbì* can get an appropriate interpretation. I formalize the idea as follows:

- (16) a.  $\langle A, s=? \rangle \|\text{shìbì}(\phi)\|^M$   
 b. Suppose that  $\alpha$ ,  $\phi$  forms a (mini) discourse.  $\alpha$ ,  $\phi$  are propositions  
 If  $\langle A, s=? \rangle$ ,  $\|\text{shìbì}(\phi)\|^M$  and  $R(\alpha, \phi)$ , then  $s = R$ .

In (16a),  $s = ?$  stands for an underspecified  $s$ . In (16b),  $R(\alpha, \phi)$  means that  $\alpha$  and  $\phi$  have a certain relation  $R$ . This  $R$  resolves the underspecified  $s$ . For example, in (10b), the two clauses are related because of a physical law, which says that one needs to live in a reasonable distance from where his job is. For this example, this physical law resolves  $s$  and hence (10b) can get an appropriate interpretation. Except for (16a, b), the semantics of *shìbì* is identical to that of *yídìng*, as in (15).

Now, with the dynamic semantics (15) and (16), we can successfully explain the two conversations in (1). For the conversation between A and B, since B says that this is a reasonable conjecture,  $s$  must represent the speaker's knowledge. Therefore, (15b) is ruled out. The information state is updated and we a strong epistemic necessity reading.

On the other hand, for the conversation between A and B', since B' says that this is a widely-known

fact,  $s$  cannot be equal to the speaker's knowledge. Hence, (15b) kicks in and we get an intensification reading.

In this section, I propose dynamic semantics for *yídìng* and *shìbì*. Both of these adverbials have an information state  $\langle A, s \rangle$ , where  $s$  is a proposition and  $A$  is an affirmative ordering. To derive a strong epistemic necessity reading, *yídìng* and *shìbì* update  $A$  with a proposition they present and specify that the proposition is a subset of or equal to  $s$ . This update holds if  $\phi$  is true in one of the absolutely affirmative worlds. To produce an intensification reading, a check is performed on an information state: if  $\phi$  is true in all of the absolutely affirmative worlds, the original information state is returned. If the condition is not satisfied, neither strong epistemic necessity reading nor intensification reading can be produced. This is the unified semantics for *yídìng* and *shìbì*.

Their difference is that the  $s$  in an information state  $\langle A, s \rangle$  for *shìbì* is underspecified, and needs to be contextually resolved so that a proposition presented by *shìbì* can get a proper reading.

## 4 Conclusion

In this paper, I propose dynamic semantics for *yídìng* and *shìbì* because truth-conditional semantics cannot deal with contextual effects in the semantics of *yídìng* and *shìbì*. Following Veltman (1996), I propose an information state  $\sigma$  is a pair  $\langle A, s \rangle$ , where  $s$  is a proposition and  $A$  is an affirmative ordering. *Yídìng*( $\phi$ ) performs update on an information state:  $A$  is update with  $\phi$  and  $s$  is specified to be a subset of or equal of  $\phi$ , as long as  $\phi$  is true in one of the absolutely affirmative worlds. Otherwise, uttering *yídìng*( $\phi$ ) leads to an absurd state. This is how a strong epistemic necessity reading is derived.

On the other hand, to yield an intensification reading, *yídìng*( $\phi$ ) performs a test on an information state. *Yídìng*( $\phi$ ) gives back the original information state as long as  $\phi$  is true in all of the absolutely affirmative worlds. Otherwise, an absurd state is produced.

As for *shìbì*, its semantics is identical to that of *yídìng*, except for the following: the  $s$  in an information state  $\sigma$  for *shìbì* is underspecified and needs to be resolved before a proposition presented by *shìbì* can get an appropriate interpretation. The

information needed to resolve the underspecified *s* for *shìbì* must be inferred from the context.

### Acknowledgements

I hereby acknowledge the financial support from Ministry of Science and Technology, Taiwan, under the grant number MOST 103-2410-H-194-037. I also thank my part-time research assistant Hsuan-Hsiang Wang for collecting data and for a preliminary analysis.

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