MODALS IN THE SCOPE OF ATTITUDES: A CORPUS STUDY OF ATTITUDE-MODAL COMBINATIONS IN MANDARIN

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ABSTRACT

This dissertation explores how attitude verbs constrain the interpretation of modal expressions in their complements, with the focus on configurations involving embedded concord modals (E-CM’s, e.g. John suspects the culprit might be Dan). The goal of this dissertation is two-fold. The first is to identify E-CM’s and the sub-variations among them. The second is to explain how each subtype of E-CM’s arises compositionally based on the lexical semantics of the attitudes and modals.

I use original data from Mandarin Chinese. Efforts are made to semi-automatically retrieve attitude verbs from a parsed corpus (Penn Chinese Treebank 7.0). The selected verbs are surveyed for their abilities to license modals of different types and forces in their complements. Two diagnostic tests are then applied to the licit attitude-modal combinations in search of constructions with E-CM’s.

I argue that E-CM’s fall into two major sub-classes: Real Concord and Pseudo Concord. Real Concord requires semantic equivalence between a sentence with the scheme a Attitude Modal p and its counterpart without the modal, a Attitude p. Pseudo Concord arises when one of a Attitude Modal p and a Attitude p entails the other, and the entailed one implicates the stronger statement. The generalization reached is that pure circumstantial modals can only exemplify Pseudo Concord; epistemics are concord under
representative verbs; priority modals are in concord with jussive and factive-emotive verbs.

It is proposed that Real Concord is from multiple sources. For attitudes with quantificational semantics (Hintikka 1962), it is a result of domain binding and vacuous quantification (Yalcin 2007). The modal retrieves the domain anaphorically from the embedding attitude. Due to domain binding, if the modal and the attitude verb have the same modal force, the quantification contributed by the attitude verb becomes trivial, and thus concord effect arises. For attitudes with neo-Davidsonian semantics (Kratzer 2013), Real Concord happens because the modal expression is an overt counterpart of the modality feature heading the complement clause. Pseudo Concord is partially explained by pragmatic mechanism. The Principle of Informativeness (Atlas & Levinson 1981) is adopted to derive the strengthening implicatures underlying the Pseudo Concord constructions.

INDEX WORDS: Modality, Semantics of Attitudes, Modal Concord, Harmonic Modal, Mandarin
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Chapter 1

Introduction

1.1 The Theme and Strategy

One of the design features of human language is that it is untied from actual here and now, and is able to make claims about hypothetical, possible situations (Hockett & Altmann 1968, von Fintel & Heim 2009). Modality is the semantic category of human language specialized to express possibilities and necessities, and modal expressions are those actual devices used in individual languages. Propositional attitudes, such as believe, hope, regret, etc. are predicates that take propositions as their complements at the level of logic form, and describe relations between individuals and propositions (Hintikka 1962, Swanson 2011).

This dissertation investigates the interaction between propositional attitudes and modal expressions that are embedded in the scope of the attitudes. This interaction can be observed in a number of configurations:

(1.1) a. She hopes grandma can stay longer.

b. I am so glad that you are able to work now.

c. John’s belief that Mary must be in her studio

d. “All of you ought to attend this conference”, he suggested.

e. He hates this possibility.

f. The general demands that the troops are obliged to leave.

...
Among the configurations above, I focus on sentences like (1a), where the modal expression\(^1\) is in the sentential complement of the matrix attitude verb. My central interest concerning the modal-under-attitude construction is the phenomenon exemplified by (1.2):

(1.2) a. The general demands that the troops must leave. (Zeijlstra 2008, p318, (7))
   b. The general demands that the troops leave.
   c. All worlds in which the general’s commands in the real world are carried out are worlds in which the troops are required to leave. (□□p)
   d. All worlds in which the general’s commands in the real world are carried out are worlds in which the troops leave. (□p)

As argued by Zeijlstra (2008), (1.2a) is roughly equal to (1.2b) in terms of truth conditions. The meaning of (1.2a-b) should be paraphrased as (1.1d) rather than (1.2c): what the general demands is intuitively not that the troops be under the obligation of leaving, but that they actually leave. What is puzzling about (1.2a) is that its meaning is not compositional in a straightforward way. Zeijlstra treats (1.2a) as a case of MODAL CONCORD, the phenomenon in which two modal elements co-occurring in a sentence behave as one operator (refer to §1.2 for a full introduction of modal concord). To distinguish sentences like (1.2a) from the canonical paradigm of modal concord, where the two modals in concord are clause-mates (e.g. Jay may possibly have read the book), I will refer to them as the EMBEDDED CONCORD MODAL (E-CM) constructions.

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\(^1\) I focus on prototypical modal expressions that are specialized to express modality, such as the English modal auxiliaries must, can, etc. Modal expressions that also have concrete lexical contents such as obliged.

\(^2\) This sentence is ungrammatical or marginally acceptable for some native speakers. As Kratzer (2013) puts it: this kind of usages is “widely attested, but not exactly in line with American prescriptive grammar.”
Not all attitude-modal combinations are in concord relations, at least in typical cases. Take (1.3) for example, the embedded modals, regardless of their \textit{flavor} (or judgment type), all contribute their own modal \textit{force}, and cannot be removed without affecting the meaning of the sentence.

(1.3) a. The soldier imagines the troops might have left.
   \[≠\] The soldier imagines the troops have left.

b. The soldier imagines the troops may leave.
   \[≠\] The soldier imagines the troops will leave.

c. The soldier imagines the troops are able to leave.
   \[≠\] The soldier imagines the troops will leave.

Distribution of E-CM’s is restricted, but E-CM’s are probably not idiosyncratic. The counterpart of (1.2a) in Mandarin (i.e. (1.4a)), a language unrelated to English genealogically, and quite different typologically, receives the same concord interpretation. In addition, E-CM’s are not limited to one type of modals and one class of attitudes. Consider (1.4b-c):

(1.4) a. Jiangjun yaoqiu jundui bixu cheli.
   general demand troop must leave
   ‘The general demands the troops must leave.’
   \[≠\] The general demands that it is required for the troops to leave.

b. Wo xiwang ming-nian neng qu kan yinghua.
   I hope next year can go see cherry blossom
   ‘I hope to go to see cherry blossom next year.’

\[3\text{ Flavor and force are the two basic parameters for classifying modal expressions in Kratzer’s framework of modal semantics. Refer to §2.2 for details.}\]
My hope is not just that I am able to see cherry blossom, but that I actually do.

c. *Yisheng jianyi  Xiao Li yinggai duo yundong.

doctor suggest Xiao Li should more exercise

‘The doctor suggested Xiao Li to do more exercises.’

The doctor’s suggestion is not that Xiao Li is required to do more exercise, but simply that he does more exercise.

In view of the examples above, intuitively, the semantics of the attitude verb plays a role in determining whether the verb is in concord with the embedded modal. For example, in the complement of demand, a deontic necessity modal\(^4\) is in concord as exemplified by (1.2a). An epistemic modal is not allowed under demand (see (1.5a)), a deontic possibility modal is not acceptable either ((1.5b)), and an ability modal is grammatically allowed, but semantically odd ((1.5c)).

(1.5) a. *The general demands that the troops must\textsubscript{epistemic} might leave.

b. *The general demands that the troops may leave.

Intended: The general demands that the troops be allowed to leave.

c. #The general demands that the troops be able to leave.

Other factors, such as the syntactic status of the modal expression and whether the flavor of the modal is lexically specified, both seem to be relevant as well. Consider a concrete example: obliged in “The general demands that the troops are obliged to leave” (sentence (1.1f)) is embedded in the complement of demand, yet the salient reading of the sentence

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\(^4\) The weak necessity modal should is less natural in the scope of demand, but examples of use can be found. Below is one instance, and it seems like should in the sentence is concord. Other concord usages of weak necessity modals will be discussed in Chapter 4.

...but God and his religion demand that he should say, after doing this “The Lord gave, and The Lord hath taken away; blessed be the name of the God”…

(http://books.google.com/books/about/Classic_Sermons_on_Death_and_Dying.html?id=6L6C7eGDpBMC)
is one in which *obliged* expresses its own force. *Obliged* differs from *must* in two respects: *obliged* is an adjective rather than auxiliary, and it has a concrete lexical meaning that restricts its flavor to be solely deontic.

The empirical goal of this dissertation is to provide a systematic description of the distribution of E-CM’s as well as the sub-variations among them. Empirical studies on E-CM’s are fairly rare in the literature. All we have is basically a descriptive working definition and some illustrative examples. My strategy to approach the empirical goal consists of two steps. The first step is to provide several implementable formal tests that assist in diagnosing E-CM constructions. The second step is to identify individual embedded concord modal constructions through a manageably scaled corpus-based survey. I choose my native language Mandarin as the subject of investigation. The results of the survey are reported in Chapter 4, after necessary background, methodology and discussion introduced in Chapter 3.

The theoretical goal of the dissertation is to come up with a system that explains when and how each type of E-CM is derived. My implicit assumption is that genuine E-CM’s, if they exist at all, should be a semantic rather than syntactic or pragmatic phenomenon. Therefore, I start with a strict logical definition of Real E-CM, and search for attitude-modal pairs that follow the definition. It is expected that there could be instances that meet the loose, descriptive definition of modal concord, but do not belong to the class of Real E-CM. I will label these cases as Pseudo E-CM. A complete theory of modal concord needs to account for both subtypes.

As mentioned earlier, in a broad sense, concord phenomenon reflects the restrictions of matrix verb on the interpretation of modals in its complement. For Real E-CM, I seek
to derive the concord effect compositionally from the semantics of various attitude verbs
(Hintikka 1962, Heim 1992, Villalta 2008, etc.) with the machinery of domain binding
(Yalcin 2007, Anand & Hacquard 2013). For Pseudo E-CM, a pragmatic approach is
pursued. The analyses are presented in Chapter 5. Although the patterns discussed are
from Mandarin data, the analyses are aimed to form a general theory of E-CM’s.

In the rest of this chapter, I will give an overview of the landscape of studies on modal
concord, with the goal of visualizing where in the bigger picture this dissertation fits in.
Then I will zoom out to provide an overview of the whole dissertation, consisting of
chapter summaries.

1.2 Empirical Scope of Modal Concord

The term modal concord is typically used to refer to the pattern as shown below:

(1.6) a. You may possibly have read my little monograph upon the subject.

b. Power carts must mandatorily be used on cart paths where provided.

(geurts & huitink 2006, §1(1))

The sentences in (1.6) contain a modal auxiliary and a modal adverb, and their
interpretations, according to geurts & huitink (2006), are not “cumulative”: what the
speaker of (1.6a) thinks is that it is possible that the addressee has read the book rather
than “it is possible that it is possible that you have done so”; in a similar way, what (1.6b)
expresses is not “it is obligatory that there is an obligation to use power carts” but simply
that the use of power carts is obligatory. The puzzle is: Two modal operators appear in
the same sentence, yet the modal force is only expressed once. Let us use this
characteristic as a working definition of modal concord:
- **Working definition**: modal concord is the phenomenon where the semantics of a sentence with two co-occurring modal elements seems to contain only one modal operator.

Modal concord is unexpected at first sight. For one thing, it contradicts the principle of compositionality. For the other, a sentence with multiple modals can actually be “cumulative” in many other cases (*c.f.* (1.7)).

(1.7) a. You **may** not **be able to** find my monograph on the subject.

   b. Power carts **probably must** be used on cart paths where provided.

In view of (1.7), a natural question to ask is under what conditions modal concord happens. Geurts & Huitink proposed two constraints, based on observations like (1.8). For the two modal elements to be in concord, they should have (a) the same modal type (“i.e., if they are both deontic, epistemic, or whatever”), and (b) the same or at least similar quantificational force.

(1.8) a. John **might** (epistemic) **have to** (deontic) work on Sunday.

   (different type; not concord)

   b. There **may** (◊) **certainly** (□) have been weapons of mass destruction in Iraq.

   (different force; not concord)

   c. Pain in these diseases **may** **probably** influence the sleep process.

   (quantificational force sufficiently close; concord)

   (Geurts & Huitink 2006, §2)

It seems to me that (1.8c) does not have a concord reading in the same sense as (1.6a-b).

It is not cumulative; but the two modals combined together express a stronger force than simple possibility. (1.8c) is equivalent to “Pain in these diseases will probably influence the sleep process”. In other words, it is the force of modal adverb that is actually
expressed. Condition (b) is problematic as well. It is not clear how to measure the similarity of quantificational force, and the threshold for “sufficiently close” is not specified either. Generally we think probably is similar to must in force. But based on (1.8c), the authors assume the force of probably is “sufficiently close to” may. Suppose the authors are correct, then we have to infer that epistemic may and must are sufficiently similar in force, given that probably is similar in force to both modal expressions.

Another property claimed to be general to modal concord pairs is strengthening effect. The two-modal sentence sounds stronger/weaker than the corresponding one-modal variant, depending on the quantificational force of the modals. For example: (1.9a) seems to express stronger obligation than (1.9b), while (1.9c) communicates lower credence of the speaker than (1.9d).

(1.9) a. Power carts must mandatorily be used on cart paths where provided.
   b. Power carts must be used on cart paths where provided.
   c. You may possibly have read my little monograph upon the subject.
   d. You may have read my little monograph upon the subject.

There are two different explanations for the strengthening effect. The semantic explanation is that the adverb serves to modify the degree of the modal auxiliary, so that the two modals combined denotes the maximal/minimal degree on the scale of necessity/possibility (Grosz 2009b). The pragmatic explanation, in contrast, says strengthening happens because the same proposition is expressed twice (Anand & Brasoveanu 2009). I will follow the latter line of argument, as a degree maximizing analysis is hard to be applied across clause boundaries.
The non-cumulative puzzle, the two constraints on modal concord, and the strengthening effect constitute the original empirical boundary of the study on modal concord. It should be noted that this phenomenon was noticed by earlier linguists (Halliday 1970, Lyons 1977), unsurprisingly. However, it was not regarded as a puzzle, neither did it receive much in depth formal analysis. What is emphasized in the early works is the “harmonic” relation between the two modals, which is rephrased as the constraints on modal concord by Geurts & Huitink.

Ever since Geurts & Huitink revisited the modal concord phenomenon in a formal semantics context, it has attracted the attention of different researchers. As a result, its empirical territory expands to various related phenomena, and the theory of modal concord has developed accordingly to capture the new findings.

Huitink (2008, 2012) presented instances of modal concord involving an auxiliary and an adverb in Dutch. There are more concord pairs found in Dutch than in English, and according to the author, this is because Dutch has more modal auxiliaries compared to English. Since these Dutch data are essentially the same kind as the examples discussed by Geurts & Huitink (2006), I will not cite and comment on them here.

The work of Grosz (2009b) extends its coverage to include some crucial facts that are not mentioned by Geurts & Huitink. Specifically, he highlighted the pattern shown below:

(1.10) In view of our special security standards, you **mandatorily may not** cross the yellow line without a special permit issued by the facility headquarters.

(Grosz 2009b, p186, (2a))

Note that what enters in concord relation with the modal adverb **mandatorily** is not **may** but the complex term **may not** which expresses deontic **impossibility**. According to
Grosz, the concord reading arises in (1.10) because *impossibility* is *strong* in its force just like *necessity*. Non-necessity, on the other hand, is *weak* in force, and patterns with possibility. In light of (1.10), Grosz argues that we should take into considerations “lexical entries for all four corners of the Square of Opposition\(^5\)” (Figure 1.1). To accommodate these new facts, Grosz adopted a more theory-neutral term *modal matching* for his research.

![Logical Force of Lexical Entries](image)

Figure 1.1: Logical Force of Lexical Entries (Grosz 2009b, p.193, (27))

In addition to complex modal expressions, Grosz also includes the German particles *ruhig*, *JA* and *bloß* to the realm of what he called modal matching elements. Different from the English modal adverbs and auxiliaries we have seen, these particles cannot used independently; they must combine with a priority modal, a modal that makes reference to someone’s commands, desires, goals, etc. Examples in (1.11) illustrate how they behave in terms of “matching”:

(1.11) a. Der Hans **darf** \{ruhig / *JA\}.den Kühlschrank ausräumen.
   
   the Hans may **RUHIG** **JA** the fridge empty
   
   ‘Hans may {ruhig / *JA} empty the fridge.’

   b. Der Hans **soll** \{JA / *ruhig\}. aufessen!
   
   the Hans shall **JA** **RUHIG** eat.up

---

\(^5\) The Square of Opposition finds its origin in Aristotle. For more detail, please refer to Horn (2001), *A natural history of negation*. 
‘Hans shall {JA / *ruhig} eat up!’

(Grosz 2009b, p198, (44a-b))

The sentences above show that ruhig co-occurs with possibility modal darf ‘may’, while JA appears with the necessity modal soll ‘shall’; and we can see from translations that neither of the particles contributes its independent modal force to the meaning of the sentence it appears in. Although these particles do match the force of the modal they co-occur with, (1.11a-b) do not follow our working definition of “concord” in a strict sense. The working definition requires both elements have an independent modal force to contribute, but ruhig, JA and bloß cannot occur without a modal. However, I think matching and concord have the same pragmatic motivation. Because in both cases, the modality the speaker intends to express gets highlighted via repetition (this idea is elaborated in §5.4).

The focus of Anand & Brasoveanu (2009) is the function of the modal adverb that stands in a concord relation with the modal auxiliary. The authors frame their question in terms of the typology of adverbs that modify modal auxiliaries. Their strategy is to study the semantics of modal adverbs in both intensional (i.e. where they serve as some kind of modal modifier; e.g. He may legally drive now.) and extensional (e.g. In We do everything legally, the adverb legally describes manner) environments. Their goal is to derive the modal modification reading from the extensional usages of the adverbs.

To start out, the authors laid out the typology of modal modifiers:

(1.12) \[
\begin{align*}
\text{FLAVOR \\ FORCE:} & \quad \text{legitimately} \\
\text{FLAVOR:} & \quad \text{legally} \\
\text{FORCE:} & \quad ---
\end{align*}
\]

Bloß is interchangeable with JA according to Grosz; for more details of the distribution of these particles, please refer to Grosz (2009a).
The left column indicates the aspects of modals the adverbs are sensitive to. For example the type FLAVOR & FORCE is exemplified by adverbs such as *mandatorily* (deontic, necessity), *legitimately* (deontic, possibility) -- these adverbs actually enter modal concord. The authors report that in addition to adverbs that are sensitive to both modal flavor and modal force, there are adverbs only sensitive to FLAVOR (e.g. *legally*) and adverbs whose flavor and force are both unspecified (e.g. *absolutely*, *definitely*). Adverbs that are sensitive to FORCE alone, however, are not found.

It is necessary to clarify that by “sensitive to force/flavor” the authors mean the adverb has an inherent, lexically specified force or flavor. For instance, *legitimately* is deontic existential, while *mandatorily* is deontic universal; their flavors and forces are both lexically specified. Contrastively, *legally* has a lexically specified flavor (it is deontic), but can modify both universal and existential modal auxiliaries; so its force is viewed as unspecified. *Absolutely* is compatible with modal auxiliaries regardless of their force and flavor; thus it has neither inherent flavor nor inherent force. With this typology in mind, the authors then narrow their view down to two case studies centering on (i) *absolutely* and its relatives and (ii) the comparison of *legitimately* and *legally*.

The first case study reveals that *absolutely* can modify modals of different flavors and forces (consider (1.13a-c)), and its semantic function is to “select the strongest meaning given the contextual modal bases / ordering sources” rather than to “serve as an epistemic or evidential marker”.

(1.13) a. There is no choice, he *absolutely must* (deontic, universal) stay in the lineup.

b. Yes, sir, you *absolutely may* (deontic, existential).
c. It probably wouldn’t make sense for a college professor, but absolutely might (epistemic) make sense for a bus driver.

(Anand & Brasoveanu 2009, (45))

Although absolutely does not enter concord with the modal auxiliaries in (1.13), we can see that its contribution is quite similar to the strengthening effect of modal concord. This similarity in effect lends support to Grosz’s treatment of the concord adverbs as degree modifiers (Kennedy & McNalley 2005, Portner 2008), even though he did not relate them to items like absolutely.

The second case study has several findings, but I will only highlight two of them. First, with respect to intensional usages, the authors apply a statistical analysis to prove that modal force affects the distribution of legitimately and legally differently. They classify the occurrences of legitimately and legally in COCA\textsuperscript{7} based on the force of modal auxiliary they co-occur with, and obtained contingency tables as below\textsuperscript{8}:

<table>
<thead>
<tr>
<th></th>
<th>legitimately</th>
<th>legally</th>
<th>(\chi^2) contributions</th>
<th>legitimately</th>
<th>legally</th>
</tr>
</thead>
<tbody>
<tr>
<td>existential</td>
<td>266</td>
<td>658</td>
<td></td>
<td>8.07</td>
<td>2.57</td>
</tr>
<tr>
<td>universal</td>
<td>26</td>
<td>257</td>
<td></td>
<td>26.34</td>
<td>8.41</td>
</tr>
</tbody>
</table>

(Anand & Brasoveanu 2009, (55))

The table shows that the frequency of “legitimately + universal” in the corpus is quite low, and contributes noticeably more to the \(\chi^2\) value compared to other cells (26.34 vs. 8.07,

\textsuperscript{7}Corpus of Contemporary American English

\textsuperscript{8}The original paper is terse about how to interpret the statistics. The underlying reasoning is as follows:

(i) the \(\chi^2\) value (the sum of the contributions in the right side table) associated with the frequencies in the left side table is 44.32;

(ii) this \(\chi^2\) value receives a \(p\) value of 2.79e-11 (not presented in the original paper; but can be looked up from significance table of 2 by 2).

(iii) The extremely low \(p\)-value indicates:

(a) the difference of frequencies contributed by the different modal forces is significant;

(b) some cells in the (left side) contingency table have observed frequency markedly differ from expected frequencies (either markedly more or markedly less).
2.57, 8.41). The rareness of this combination is compatible with the intuition that *legitimately* is existential, and thusly does not fit well with a universal modal. This case study provides an example of how quantitative corpus data can be utilized in theoretical reasoning. I apply similar statistical analysis to E-CM constructions in §5.1.

With respect to extensional usages, the authors reveal that *legally* has a broader range of interpretations than *legitimately*. The latter is limited to MANNER and CLAUSAL readings, while the former allows DOMAIN/MEANS-DOMAIN\(^9\) interpretations in addition to the MANNER and CLAUSAL usages. Take the following sentences (from their (60) and (66)) for illustration:

(1.14) a. No laws had been broken, and, after all, David was *legally* an adult.

\begin{itemize}
\item b. I mean, we do everything *legally*.
\item c. *Legally*, it’s used as an anesthetic.
\end{itemize}

(1.15) a. Some did finally give up the ghost *legitimately*, but others doubtless were scuttled.

\begin{itemize}
\item b. Someone who invites you to lunch *legitimately* wants to get to know you.
\end{itemize}

Getting back to the question of whether the modal modification reading can be unified with the extensional readings, the authors propose that the modal modification use of *legally* is most likely derived from the DOMAIN use; while for *legitimately*, modal modification seems to have evolved from a different route. I will not get into the details of their arguments for this conclusion. Instead, I will highlight what is relevant to this

\(^9\) The terms clausal, manner, domain…come from Ernst (2007)
the dissertation: the overall strategy of investigation adopted by the authors. The crucial 
assumption of their approach is that the concord use of adverbs is not an isolated 
phenomenon. It is probably derived from other usages of the same adverb, and is better 
understood in comparison with the behaviors of other adverbs that appear in the same 
position. This “widening the net” strategy, as Anand & Brasoveanu name it, is shown to 
be fruitful in revealing the properties of a phenomenon for which a solid empirical 
ground is not established yet. I employ the same strategy for the study of E-CM. To be 
specific, I view the concord phenomenon of embedded modal as a special case of the 
more general interactional pattern between the matrix attitude and the modal in its 
complement.

While the researchers introduced above limit themselves to sentences where the two 
modals are clause-mates, Zeijlstra (2008) takes a step forward to include the cases where 
a modal auxiliary is in the complement of an attitude verb. This is a natural move to take, 
since attitude verbs are also treated as quantifiers over possible worlds in the tradition 
stemming from Hintikka (1962). Thus, it is worth asking whether modal concord can 
happen across clausal boundary.

This move makes the study of modal concord converge with some other independent 
inquiries that are concerned with the interpretation of modals occurring in the 
complement of attitude predicates. Consider (1.16):

(1.16) a. I pray that God may bless you. (Portner 1997, p201, (42b))
     b. Vann believes that Bob might be in his office. (Yalcin 2007, p996, (19))
     c. Ralph advised that Ortcutt should turn himself in. (Kratzer 2013, p11, (8))
d. Dearest, I hope we may be on such terms twenty years hence.

(Yanovich 2013, p99, (87))

Portner (1997) extends the semantics of verbal mood to accommodate sentences like (1.16a), treating the embedded *may* as a mood indicator. This treatment is based on the fact that *may* does not contribute its own force under *pray*. The sentence does not mean, for example, “I pray that it is possible for the God to bless you” or “I pray that it is compatible with my desires that the God will bless you”.

Apparently, (1.16b) is different from (1.16a), since *might* does contribute its own force. As pointed out by Yalcin (2007), the sentence (1.16b) is not a “second-order” attitude ascription. The natural interpretation of the sentence is “It is compatible with what Vann believes that Bob is in his office”. In other words, the verb and the epistemic modal combined together behave as if the dual of the verb. Therefore, in (1.16b), the two modal operators behave as if one, just like what happens in (1.16a). Yalcin proposes a static version of dynamic semantics (Groenendijk, Stockhof & Veltman 1996, Veltman 1996) to explain (1.16b) and the facts he calls EPISTEMIC CONTRADICTIONS (§2.3.2). The central idea of the theory is that the domain of the attitude is passed down to the embedded epistemic modal. I adopt this idea as the core mechanism of my account of real E-CM.

Sentence (1.16c) is one of the examples Kratzer (2013) used to motivate a new style of semantics for deontic modals and embedding. She describes (1.16c) as having a “harmonic interpretation” which is not expected by the “textbook analysis” (see also §2.4.2). Regardless of the difference in terminology, Kratzer (2013) deals with the same kind of phenomenon as I do in this dissertation. The harmonic modal is determined by the modality expressed by the predicate upstairs, and sometimes is not absolutely
grammatical according to the diagnostic grammar. As will be reviewed in §2.4.2, Kratzer accounts for harmonic modal relying on a new theory of complementation, which decomposes attitude verbs into an event predicate and a modal head gluing together the complement clause and the embedded attitude. The harmonic modals are treated as the overt incarnation of the modal head.

Finally, (1.16d) is an example of what is labeled as *may*-under-*hope* construction by Yanovich (2013). He argues that this construction is not compositional, because “in order to use them correctly, a language speaker needs to know the construction itself”. With this stance, Yanovich focuses on the historical development of the construction, rather than the formal analysis of its semantics.

Sentences like (1.16a-d) are all in the scope of this project. Following Zeijlstra, I widen the boundary of modal concord along the dimension of the combination of a modal and its embedding attitude verb. The sentences in (1.16) will be revisited as the dissertation goes along. To conclude, I sketch the landscape of the studies for modal concord and attitude-modal combinations in Figure 1.2.

The dashed black box in the center corresponds to the canonical patterns of modal concord studied in Geurts & Huitink (2006) and Huitink (2008). The red box captures the data discussed in Grosz (2009). The blue box maps to the work of Anand & Brasoveanu (2009), and the green box to Zeijlstra (2007). The solid black box shows the scope of this dissertation: the attitude-modal combinations, the constructions where an attitude verb takes a modalized complement. I will broaden the empirical scope by looking at a language that has not been studied in this domain, namely Mandarin Chinese.
Figure 1.2: The Landscape of Studies on M.C. and Attitude-Modal Combinations

1.3 Dissertation Overview

The rest of this dissertation consists of four chapters. Chapter 2 introduces the theoretical assumptions I make in conducting the whole project and important ideas that I adopt to build my analyses for the empirical facts. Chapter 3 and Chapter 4 report the procedure and results of the descriptive efforts, including the selection of attitude verbs and modals, the compatibility of each attitude-modal pair, and the interpretation of individual combinations. Chapter 5 presents the theoretical analyses of different sub-types of E-CM’s, and concludes the dissertation. Below are summaries of each chapter:

The main contents of Chapter 2 consist of four parts. The first part presents standard theories that serve as the foundation of the remaining sections of the chapter: Kratzer’s (1991, 2012) framework for modal semantics, and Hintikka’s (1962) analysis of
propositional attitudes. The second part discusses an influential framework alternative to the standard theories, namely, the scalar framework for modality (Portner 2009, Lassiter 2011, Portner & Rubinstein 2014). The third part introduces some notions and ideas from the dynamic view of modals. The most important among them is the anaphoric analysis of epistemic modals (Yalcin 2007). The last section reviews two developments in the theory of attitude ascriptions.

Chapter 3 serves as a direct background for the patterns reported in Chapter 4. This chapter discusses the basic syntactic and semantic properties of the modal expressions I pick out for this dissertation. Then it introduces the attitude verbs selected for this study, along with the methodology applied to collecting the verb from a parsed corpus, and the clustering of the verbs according to different factors. Next the specific attitude-modal combinations are examined for their acceptability.

Chapter 4 is devoted to present the specific instances and subtypes of E-CM’s. I firstly provide a formal definition of Real E-CM based on the semantic equivalence of “x Attitude M p” and “x Attitude p”, and from that distinguishes Real Concord and Pseudo Concord. Two tests, the Deletion Test (x Attitude M p & ¬(x Attitude p)) and the Insertion Test (x Attitude p & ¬(x Attitude M p)), are proposed to help identify concord pairs. If both tests turn out to be invariably contradictory in all scenarios, then the attitude modal is in Real Concord. If the two tests are both contradictory in some but not all possible worlds, then the attitude-modal pair is in Pseudo Concord. The generalization reached is: Concord effect is derived from various sources. Pure circumstantial modals can only exemplify Pseudo Concord; epistemic verbs exemplify concord under some
representative verbs; priority modals are in concord with jussive verbs and the factive-emotive verb.

Both real concord and pseudo concord E-CM’s are analyzed in Chapter 5. In this chapter, I first evaluate the non-compositional approach to E-CM, which treats the concord phenomenon uniformly as a result of conventionalization. I argue that collocationality may play a role, but is not sufficient to account for all the facts we have found. The principle of informativeness is adopted to derive the strengthening implicatures that gives rise to the pseudo concord phenomenon. The fundamental idea in my account of Real Concord E-CM’s builds on Yalcin’s (2007) theory of domain sharing. I propose that the embedded modal is anaphoric to the embedding attitude under certain conditions, and retrieves the quantificational domain from the attitude. When the embedded modal has the same force as the modality expressed by the attitude, the attitude only contributes a vacuous layer of quantification, and is redundant as a result. Exceptional cases are account for by adopting Kratzer’s (2013) decomposing approach to attitude verbs. Lastly, I propose that the conversational function of E-CM’s is highlighting the kind of modality intended to express through repetition.
2.0 Overview

This chapter introduces the theoretical assumptions I take throughout the dissertation, and the important ideas I borrow to analyze the embedded concord modals. Section 2.1 lays out the “standard theory” in the study of propositional attitudes and modality: Hintikka’s (1962) analysis of attitude ascriptions and the framework developed by Kratzer (1977, 1981, 1991, 2012) to deal with modal expressions.

Section 2.2 introduces the scalar approach to modality, an alternative framework to Kratzer’s theory that has received much attention in recent years (Kennedy 2007, Kennedy & McNally 2005, Yalcin 2007, Portner 2009, Lassiter 2011, Cariani 2013 among others). I outline the main facts that motivate a scalar analysis, and compare two different ways to generate the relevant scales for modal expressions (Lassiter 2011 and Portner & Rubinstein 2014).

Section 2.3 introduces several terminologies and ideas from dynamic semantics (Stalnaker 1974, 1978, 1984; Veltman 1996; Groenendijk, Stokhof and Veltman 1996), which are important ingredients of my analyses of E-CM’s and many attitude verbs. §2.3.1 introduces the concept of common ground (Stalnaker 1974, 1978) and To-Do List Function (Portner 2004), and how they are connected to each other. In §2.3.2, I review the line of efforts to apply the dynamic analysis in the framework of static semantics. I first review Yalcin’s version of static dynamic semantics for epistemic modals, and then describe how it is further developed in Anand & Hacquard (2013).
Section 2.4 shifts the focus back to semantics of propositional attitudes. In §2.4.1, I review the comparative semantics proposed for desire predicates (Heim 1992; Villalta 2006, 2008; Rubinstein 2012). Then in §2.4.2, I discuss Kratzer’s (2013) innovative approach to embedding, which assigns the embedding predicates neo-Davidsonian-style semantics, and attributes the quantification over alternative worlds to different modality feature heading the complement clause.

Lastly, section 2.5 summarizes the chapter by making explicit where I stand. In short, I assume possible worlds semantics for modals and attitudes as default, although I believe the same analyses can be transposed into the framework of pure scalar semantics as well. My analyses for the various subtypes of E-CM’s respect the quantificational framework, but embrace a range of conservative amendments.

2.1 Standard Theory of Attitude Verbs and Modals

2.1.1 Hintikka’s Idea

Hintikka’s approach to propositional attitudes such as knowledge, belief, memory, hope, desire, etc. is probably the first analysis that would be taught under the attitude predicate section of any semantics textbook (von Fintel & Heim 2009, for example). And because there are actually not much works on the semantics of many individual attitudes, a Hintikkan analysis becomes a “generic” solution adopted by people who work on other topics yet need a treatment of propositional attitudes as part of their theory (Potts 2007, Moulton 2009, to name a couple).

The influential paper of Hintikka (1962) is often cited for its analysis of propositional attitude verbs within possible worlds semantics. However, his main goal of writing the paper was not to analyze the attitude predicates. The paper was written in the context of a
debate in philosophy of logic on whether a distinction of *sense* and *reference* is needed for the semantics of noun phrases\(^{10}\); and Hintikka’s stance was against a theory of sense. He utilized the concept of possible worlds to characterize the semantics of propositional attitudes, and then argued that if we allow the referent of a term to vary in different worlds, the sense of a term can be reduced to its reference. In this subsection, however, I only present Hintikka’s analysis of propositional attitudes, and skip other parts of his argument, although they make the main point of the paper.

Hintikka points out that the distinctive feature of propositional attitudes “is the fact that in using them we are considering more than one possibility concerning the world” (Hintikka 1962, p24). In a more technical way, a propositional attitude divides the worlds in logic space into two classes: those in accordance with the attitude in question and those incompatible with it. And the first class is what we need to care about. With this restricted set of worlds, propositional attitudes can be informally analyzed as follows (take believe for example):

(2.1) a. *a* believes that \(p =\) in all the possible worlds compatible with what *a* believes it is the case that \(p\).

b. *a* does not believe that \(p\) (in the sense ‘it is not the case that *a* believes that \(p\)’) = in at least one possible world compatible with what *a* believes it is not the case that \(p\).

(Hintikka 1962, p26)

\(^{10}\) Refer to Barbara Abbott’s (2010) book *Reference* for more details of the debate.
More precisely, the truth condition of “a believes that $p$” can be written as (2.2), where $a$ is an individual, $\mu$ is a given world, and $\phi_B$ is a function that assigns the individual-world pair the set of alternative worlds that are compatible with what $a$ believes in $\mu$, $\phi_B(a, \mu)$.

(2.2) $B_a p$ is true in $\mu$ if and only if $p$ is true in every member of $\phi_B(a, \mu)$.

(Hintikka 1962, p28)

Hintikka did not give a lexical entry for the verb believe, but we can derive one from (2.2) that fits into modern theories:

(2.3) $[\text{believe}]^{\mu, \theta} = \lambda p. \lambda x. \phi_B(x)(w) \subseteq p$

Essentially, according to Hintikka all propositional attitudes receive a uniform treatment\(^{11}\) similar to (2.3) (see the quotation below).

[...] The meaning of the division in the case of such attitudes as knowledge, belief, memory, perception, hope, wish, striving, desire, etc. is clear enough. For instance, if what we are speaking of are (say) a’s memories, then, these worlds are all the possible worlds compatible with everything he remembers.

(Hintikka 1969, p25)

This uniform picture, however, is argued to be inappropriate by later studies. In one direction, Heim (1992) inspired by Stalnaker (1984) and followed by Villalta (2006, 2008) argues that desire verbs such as want, wish, glad etc., unlike believe, have a preference-based meaning. Citing Heim’s words, “John wants you to leave means that John thinks that if you leave he will be in a more desirable world than if you don’t leave” (Heim 1992, p193). These researchers have developed for desire verbs lexical entries that

\(^{11}\) It is noted by Hintikka that the general analysis he proposed is not possible for some propositional attitudes. As he puts it: “Some such attitudes can be defined in terms of attitudes for which the assumptions do hold, and thus in a sense can be “reduced” to them. Others may fail to respond to this kind of attempted reduction to those ‘normal’ attitudes which we shall be discussing here”. However, he did not provide any specific examples to make this point clear.
involve comparison of contextual alternatives. I will discuss more about this line of works in 2.3.1. In the other direction, Anand & Hacquard (2009, 2013) notice that attitude verbs split in their behavior of embedding epistemic modals. For example, \textit{believe} allows both \textit{must} and \textit{might} in its complement, but \textit{hope} only marginally licenses \textit{might}, and many verbs disallow both. A unified analysis of all attitude verbs assumes that the only distinction of those attitudes is a distinctive accessibility relation, and basically leaves no room to account for this kind of variation among attitude verbs. The works of Anand and Haquard will be reviewed in §2.3.2.2.

Giving one template for all attitudes might be over-simplifying the task. One of the goals of this dissertation is to provide a refined semantics for some subtypes of attitudes, especially for those allow an embedded concord modal (e.g. \textit{assure}, \textit{guess}, \textit{permit}…). But I assume a Hintikkan style lexical entry as the “initial value” for all attitudes, and will revise it as the empirical evidence requires.

\textbf{2.1.2 Kratzer’s Framework}

The modal semantics established by Angelika Kratzer (1977, 1981, 1991) can be considered as the “standard” analysis for modal expressions of natural languages. I quote Portner (2009) for explaining why it is so:

[...] This work is the standard in that it is the one which a linguistically oriented semanticist is most likely to recommend to students or colleagues who wish to learn about the theory of modality, and in that it is one which can be taken on as a working assumption in semantic research without there being much risk that other scholars will object that it is a poor choice.

(Portner 2009, §3.1)
As the main theme of this dissertation is modality in attitude context, whether or not I accept Kratzer’s theory as a whole, I am obliged to discuss it in sufficient detail. Kratzer’s framework has been updated many times since the first edition (Kratzer 1977) was published. In this subsection, I review the most cited version Kratzer (1991) as a benchmark, and compare the most recent version Kratzer (2012) to it.

The framework established in Kratzer (1991) characterizes the meaning of a modal with three dimensions: modal force, modal base and ordering source. The first is the quantificational force of various grades (e.g. necessity, possibility, slight possibility, good possibility…), the remaining two are contextual components that jointly determine the “reading” or FLAVOR (epistemic, deontic, etc.) of a modal. The core semantics of a modal is quantification (according to the modal’s force) over the set of worlds determined jointly by modal base and ordering source.

The crucial underlying intuition of this approach is, as declared in (Kratzer 1991, §1), that “modality is relative modality”: the interpretation of a modal is always relative to certain contextual information. How exactly does context play a role in the interpretation of a modal? In a nutshell, we have two conversational backgrounds. One is MODAL BASE $f$. This is a function from a world $w$ to a set of propositions $f(w)$; $f(w)$ then further determines $\cap f(w)$, the set of worlds that are accessible from $w$. The other conversational background is ORDERING SOURCE $g$, which also assigns a set of propositions $g(w)$ for a world $w$; $g(w)$ then induces an ordering on the $\cap f(w)$, worlds that are picked out by the modal base.

Following Lewis (1981), Kratzer define ordering relation as below:

(2.4) For all $w, w' \in W$, for a set of propositions A:
\[
    w \leq_A w' \iff \{ p: p \in A \text{ and } w' \in p \} \subseteq \{ p: p \in A \text{ and } w \in p \}
\]

(Kratzer 1991, p644)

The definition above says a world \( w \) is at least as good as a world \( w' \) with respect to the ideal set by \( A \), if and only if any proposition of \( A \) that is true in \( w \) is also true in \( w' \).

Mathematically speaking, this is a **pre-order**, which is **reflexive** \((w \leq_A w)\), and **transitive** (if \( w \leq_A w' \), \( w' \leq_A w'' \), then \( w' \leq_A w'' \))

For example, an ordering source \( g(w) = \{ p, q, r \} \) will order the modal base worlds as shown in Figure 2.1.

![Figure 2.1: Ranking of Worlds Induced by Ordering Source \( g(w) = \{ p, q, r \} \)](image)

The worlds in which all of the three ordering source propositions are true are ranked over the worlds where only two propositions are true; and the worlds in which two of the ordering source propositions hold are ranked higher than the worlds where only one of the two propositions is true; and the worlds where none of the ordering source propositions are true are at the bottom of the ordering. Note that the subset relation is crucial in ordering: for two worlds, if the ordering-source-propositions that are true in a world \( u \) is not a subset (or superset) of the ordering-source-propositions that hold in the other world \( v \), then the two worlds \( u \) and \( v \) are not comparable. Take Figure 2.1 for
illustration, the \( \{p, q\} \)-worlds are no better than the \( \{r\} \)-worlds, because there is no subset/superset relation between \( \{p, q\} \) and \( \{r\} \). Therefore, there is no arrow between the two blocks. The same logic applies to other non-connected worlds.

However, there are cases where, at first sight, sheer number of ordering source propositions satisfied in a world, regardless of the subset relation, matters in ordering. Consider the scenario below:

• **The Macaroni Problem:**

  Bill is extremely predictable, and he almost always drives to and from work, arrives home by 6PM, and has macaroni for dinner. But it is more likely that Bill will have something other than macaroni for dinner than it is that he will both fail to be home by 6PM and fail to drive his car.

  (Lassiter 2011, p62, (3.32))

Let \( p = \) Bill drives his car; \( q = \) Bill is at home by 6PM, and \( r = \) Bill has macaroni for dinner. Although we just said that \( \{p, q\} \)-worlds are no better than \( \{r\} \)-worlds, but intuitively, \( \{p, q\} \) is more likely than just \( \{r\} \). It is proposed that a derived ordering source is in effect in such kind of cases (Katz, Portner & Rubinstein 2013). We will look at the derivation closely in the next section.

Given the ordered set of accessible worlds, several grades of modal force are defined individually, including necessity (*must*), good possibility (*there is a good possibility that*), possibility (*might*), weak necessity (*probably*), and slight possibility (*there is a slight possibility that*). Also defined is comparative possibility: at least as good a possibility and better possibility (*is more likely than*). Kratzer (2012) stepped back from giving individual definition for all of these grades of possibility. The new book chapter only provides a definition for necessity, possibility and a tentative definition of comparative
possibility, which differs from the old definition in a crucial way. I think this move is reasonable, particularly in the view of facts about degree specification:

(2.5) There is 90% probability that it will snow on Wednesday.

If the degree of modals can be specified by numbers, we will potentially need infinite number of definitions for grades of possibility. Modality and gradability are two distinctive features of many human language modal expressions, although not all modals are gradable. An adequate theory of those gradable modal expressions (GME’s) should be able to deal with both features. Kratzer’s strategy is to derive the grades from the ordering of accessible worlds. This is not the only option. Alternatively, we can integrate the ordering semantics into the existing framework designed for analyzing gradable expressions (Katz, Portner & Rubinstein 2013, Klecha 2012). I will introduce this alternative approach in §2.2, and return to the basic modal relations for now.

**Necessity.**

A proposition \( p \) is a necessity in a world \( w \) with respect to a modal base \( f \) and an ordering source \( g \) iff the following condition is satisfied:

For all \( u \in \cap f(w) \) there is a \( v \in \cap f(w) \) such that for all \( z \in \cap f(w) \) : if \( z \leq_{g(w)} v \) then \( z \in p \)

**Possibility.**

A proposition \( p \) is a necessity in a world \( w \) with respect to a modal base \( f \) and an ordering source \( g \) iff \( \neg p \) is not a necessity in \( w \) with respect to \( f \) and \( g \).

(Kratzer 1991, p644, Definition 6, 8)

The first definition roughly says a proposition is a necessity if and only if it is true in all modal base worlds that are closest to the ideal set by the ordering source. Necessity
defined as such is called “human necessity” in Kratzer (1981). The terminology is still used in some recent articles (e.g. Cariani, Kaufmann & Kaufmann 2013). A shorthand \textsc{best}(f(w),g(w)) or \textsc{best}_MBOR(w) are often adopted to refer to the “closest” accessible worlds with the assumption there are not “ever better worlds” for every chain of ordered worlds (“Limit Assumption”). Possibility is the logical dual of necessity. With set up above, the truth condition of a sentence with the logic form \textit{must} \( p \) and \textit{may} \( p \) can be written as (2.6a-b).

\[(2.6) \text{ a. } [\textit{must} \ p]_{w,f,g}=1 \text{ iff } \forall w \in \textsc{best}(f(w),g(w)) : p(w) = 1\]
\[(2.6) \text{ b. } [\textit{may} \ p]_{w,f,g}=1 \text{ iff } \neg \forall w \in \textsc{best}(f(w),g(w)) : \neg p(w) = 1 \text{ iff } \exists w \in \textsc{best}(f(w),g(w)) : p(w) = 1\]

Note that, although in the natural languages we are most familiar with necessity and possibility are expressed by different lexical items, it has been discovered that in some languages the distinction is collapsed (Rullmann, Matthewson & Davis 2008). In other words, there are modal expressions whose force is not lexically specified.

Now consider the “at least as a good possibility” relation.

\textit{Comparative possibility.}

\textbf{Old definition}: \( p \) is \textit{at least as good a possibility as} \( q \) in a world \( w \) with respect to a modal base \( f \) and an ordering source \( g \) iff for all \( u \) such that \( u \in \cap f(w) \) and \( u \in q \) there is a \( v \in \cap f(w) \) such that \( v \leq_{g(w)} u \) and \( v \in q \). And, \( p \) is a better possibility than \( q \), just in case \( p \) is at least as good a possibility than \( q \), but not vise versa.

This definition has some undesirable predictions; here is one pointed out by Kratzer herself in her 2012 book chapter:
Suppose, for example, that there is a world $w$ that is better than any other world. We would now predict that all propositions containing $w$ are equally good possibilities. $W$ and $\{w\}$ should be equipossible, then.

(Kratzer 2012, p41)

Let’s take a concrete example. Suppose the ordering source $A=\{\text{you pray, you do good, you confess}\}$. The accessible worlds will be ranked as in Figure 2.2. Let $p =$ “you confess and do good” and $q =$ “you confess”. Then $p$-worlds amount to $W1 \cup W3$ (worlds contained in the dotted box), while $q$-worlds are $W1 \cup W3 \cup W4 \cup W7$ (enclosed by the solid line). Since both $p$ and $q$ contain $W1$, the best among the accessible worlds, for every $p$-world $u$, we can find a $q$-world $v$ at least as good as $u$, and for every $q$-world $v$, a $p$-world $u$ as good as $v$. As a result, $p$ and $q$ end up as equipossible. This is counterintuitive, because confessing and doing good is better than just confessing.

![Diagram](image.png)

Figure 2.2: A Problem Concerning the Old Definition of Comparative Possibility
The concerns above motivate the new definition of comparative possibility: a proposition $p$ is at least as good a possibility as $q$ with respect to a modal base $f$ and an ordering source $g$, if and only if:

$$(2.7) \neg \exists u (u \in \cap f(w) \& u \in q - p \& \forall v ((v \in \cap f(w) \& v \in p - q) \rightarrow u \prec_{g(w)} v))$$

(There is no $u$ in $q$-$p$ such that for all $v$ in $p$-$q$, $u \prec_{g(w)} v$)

And again, $p$ is a better possibility than $q$, if and only if $p$ is as good a possibility as $q$, but not vice versa.

The key point of (2.7) is to ignore the $(q \land p)$-worlds, and compare the $q$-but-not-$p$-worlds and $p$-but-not-$q$-worlds. The definition basically says that for $p$ to be at least as good a possibility as $q$, there should be no $q$-but-not-$p$ world that out beats all the $p$-but-not-$q$ worlds. Put it differently, for every $q$-but-not-$p$ world, there must be a $p$-but-not-$q$ world that is as good as it. Take Figure 2.2 above again, the intersection of $p$ and $q$ (i.e. $W1 \cup W3$) is now ignored, and the $p$-but-not-$q$ world is empty. Consequently, it is trivially true that no world in $p$-$q$ (the $\emptyset$) is better than all the $q$-$p$ worlds (i.e. $W4 \cup W7$, the yellow blocks), and that $q$-$p$ worlds are all better than $p$-$q$ worlds, as it is empty. Therefore, $p$ turns out to be a better possibility than $q$ as we want$^{12}$.

Besides quantificational force, another characteristic aspect of modality is modal type or flavor, i.e. what kind of conversational backgrounds its interpretation is relative to.

The distinction between epistemic and root modality has long been discussed in linguistics (Ross 1969, Brennan 1993). Kratzer argues that epistemic modality is

---

$^{12}$ Kratzer acknowledges that this new definition is not without problem either. There is also discussion on how to relate this definition of comparative possibility to the notions of numeric probability (Kratzer 2012, pp.42-43). Since I do not adopt that component of Kratzer’s theory, I will not introduce it here.
associated with an *epistemic* modal base, while root modality consists of modals with a *circumstantial* modal base. Take the hydrangeas example for illustration:

(2.8)  

a. Hydrangeas can grow here.

b. There might be hydrangeas growing here.  
   (Kratzer 1991, p646, (21a-b))

Sentence (2.8a) uses a circumstantial modal base that comprises with facts about the climate, soil, the properties of hydrangeas, etc. The utterance concerns about whether the plant would grow in the place. Example (2.8b), in contrast, uses an epistemic modal base that comprises with the evidence such as the continent had been in contact with Asia where hydrangeas prosper, I saw hydrangea leaves in the strong wind, and so forth. The claim is about whether there are hydrangeas growing in the place already.

(2.8a) is a case of pure circumstantial modality with empty order source. With a non-empty ordering source, root modals can be very diverse:

(2.9)  

a. Given that you want to become popular, you should go to the pub.

b. Since you like outdoor exercises, you should hike in the mountains.

c. Given your state of health you’d better off going to Davos than to Amsterdam.

   (modified from Kratzer 1991, p646-648, (22-23))

(2.9a) has a *bouletic* (what a person desires) ordering source, (2.9b) a *teleological* (goal-oriented) one. The ordering source of (2.9c) is what is good for the person. Modals of these flavors all fall into a class dubbed *priority* modal (Portner 2009).

It is worth noting that Kratzer (2012, p50) has a remark on epistemic modality. “Epistemic” modals are not necessarily dependent on somebody’s knowledge. In many cases the modal base of an epistemic modal is “evidence of things” (Hacking 1975). Also,
the ordering source for epistemic modals can be *stereotypical* (in view of the normal course of events) or *informational* (according to the content of…). Consider (2.10):

(2.10) a. Given the rumor, and according to Roger’s weird behavior lately, he must have been elected chief.

\[(f: \text{evidential}; g: \text{stereotypical})\]

b. According to the rumor, Roger must have been elected chief.

\[(f: \text{empty evidential}; g: \text{informational})\]

(modified from Kratzer 2012, p35, (8))

In (2.10a), “given the rumor” introduces an evidential conversational background, and the conversational background invoked by the following adverbial phrase is stereotypical. The sentence is interpreted relative to an evidential modal base and a stereotypical ordering source. In (2.10b) there is no explicit phrase corresponding to modal base\(^{13}\), and “according to the rumor” serves as an informational ordering source. Different conversational backgrounds lead to noticeably different interpretations of *must* in (2.10a) and (2.10b). While (2.10a) expresses the speaker’s conjecture about the result of the election, (2.10b) is about the content of the rumor, rather than what the speaker believes.

So far I have introduced the core ingredients and machineries of Kratzer’s modal semantics. Let’s take a break and summarize the contents of this subsection: the range of modal meaning expressed in human languages can be captured by two dimensions: the quantificational force and the modal flavor\(^{14}\). The latter is determined by two conversational backgrounds: modal base and ordering source. These two contextual

\(^{13}\) Kratzer assumes empty modal base “to be a possible instantiation of an evidential modal base”.

\(^{14}\) The term “flavor” is not found in Kratzer’s original work, but is widely used in the field to refer to the judgment types of modal expressions.
parameters not only specify the interpretation of a modal (e.g. an evidential modal base gives an epistemic reading, a circumstantial modal base leads to for the root modals, a normative ordering source leads to a priority flavor...), but also provide the ordering of accessible worlds based on which different modal forces are defined. Figure 2.3 below provides an overview of the framework:

<table>
<thead>
<tr>
<th>Force/Grades</th>
<th>Double relativity</th>
<th>Flavor/Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(often lexically specified)</td>
<td>- modal base(m.b.): f &amp; gives accessible worlds: ( \cap f(w) )</td>
<td>(relative to context: f.g )</td>
</tr>
<tr>
<td>Force relations:</td>
<td>- ordering source (o.s.) g induces ordering ( \leq_{g(w)} ) on ( \cap f(w) )</td>
<td>Flavor types:</td>
</tr>
<tr>
<td>Necessity:</td>
<td></td>
<td>Epistemic (evidential or empty m.b.)</td>
</tr>
<tr>
<td>p is true in all ( \text{BEST}_{M,OR}(w) )</td>
<td></td>
<td>- with stereotypical o.s.</td>
</tr>
<tr>
<td>Possibility:</td>
<td></td>
<td>- with informational o.s.</td>
</tr>
<tr>
<td>( \neg p ) is not necessity</td>
<td></td>
<td>vs.</td>
</tr>
<tr>
<td>Comparative Possibility</td>
<td></td>
<td>Root (circumstantial m.b.)</td>
</tr>
<tr>
<td>- at least as a good possibility (p):</td>
<td></td>
<td>- Pure circumstantial (empty o.s.)</td>
</tr>
<tr>
<td>( \neg \exists u (u \in \cap f(w) &amp; u \in q \rightarrow p &amp; \forall v(v \in \cap f(w) &amp; v \in p \rightarrow q \rightarrow u &lt;_{g(w)} v) )</td>
<td></td>
<td>- Priority (non-empty o.s.)</td>
</tr>
<tr>
<td>- better possibility:</td>
<td></td>
<td>deontic, bouletic, teleological …</td>
</tr>
<tr>
<td>p is at least as a good possibility as q</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&amp; q is not at least as good a possibility as p</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2.3: Summary of Kratzer's (2012) Framework of Modal Semantics

Next, let’s see how the theory just introduced extends to conditionals. Kratzer argues that a conditional sentence with the form “if \( \alpha \), must \( \beta \)” should be analyzed as below:

\[
(2.11) \left[ \text{if } \boldsymbol{\alpha}, \text{must } \boldsymbol{\beta} \right]^{f,g} = \left[ \text{must } \boldsymbol{\beta} \right]^{f',g}
\]

where for all \( w \in W, \ f'(w) = f(w) \cup \{[\boldsymbol{\alpha}]^{f',g}\} \)

Basically, (2.11) suggests that the if-clause modifies the context by adding the proposition it denotes to the original modal base \( f(w) \). This analysis applies to
conditionals with non-modalized consequent as well, where there is assumed to be a convert epistemic necessity modal. In other words, the main clause of a conditional is always assumed to be a modalized sentence. This unified analysis for modals and conditionals shows a desirable elegance; and as a result, compatibility with conditionals becomes an important factor in evaluating alternative approaches to modality.

In this dissertation, I assume a modal semantics as depicted in Figure 2.3 except for the definition of comparative possibility. Specifically, I accept context-relativity, ordering semantics, and necessity as universal quantification over best worlds. Since the core patterns I aim to account for do not involve comparatives and numerical degrees, I opt for this streamlined framework.

2.2 Gradability and the Scalar Approach to Modality
Kratzer’s framework is not the only approach toward modal semantics. The framework, although successful in accounting for a number of facts about modalities, may fail to provide satisfactory explanations for a range of problems. A collection of these challenges can be found in Cariani (2013) and Lassitter (2011). Most of the problems are shown to be solvable with conservative amendments to Kratzerian semantics (von Fintel 2012, Portner 2012, Katz et al. 2012). However, the facts concerning the gradability of modals seem to favor supplementing the Kratzerian framework with the apparatus of scalar semantics. In the rest of this section, I first lay out facts about complex modal expressions with degree modifications that raise problems to Kratzer’s theory, and then introduce the framework of scalar semantics, which is originally developed to analyze adjectives, the most well-studies type of gradable expressions. Next, I compare two approaches that implement scalar semantics for the analysis of modality: one approach
makes use of the scale of numeral probabilities (Lassiter 2011), while the other generates the scale from ordering of propositions (Villalta 2006, Portner 2009, Portner & Rubinstein 2014).

2.2.1 Gradability and Scalar Semantics

2.2.1.1 Gradability

It is long been observed that gradable predicates such as tall, expensive, desirable, etc. distinguish from non-gradable predicates exemplified female and American in several syntactic behaviors (Bolinger 1972). The gradables can be modified by degree adverbs or numerical degrees, and appear in comparative constructions. Non-gradables, in contrast, normally do not accept these syntactic operations. Consider the examples below:

(2.12) a. Alex is very tall. (Degree modification)
   b. *Alex is very female.

(2.13) a. Alex is 175cm tall. (Degree specification)
   b. ?Alex is 75% female. [only acceptable with coerced interpretation]

(2.14) a. Alex is taller than Chris. (Comparative construction)
   b. *Alex is more female than Chris.

It is clear that in (2.12) and (2.14) the (b)’s are ungrammatical while the (a) sentences are acceptable. (2.13b) is acceptable only with a coerced interpretation. For example, Alex is a sci-fi character whose body is assembled partly from a woman and partly from a man. In this context, (2.13b) means ¾ of Alex’s body is from the woman.

Gradability is common among modal expressions, especially probability expressions, as the examples in (2.15) show:
(2.15) a. It is extremely likely that it will rain tomorrow.

b. There is a 60% probability that it’s raining (Portner 2009, p73, (107a))

c. It’s more probable that Alex will win than that Chris will win.

Portner (2009) points out that complex expressions of probability and possibility such as (2.15b) impose a problem for Kratzer’s theory of modality, because the framework cannot provide fine enough distinctions to account for the infinitely many numerical degrees. Examples like (2.15a) are problematic for Kratzerian semantics as well, because the theory does not provide a distinct quantificational force between must (necessity) and probable (weak necessity in Kratzer’s terms), but intuitively, extremely probable is stronger than probable yet weaker than must.

In sum, although the classic framework has its component designed to deal with gradable modality, it is challenged by the data concerning degree modification and specification for modal expressions. To better explain these data, semanticists proposed various solutions built on scalar semantics, the framework originally dedicated for analyzing gradable expressions.

2.2.1.2 Scalar Semantics for Adjectives

In this subsection I focus on the analysis articulated in Kennedy (1999, 2007) and Kennedy & McNally (2005). In the center of the theory is the notion of SCALE, which is a set of DEGREES totally ordered along some DIMENSION. In this theory, \( d \) (“degree”) is a primitive type in addition to \( e \) (individuals), \( t \) (truth values) and \( s \) (worlds). Gradable adjectives are measure functions with type \( \langle e, d \rangle \), i.e. functions from individuals to degrees on the appropriate scale. For example, the semantics of expensive is a function that maps its argument onto the scale associated with the adjective -- the scale of cost.
Degree morphology, such as comparatives (as, more, less), degree adverbs (extremely, very), numerical degrees (60%) and so forth, plays an essential role in rendering the right truth conditions for sentences containing gradable adjectives. The unmarked positive form is assumed to be derived via a silent operator pos. The function of degree morphemes is double-fold:

\[ \text{[T]hey introduce an individual argument for the measure function denoted by the adjective, and they impose some requirement on the degree derived by applying the adjective to its argument, typically by relating it to another degree.} \]

(Kennedy 2007, p5)

Take the comparative morpheme more/-er for example. Its lexical semantics is like (2.17). (2.18) illustrates how the meaning of a sentence containing a comparative predicate is derived:

(2.17) \[ [\text{more/-er}] = \lambda G \lambda y \lambda x. G(x) > G(y) ] \]

(2.18) a. Chicago is larger than Rome.

b. \[ [ (2.18a)] = [[\text{Chicago [-er large]} [p\text{than Rome }]]] = 1 \text{ iff } [\lambda G \lambda y \lambda x. G(x) > G(y)](\text{large})(\text{Rome})(\text{Chicago}) = 1 \text{ iff } \text{large}(\text{Chicago}) > \text{large}(\text{Rome}) \]

c. large(Chicago) > large(Rome)

The pos morpheme picks out a standard of comparison, the minimum degree needed to stand out in context relative to the kind of measurement encoded by the adjective. The positive form of a gradable adjective thus denotes a property of having a greater degree than the standard:
(2.19) $[[\text{Deg pos}]] = \lambda G \lambda x. G(x) > d_s$

($d_s$ is shorthand for the contextually appropriate standard of comparison)

(2.20) a. Chicago is large.

b. $[[(2.20a)]] = [[\text{Chicago pos large}]] = 1$ iff $\text{large}(Chicago) > d_s$

What value on the scale servers as the standard of comparison is determined by the structure of the scale. The theory of scale structure is an important component of the scalar analysis for adjectives. Kennedy & McNally (2005) argue that scales come into four types according to whether a scale contains a maximum/minimum element. The four types are: upper-closed, lower-closed, fully closed, and fully open. Upper-closed-scale adjectives can co-occur with maximizing degree modifiers (e.g. totally, completely, absolutely…). Lower-closed (but not upper-closed) scales can be associated with minimizing degree modifiers (e.g. slightly and a little). Fully-closed-scale adjectives are acceptable with proportional degree modifiers (e.g. n%, half, partially, etc.). Open-scale adjectives are not compatible with any of the three classes of degree modifiers.

(2.21) a. The cup is {totally/#partially/#slightly} dry.

b. The cup is {totally/partially/#slightly} full.

c. The cup is {#totally/#partially/slightly} dirty.

d. The cup is {#totally/#partially/#slightly} big.

Thus, the diagnostics in (2.21) show that dry and full are upper-closed; full is fully-closed; dirty is lower-closed and big is fully open.

The positive meaning of upper-closed (but not lower-closed) adjectives is maximal. For lower-closed (but not upper-closed) adjectives, the positive meaning is minimal. If an adjective is fully-closed, its positive form can be either minimum or maximal; and if an
adjective is fully open, its positive meaning and the standard of comparison is determined by context.

The major difference among recent works on scalar analysis of modal expressions lies in how the scales associated with each modal expression is built. There are mainly two approaches: Lassiter (2011) seeks to associate a common scale of numeral probability to all epistemic modals, and construct a scale of expected utility for obligation and desire modals. In contrast, Klecha (2012) and Portner & Rubinstein (2014) adopt a more conservative approach that maintains the premise semantics, and derive the scales associated with modals from the ordering of modal base worlds.

2.2.2 Scalar Analysis Based on Numeral Probability

This subsection reviews Lassiter’s version of scalar analysis for modal expressions. I focus on his treatment of epistemic modals. Lassiter’s position is to reject Kratzer’s classical framework as a whole, so in building the scales for the modals, he does not make reference to the contextual premises at all. Instead, he argues that possible, certain and likely/probable all share a common scale of numeral probability, and differ only in their selection of positive standards: the standard of possible is the minima on the scale (i.e. 0); certain, on the other hand, picks out the maxima (the probability 1) as the standard for comparison; probable and likely are relative, so for them, the standard is context dependent (Lassiter 2011, §3.4, p64). The truth conditions of these adjectival epistemics are as below:

\[
(2.22) \begin{align*}
\text{a. } & \phi \text{ is pos possible} \equiv^{M,w,g} 1 \text{ iff } \mu_{\text{possible}}(\phi) > \mu_{\text{possible}}(\bot_{\text{possible}}) \\
\text{b. } & \phi \text{ is pos certain} \equiv^{M,w,g} 1 \text{ iff } \phi \approx_{\text{certain}} \top_{\text{certain}} \mu(\phi) = \mu(\top_{\text{certain}}) \\
\text{c. } & \phi \text{ is pos likely / probably} \equiv^{M,w,g} 1 \text{ iff } \phi \succ_{\text{likely}} \theta_{\text{likely}}
\end{align*}
\]
The advantage of the co-scalar analysis is that it provides a simple explanation for the entailment relationships and quantity implicatures concerning epistemic claims as shown in (2.23):

(2.23)  

a. It is certain that we will win. \( \models \) It is likely/probably/possible that we will win.  
b. It is probable/likely that we will win. \( \models \) It is possible that we will win.  
c. It is possible we will win. \( \bowtie \) It is not likely/probable/certain that we will win.  
d. It is probable/likely that we will win. \( \bowtie \) It is not certain that we will win.

However, the simplicity of co-scalar analysis comes with cost. Portner (2009) and Klecha (2012) pointed out the problems of this approach. Below are the major ones: First, suppose an epistemic adjective combines with the fully-closed numeral probability scale of \([0,1]\), it should accept modification by maximizing and proportional degree modifiers, but reject minimizing degree modifiers. However, as the data in (2.24) show, none of the four adjectives behave as expected. Possible can co-occur with slightly, likely rejects completely, and all of them are not good with proportional degree modifiers except for \( n \) percent.

(2.24)  

a. It is \{completely/#partially/50%/slightly\} possible that the Jets will win.  
b. It is \{completely/??partially/?50%/#slightly\} certain that the Jets will win.  
c. It is \#completely/#partially/50%/#slightly\} likely/probable that the Jets will win.

Second, in the standard scalar semantics, the scale type determines the positive meaning of an adjective. Thus, if two adjectives share a scale, they should have the same positive reading. To argue for a common scale for the four modal adjectives, one has to explain
why they pick different standards of comparison. Third, if these modals share the same scale, \( x \) is completely certain and \( x \) is completely possible should both mean \( x \) has a probability of 1. Similarly, \( x \) is 90% possible, \( x \) is 90% certain and \( x \) is 90% likely should all be interpreted as \( x \) has a probability of 0.9. However, these predictions are against human judgments.

Lassiter (2011) responds to the problems as follows. First, he unties positive meaning of a gradable adjective from the scale type associated with it. So whether an adjective has a maximum, minimum or relative standard is independent of the boundness property of the scale. He argues that the degree modification tests are not “if and only if” statements about boundness, but rather conditions about the type of standard. For example, the minimizing test should be interpreted as follows:

(2.25) a. If \( x \) is slightly \( A \) is felicitous with a “just above minimum” interpretation, then \( A \) is associated with a lower-bounded scale.

b. If \( x \) is in the domain of \( A \), and \( x \) is slightly \( A \) is infelicitous, then \( A \) is not a minimum standard adjective.

Given (2.25), that “\( p \) is slightly likely” is infelicitous does not indicate that the scale of likely is not lower-bounded, but indicate that likely is not a minimum-standard adjective.

Second, Lassiter argues that completely is ambiguous. In addition to the degree maximizing meaning, it also has distributional reading and emphatic usage. For example, (2.26a) means everywhere in the neighborhood is dangerous, and completely emphasizes that the president is tall without question. The sentence \( x \) is completely likely/possible does not mean \( x \) has a probability of 1, because the emphatic completely is used in the context.
a. The neighborhood is completely dangerous.

b. (Disagreeing with the addressee) The president is completely tall.

I think these responses need improvement. Denying the correlation between boundness and positive meaning is indeed a solution to the first two problems raised above. However, the argument feels weak without the support from other independent evidence. Moreover, co-scalar analysis is not the only plausible account of the epistemic adjectives, so it is not convincing why this amendment to the standard theory is necessary or favorable. As for the polysemous approach to distinguish different interpretations of $x$ is Degree A for co-scalar adjectives, it is not problem free either. Completely possible is arguably more acceptable than completely likely. If completely is emphatic in both cases, it is puzzling why likely is not quite compatible with it.

In sum, co-scalar analysis of adjectival epistemics based on numeral probability scale has its advantages, but the problems are obvious as well. Associating the same scale to likely, probable, possible and certain will violate a fundamental theoretical assumption in the standard scalar framework (i.e. the positive meaning is determined by the scale type). Moreover, it will obscures many interesting semantic differences among these items. Therefore, I think each of the modals should be associated with its own separate scale.

2.2.3 Building Scales from Premises

In this subsection, I introduce the conservative scalar approach to modality, which builds the scale associated with a modal from the premises it is relativized to in Kratzerian framework. I choose to review the recent work by Portner & Rubinstein (2014). This article is picked because it addresses another hot topic in the recent developments of modal semantics, namely the distinction between strong vs. weak necessity modals. As
2.2.3.1 Background on Weak Necessity Modals

Von Fintel & Iatridou (2008) studied a class of expressions dubbed as weak necessity modals, represented by English ought and should. Note that these modals do NOT have the weak necessity force defined by Kratzer (1991), quoted in (2.27):

(2.27) **Weak necessity**: A proposition $p$ is a weak necessity in $w$ with respect to a modal base $f$ and an ordering source $g$ iff $p$ is a better possibility than $\neg p$ in $w$ with respect to $f$ and $g$.

(Kratzer 1991, p644)

Instead, the term is used because these items seem weaker than necessity modals such as have to and must, and thus considered as a sub-variety of necessity modals. Look at the contrast illustrated in (2.28):

(2.28) a. You ought to do the dishes but you don’t have to.
   
   c. #You have to do the dishes but you don’t have to.
   
   d. #You must do the dishes but you don’t have to.
   
   e. You ought to wash your hands -- in fact, you have to.
   
   f. ??You have to wash your hands -- in fact, you ought to.

The examples in (2.28) show that ought to $p$ triggers a scalar-like implicature not have to $p$ ((2.28a) is felicitous), which can be canceled by an “in fact”-statement ((2.28e)). In contrast, similar implicature is not available with must and have to ((2.28c-d) are infelicitous).
There are two ways to account for the force difference as shown above in Kratzerian framework. One is to define a new modal force different from the necessity force associated with *have to*. The other is to restrict the domain of *ought to*, so that it requires its prejacent to be true in *most* but not *all* the favored worlds. The authors did not pursue either approach. Instead, they modified Kartzer’s framework by adding a secondary *ordering source*, which is visible to the weak necessity modals but not the strong necessity ones.

The leading intuition of their proposal is as follows:

...We think that a sentence like *You ought to do the dishes* means not that among the favored worlds, most are worlds where you do the dishes. Rather, it means that among the favored worlds, all the very best ones are worlds where you do the dishes. That is, the *ought*-claim makes a further distinction as to how good particular worlds among the favored world are.

von Fintel & Iatridou (2008, p118)

The function of the secondary ordering is to pick out the “very best” worlds in the set of favored worlds. This idea is also inspired by the empirical fact that in some languages weak necessity is not expressed by the choice of lexical item, but by using a strong necessity modal in combination with *FUTURE + PAST* morphosyntax, an expression of counterfactuality. Take Greek for example:

(2.29) *Θα επρέπε*  μα πλίνις τα πιάτα αλά δεν ίσπευρομένος μα το κανίς

*FUT must+PAST*  NA wash the dish but NEG are obliged  NA it do

‘You ought to do the dishes but you are not obliged to do it.’

The authors argue that the contribution of the counterfactuality morphology is to promote the secondary ordering source, saying “if the secondary ordering source were relevant”.

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Throughout the paper, von Fintel & Iatridou strive to argue for the relevance of secondary ordering source in the semantics of weak necessity modals, but they were not explicit about what determines the difference between the primary and secondary ordering sources. Rubinstein (2012) started from where they stopped. She proposed that the crucial difference between primary and secondary ordering sources is whether the priority is presupposed to be collectively committed to by all parties in the conversation. Primary ordering source consists of priorities that are collectively committed to, while the priorities on the secondary ordering source do not have this property. This analysis is formally expressed as (2.30):

\[(2.30) \text{\texttt{ought to}}^C = \lambda q_{<s,t>} \lambda w. \lambda w': w' \in \text{\texttt{Fav}}^C(w) \cap b. q(w'), \] where \(b\) is a secondary priority in \(C\) and \(b\) is a pertinent answer to \(QUD^C\).

Combining the ideas from the two studies, the patterns in (2.28) can be explained as follows: \textit{have to} \(p\) means that \(p\) is settled in the worlds compatible with the commitments that everybody agrees on. In contrast, \textit{ought to} \(p\) says that \(p\) follows from a bag of mixed priorities consists of both the all-agreed commitments and commitments that are not presupposed to be so; hence the necessity of \(p\) is not absolute. In this sense, \textit{ought to} \(p\) expresses a weaker necessity than \textit{have to} \(p\).

2.2.3.2 Building Scales From Premises

The ideas on weak necessity modals introduced in the previous subsection are used as a foundation to build the scalar analysis for \textit{must} and \textit{should} in a recent work by Portner & Rubinstein (2014). The other ingredient of the analysis is the theory of \textbf{extreme expressions} (Bolinger 1972, Paradis 2001, Morzycki 2012). Some examples of extreme adjectives and their non-extreme counterparts are listed in (2.31):
(2.31) a. gigantic -- big
   b. gorgeous -- beautiful
   c. bad -- terrible
   d. good -- excellent

The authors argue that strong necessity modals are extreme expression. As (2.32-2.33) demonstrate, must share all the five characteristic properties of extreme adjectives: (a) accepts extreme modifiers; (b) resists very/very much; (c) is not acceptable in comparatives; (d) is acceptable in equatives; (e) cannot be placed in the comparative with non-extreme counterpart.

(2.32) a. Susan flat-out must/*should call her mother.
   b. Susan very much *must/should call her mother.
   c. *Susan must call mother more than she must call her father.

   Susan should call mother more than she should call her father.
   d. Susan must/should call her mother just as much as she must/should call her father.
   e. *Susan must call her mother more than she should call her father.

   (Modified from Portner & Rubinstein 2014, (34-38))

(2.33) a. flat-out excellent/??good
   b. very ??excellent/good
   c. The salsa is ? more terrible/worse than the guacamole.
   d. The salsa is as terrible as the guacamole.
   e. *The salsa is more terrible than the guacamole is bad.

   (Modified from Portner & Rubinstein 2014, (22-28))
Portner & Rubinstein adopts Morzycki’s (2012) analysis of extreme adjectives, which proposes that the extreme adjectives assign their arguments a degree that is above the contextually salient portion of the scale. For example, gigantic($x$) says that the size of $x$ is greater than what counts as big for $x$ in the context. The formal analysis as (2.34), where $D_C$ refers to the contextually salient port of degrees.

$$(2.34)\ a. \ \left[\text{big}_{D_C}\right] = \lambda x\lambda d. \ d \in D_C \land x \text{ is } d\text{-big}$$

$$b. \ \left[\text{gigantic}_{D_C}\right] = \lambda x\lambda d. \ d > \text{max}(D_C) \land x \text{ is } d\text{-big}$$

Building on Morzycki’s idea, Portner & Rubinstein construct the salient portion of the scale from the secondary ordering source, and derive the extreme portion of the scale on the basis of primary ordering source. Specifically, the extended scale $S_{c,w}^+$ consists of a salient portion $S_{c,w}$, and an extreme portion. $S_{c,w}$ and $S_{c,w}^+$ are defined as (2.35) and (2.36) respectively.

$$(2.35) \ S_{c,w} \text{ is only defined if } f(o_2(w)) \text{ is defined, for every worlds } w. \text{ When defined,}$$

$$S_{c,w} = \langle D_w, \leq \rangle: D_w = \{ \{p: \text{Best}(m(w), o_1(w)), o' \leq p\} : o' \in f(o_2(w)) \}$$

$$\leq = \{ (d_1, d_2) : d_1, d_2 \in D \land d_1 \supseteq d_2 \}$$

$$(2.36) \ S_{c,w}^+ \text{ is only defined if } f(o_1(w)) \text{ and } S_{c,w} \text{ are defined, for every worlds } w.$$  

When defined,

$$S_{c,w}^+ = \langle D_w^+, \leq^+ \rangle: D_w^+ = D_w \cup \{ \{p: \text{Best}(m(w), o') \leq p\} : o' \in f(o_1(w)) \}$$

$$\leq^+ = \{ (d_1, d_2) : d_1, d_2 \in D^+ \land d_1 \supseteq d_2 \}$$

(Portner & Rubinstein 2014, (42-43))

The primary and secondary ordering sources are represented by $o_1$ and $o_2$. The function $f$ returns a set of non-empty subsets of the ordering sources. Each subset of $o_2(w)$ defines a
degree of necessity. The propositions that make the same set of priorities true will be of the same degree of necessity. The derived degrees are then ordered by superset relation. The last piece of the analysis is to associate a measure function with the scale of necessity defined above:

\[
\mu_\Sigma(p, w) \text{ is the highest degree } d \text{ in } D_w^+ \text{ such that } p \in d.
\]

\[\text{a. } \llbracket \text{should} \rrbracket^c = \lambda p \lambda w: \mu_\Sigma(p, w) \in D_w. \mu_\Sigma(p, w)\]

\[\text{b. } \llbracket \text{must} \rrbracket^c = \lambda p \lambda w: \mu_\Sigma(p, w) \in (D_w^+ - D_w). \mu_\Sigma(p, w)\]

(2.37) Measure function: For any proposition p, world w, and necessity scale \(\Sigma\),

\[
\mu_\Sigma(p, w) \text{ is the highest degree } d \text{ in } D_w^+ \text{ such that } p \in d.
\]

a. \(\llbracket \text{should} \rrbracket^c = \lambda p \lambda w: \mu_\Sigma(p, w) \in D_w. \mu_\Sigma(p, w)\)

b. \(\llbracket \text{must} \rrbracket^c = \lambda p \lambda w: \mu_\Sigma(p, w) \in (D_w^+ - D_w). \mu_\Sigma(p, w)\)

(Portner & Rubinstein 2014, (44))

The advantage of this hybrid approach to modality is that it keeps the explanatory power of the standard theory, and at the same time is able to provide a unified account of the patterns found in modal expressions and gradable expressions in other categories. It will be interesting to see how the analysis applies to the adjectival epistemic modals (possible, likely, probable, certain) studied by Lassiter. In particular, the ideas will help to determine whether certain shares the same probability scale with likely and probable as an extreme expression.

2.3 Useful Ideas from Dynamic View of Meaning

The previous section reviewed the scalar semantics and the analyses of modality proposed within the framework. This section introduces several notions and ideas from theories that share dynamic view of meaning. In §2.3.1, the concept of common ground (Stalnaker 1974, 1978, 1984) and To-Do List Function (Portner 2004) are introduced. Then, in §2.3.1, I review two works that seek to implant ideas from dynamic semantics in
static framework (Yalcın 2007, Anand & Hacquard 2013). All these theoretical devices will be used in crafting explanations for E-CM’s.

2.3.1 Common Ground and To-Do List

Stalnaker (1978) proposed the concept of **common ground** (CG) in order to give a dynamic analysis for the speech act of **assertion**. CG is the set of propositions all participants of the conversation pragmatically presuppose. Note that pragmatic presuppositions do not have to be beliefs.

A proposition can be modeled as a set of possible worlds. Intersecting propositions in the common ground renders the set of worlds \( \cap \text{CG} \) which is labeled as **context set** (cs). With the notion of cs, the dynamic meaning of a proposition then can be viewed as its context change potential, which updates cs to a new context set cs’.

Assertion is analyzed as the act of adding the asserted proposition into CG, and thusly shrinks cs. The basic context change potential of declaratives is assertion. However, sentences come in other clause-types (interrogative, imperative, exclamative, etc.) as well, and the context change potential of non-declaratives is obviously not the same as declaratives. The notion of To-Do List Function (Portner 2004) is introduced to capture the sentential force of the imperative clause type. Portner defines To-Do List Function (TDL) as a function from individuals to sets of properties. In imperative sentence updates the context by adding the property it denotes to the addressee’s TDL.

Portner also argues that CG and TDL are tightly integrated. CG can be related to the modal base, and TDL to the ordering source in Kratzer’s framework of modal semantics. CG corresponds to the agent’s beliefs, and TDL to the agent’s desires, except that CG and TDL are public to all conversation participants. The pragmatics of imperatives can be
formally described implementing the two concepts. TDL can be used to define a partial
ordering on the cs (=\(\cap\)CG) worlds, which is then used as a background to define rational
actions.

(2.38) **Partial Ordering of Worlds**

For any \(w_1, w_2 \in \bigcap\)CG, \(w_1 \prec_i w_2\) iff 
\[
\exists P \in \text{TDL}(i): (P(w_2)(i) = 1 \land P(w_1)(i) = 0)
\]
\[
\land (\forall Q \in \text{TDL}(i): (Q(w_1)(i) = 1 \rightarrow Q(w_2)(i) = 1))
\]

(Following from Portner 2004, (12))

(2.39) **Agent’s commitment**

For any agent \(i\), the participants in the conversation mutually agree to
dee\(n\) \(i\)’s actions rational and cooperative to the extent that those actions in
any world \(w_1 \in \bigcap\)CG tend to make it more likely that there is no \(w_2 \in \bigcap\)CG such that \(w_1 \prec_i w_2\).

(Portner 2004, (13))

According to (2.38-2.39), the addressee is judged as rational if she seeks to make as many
properties in her TDL updated by the imperative utterance true. This is the pragmatic
interpretation of imperatives.

Many of the verbs that express a particular attitude of the agent denotes discourse
move events that attempt to update the context in certain ways (§3.3.2). I analyze the
semantics of these verbs in terms of the interaction of CG and TDL.

2.3.2 **Static Dynamic Semantics**

2.3.2.1 **Epistemic Contradictions and Domain Semantics for Epistemic Modals**

Yalcin (2007) develops an analysis what he dubbed as domain semantics for epistemic
modal *might*. Portner (2009) calls this approach “static dynamic semantics”. It is static in
the sense that the sentence containing an epistemic modal has truth conditions. It is
dynamic, because it adopts the idea that the dynamic meaning of $\Diamond \phi$ is to check whether $\phi$ is compatible with current information state $s$.

The linguistic facts that motivate this hybrid analysis is what Yalcin calls *epistemic contradictions*, the defective conjunctions like (2.40a-b). Epistemic contradictions are not only defective in root environments, but also in embedded contexts. In Yalcin’s term, they are even not “supposable” (see (2.41)):

(2.40) #a. It is raining and it might not be raining. $\phi \land \Diamond \neg \phi$

#b. It is not raining and it might be raining. $\neg \phi \land \Diamond \phi$

(Yalcin 2007, (1), (3))

(2.41) #a. Suppose it is raining and it might not be raining.

#b. Suppose it is not raining and it might be raining.

(Yalcin 2007, (7), (8))

The patterns above lead to the analysis of epistemic modals formalized as (2.42).

(2.42) $\llbracket \Diamond \phi \rrbracket_{s,w}^{c,s,w}$ if true iff $\exists w' \in s: \llbracket \phi \rrbracket_{s,w'}^{c,s,w'}$

($s$ is the information state; an epistemic modal is interpreted relative to $s$)

With (2.42), (2.40) is accounted for as follows: *It is raining* is asserted, so the speaker knows that it is raining. Therefore, by the time of uttering *it might not be raining*, the information state $s$ is such that it is raining in all worlds in $s$. Hence, it is contradictory to assert some worlds in $s$ are non-raining worlds.

To account for the unacceptability of epistemic contradictions in embedded contexts (i.e. examples like (2.41)), a machinery of domain shifting is proposed. Take (2.43) for illustration:
(2.43) a. \[ [x \text{ suppose } \phi]^c,S,w \text{ if true iff } \forall w' \in S^w_x: [\phi]^c,S^w_x,w' \]

b. \[ [x \text{ suppose might } \phi]^c,S,w \text{ if true iff } \forall w' \in S^w_x: [\text{might } \phi]^c,S^w_x,w' \]

\[ = \forall w' \in S^w_x: \exists w'' \in S^w_x: [\phi]^c,S^w_x,w'' \]

\[ = \exists w'' \in S^w_x: [\phi]^c,S^w_x,w'' \]

\((S^w_x \text{ are defined as the set of worlds not excluded by what } x \text{ supposes in } w)\)

(Yalcin 2007, (7), (8))

When \(\Diamond \phi\) is in a complement clause, it checks whether \(\phi\) is compatible with the information state shifted by the matrix verb. In (2.45), \(s\) is shifted by \(S^w_x\), the worlds that are compatible with what \(x\) supposes in \(w\). The consequence of domain shifting is that the two quantifiers over possible worlds share the same domain. As a result, the verb ended up contributing a vacuous layer of universal force, and the whole sentence appears to contain only one modal operator -- the dual of the matrix verb. Schematically, the embedding verb (\(\Box\)) and the epistemic modal (\(\Diamond\)) interact as follows: \(\Box \Diamond \phi \leftrightarrow \Diamond \phi\) (Yalcin 2007, p997).

Applying the semantics in (2.43) to (2.40a), when \textit{Suppose it is raining} is asserted, the information state \(S^w_x\) is such that it is raining in all worlds in \(S^w_x\). Then, \textit{It might be not raining} is interpreted relative to \(S^w_x\). As the derivation in (2.44) below shows, for the sentence to be true, some worlds in \(S^w_x\) have to be not-raining worlds. However, all worlds in \(S^w_x\) are raining worlds, so the contradiction arises.

(2.44) \[ [\text{Suppose it might not be raining } ]^c,S,w \text{ if true iff } \]

\[ \forall w' \in S^w_x: [\text{might (it not be raining)} ]^c,S^w_x,w' \]

\[ = \forall w' \in S^w_x: \exists w'' \in S^w_x: [\text{it is not raining} ]^c,S^w_x,w'' \]
Yalcin’s theory predicts that if a necessity epistemic modal will be in concord with *suppose*. See the derivation below:

\[
\exists w'' \in S^w_x: [\text{it is not raining}]^{c, S^w_x, w''}
\]

\[
(S^w_x = \text{the set of worlds compatible with what the addressee } x \text{ supposes in } w.)
\]

As (2.45) shows, the truth conditions of “*x suppose must φ*” are the same as that of “*x suppose φ*” (2.42)). *Must* under *suppose* is indeed in concord the matrix verb following the definition of modal concord. This example suggests that domain shifting has the potential to account for some patterns I aim to explain in this dissertation. As §5.3 will present, I adopt the idea of domain shifting to account the subtype of concord modals that I label as Real E-CM’s.

### 2.3.2.2 Epistemic Modals in Attitude Contexts

Anand & Hacquard (2013) implemented Yalcin’s domain semantics to account for the distribution patterns of epistemic modals in the complements of attitude verbs. The core pattern they seek to explain is that some verbs such as *hope* and *doubt* license possibility epistemic modals but not necessity epistemecics:

\[
\text{(2.46) a. John hopes that Mary } *\text{must/might be the murderer.}
\]

\[
\text{b. John doubts that Mary } *\text{must/might be the murderer.}
\]
Their solution to the puzzle consists of the following components: (i) representationality hypothesis; (ii) domain semantics of epistemic modals; (iii) hybrid analysis of the attitudes. Let us look at these ideas one by one.

The representationality hypothesis says that epistemic modals track whether the embedding attitude is representational, i.e. describes an information state, a set of consistent propositions. If an attitude accepts an epistemic modal in its complement, then it describes an information state. Otherwise, it lacks one. This hypothesis predicts that hope is associated with an information state. However, it does not explain why the necessity epistemic is not licensed.

The unacceptability of must under hope is derived from the contradiction between the uncertainty presupposition and doxastic assertion expressed by hope. Specifically, hope is analyzed as follows:

\[(2.47) \left[ a \text{ hopes}_c \text{ that } \phi \right]^{c,w,S,i} \text{ is defined iff} \]

- \(\phi\)-verifiers in \(S' \neq \emptyset\) \& \(\phi\)-falsifiers in \(S' \neq \emptyset\). Uncertainty condition
- If defined = 1 iff
- \(\exists w' \in S': [[\phi]]^{c,w',S',i} = 1 \) \& Doxastic assertion
- \(\phi\)-verifiers \(\geq_{DES_{a,w}} \phi\)-falsifiers Preference assertion

where \(S' = Dox_{a,w}; \phi = Mod \ p \ or \ p, p \text{ is not modalized}; \) and \(\phi\)-verifiers in

\(S' = S'' \wedge S''' \subseteq S''[[p]]^{c,w',S'',i} = 1\] = \(\text{pow}(S' \cap p)\)

\(\phi\)-falsifiers in \(S' = \neg \phi\)-verifiers in \(S' = \text{pow}(S' \cap \neg p)\)

Hope presupposes that the attitude holder is uncertain about the truth or falsity of the complement, and asserts that the complement is compatible with the attitude holder’s
beliefs in the evaluation world. In the meantime, hope compares the complement to its negation, and asserts that the positive form is more preferable.

The crucial idea in describing the definedness condition in (2.47) is evaluating the complement, regardless of whether it is modalized or non-modalized, against the information state determined by the embedding attitude. Verifier, falsifier and certainty are notions from dynamic semantics, in which modalized propositions are evaluated relative to information states, as (2.48) shows:

\[(2.48)\]

a. \(\phi\) is non-modalized: \([\phi]^{S'} = 1\) iff \(\forall w' \in S': [\phi]^{w'} = 1\)

b. \(\phi = \text{might } p\): \([\phi]^{S'} = 1\) iff \(\exists w' \in S': [p]^{w'} = 1\)

c. \(\phi = \text{must } p\): \([\phi]^{S'} = 1\) iff \(\forall w' \in S': [p]^{w'} = 1\)

An information state \(S\) is a \(\phi\)-verifier if and only if \(\phi\) is true in \(S\), and \(S\) is certain about \(\phi\): the truth value of \(\phi\) does not vary across subsets of \(S\). In contrast, \(S\) is a \(\phi\)-falsifier, if and only if \(\phi\) is false relative to \(S\) and certain in \(S\). For example:

\[(2.49)\]

Suppose: information state \(S = \{w_1, w_2, w_3, w_4\}\);

\(p\) is true in \(w_1, w_2\), and false in \(w_3, w_4\);

\(S_1 = \{w_1, w_2\}, S_2 = \{w_3, w_4\}, S_3 = \{w_1, w_4\}\).

In \(S_1\): \(p\) is true and certain; \(\text{might } p\) is true and certain; \(\text{must } p\) is true and certain

In \(S_2\): \(p\) is false and certain; \(\text{might } p\) is false and certain; \(\text{must } p\) is false and certain

In \(S_3\): \(p\) is false and uncertain; \(\text{might } p\) is true and uncertain; \(\text{must } p\) is false and uncertain

\(S_1\) is a verifier of \(p, \text{might } p\) and \(\text{must } p\); \(S_2\) is a falsifier of \(p, \text{might } p\) and \(\text{must } p\)
According to the definitions above, we may infer that no matter the complement of hope is of the form \( p, \) might \( p \) or must \( p \), the presupposition of hope is the same: in the attitude holder’s information state \( S' \), there are both \( p \)-verifiers and \( p \)-falsifiers. Formulate it in world-relative terms, \( \exists w' \in S': [p]^{w'S'}=1 \land \exists w' \in S': [p]^{w'S'}=0. \) However, suppose the complement \( \phi = \text{must } p \), the sentence will make the doxastic assertion as (2.50), which says all worlds in \( S' \) are \( p \) worlds (note that the domain of must is shifted by \( S' \)). This result conflicts with the definedness condition of the sentence, and thus must is not accepted under hope.

(2.50) \( \lbrack a \text{ hopes } c \text{ that must } \rbrack^{c,w,S,g} = \text{iff} \)
\[ \exists w' \in S': [p]^{c,w',S',g}=1 \land \exists w' \in S': [p]^{c,w',S',g}=0. \] If defined,
\[ \exists w' \in S': \forall w'' \in S': [p]^{c,w'',S',g}=1, \text{ iff} \]
\[ \forall w'' \in S': [p]^{c,w'',S',g}=1 \]

What is innovative about Anand & Haquard’s (2013) work is that it brings in the notion of verifier and falsifier to describe the uncertainty presupposed by particular attitudes. The definition of \((\text{Mod } p)\)-verifier/falsifier implements the dynamic meaning of epistemic modals: a possibility epistemic modal checks whether an information state is compatible with the prejacent; and the necessity epistemic modal tests whether the information state already contains the prejacent. I borrow these notions in my analysis of epistemic \( E \)-CM’s, and also try to extend their use to priority modals. The idea is this: in analogous to epistemic modals performs tests on information states, priority modals test whether the prejacent is permitted/required relative to the favored-worlds set given to the contextually salient priorities.
2.4 New Approaches to Attitudes

In this section I review two alternative approaches of the standard Hitikkan analysis of attitude predicates. One is the comparative semantics for \textit{want} proposed by Heim (1992), inspired by Stalnaker (1984), and later improvements of the analysis by Villalta (2008). The other theory reviewed in this section is the neo-Davidsonian treatment of attitude verbs proposed by Kratzer (2006, 2013).

2.4.1 Comparison of Alternatives

The idea that predicates of desires involve comparison of alternatives is due to Stalnaker (1984). He described the attitude of wanting something as “preferring it to certain relevant alternatives, the alternatives being those possibilities the agent believes will be realized if he does not get what he wants.” (Stalnaker 1984, p89). Heim (1992) took this analysis and proposed a conditional comparative semantics for desire verbs. The semantics is comparative, because it compares the relevant alternatives; it is conditional, because the alternatives are conditional: “if one gets what he wants” vs. “if one does not get what he wants”.

The semantics for conditionals proposed by Stalnaker (1968) and Lewis (1973) was used as a building block for the semantics of \textit{want}. According to their analysis, a conditional \textit{if} $\phi$, then $\psi$ is true in $w$ if and only if $\psi$ is true in all the $\phi$-worlds that are most similar to $w$.

\begin{align*}
(2.51) & \quad \text{a. } w \in \llbracket \text{if } \phi, \psi \rrbracket \iff \text{Sim}_w(\llbracket \phi \rrbracket) \subseteq \llbracket \psi \rrbracket \\
& \quad \text{b. } \text{Sim}_w(p) = \\
& \quad \{w' \in W : w' \in p \text{ and } w' \text{ resembles } w \text{ no less than any other worlds in } p\}.
\end{align*}

(Heim 1992, p195, (34-35))
The semantics of *want* formulated in static semantics (Heim (1992) employs a Context Change Semantics framework) is like (2.52). The $<_{a,w}$ relation orders worlds according to the individual $a$’s desires in $w$. A proposition $p$ is more desirable than the other proposition $q$ if and only all $p$-worlds are ranked higher than $q$-worlds by $<_{a,w}$.

(2.52) a. $\left[ a \text{ want } \phi \right] = 1$ iff

$$\forall w' \in \text{Dox}_a(w): \text{Sim}_{w'}(\text{Dox}_a(w) \cap \phi) <_{a,w} \text{Sim}_{w'}(\text{Dox}_a(w) \cap \neg \phi)$$

(Following from Heim 1992, p197, (39))

b. For any $w, w', w'' \in W$,

$$w' <_{a,w} w'' \text{ iff } w' \text{ is more desirable to } a \text{ in } w \text{ than } w''.$$  

c. For any $w \in W, X \subseteq W, Y \subseteq W$,

$$X <_{a,w} Y \text{ iff } w' w' <_{a,w} w'' \text{ for all } w' \in X, w'' \in Y.$$  

(Heim 1992, p197)

As we can see from (2.52a), Heim’s analysis for *want* restricts the comparison of worlds within the doxastic alternatives of $a$ in the evaluative world $w$. This connection between desires and beliefs is motivated by examples such as (2.53):

(2.53) a. Patrick is under the misconception that he owns a cello, and he wants to sell his cello.

b. I want to teach Tuesdays and Thursdays next semester.

(Heim 1992, (2), (33))

Suppose comparison of desirability is not limited to doxastic worlds. In a world not doxastically accessible, because Patrick does not have a cello in it, the proposition *Patrick wants to sell his cello* is trivially false. However, (2.53a) is true, so it seems that
comparison does not go beyond the doxatically accessible worlds. Similarly, (2.53b) is usually judged as true, even if the most desirable alternative is I do not teach at all next semester. Asserting (2.53b) presupposes that the speaker believes that she has to teach. The truth of the sentence is explainable if we assume that only the doxastically accessible worlds are compared for desirability.

Heim’s analysis of want is the first elaborated one in formal semantics literature. It is characterized by comparison of conditional alternatives, and restriction of desirability comparison within doxastically accessible worlds. The first idea remained being an important ingredient in the relevant studies coming after Heim’s work, while the second idea was criticized and discarded by researchers.

Next let us turn to Villalta’s (2008) criticism of Heim’s theory, and the solution for the problem she pointed out. Villalta’s analysis of desire verbs diverts from Heim in two aspects. Firstly, she unties the close connection between beliefs and desires in Heim’s conditional comparative semantics. Secondly, she proposed the comparison is not between the complement and its negation, but the alternative set generated by focus.

The first revision mentioned above is motivated by examples like (2.54):

(2.54) a. I want to teach Tuesdays and Thursdays next semester.

    b. I believe that I will teach Tuesdays and Thursdays next semester if and only if I work hard now.

    c. Invalid inference: I want to work hard now.

Heim’s analysis in (2.52) predicts that if one believes that two propositions \( p \) and \( q \) are true in exactly same set of worlds, they should be equally desirable. Thus given (2.54a-b), (2.54c) should be inferred as true. Yet, this inference is invalid. One can believe \( p \) and \( q \)
are equivalent, but want \( p \) without wanting \( q \) or vise versa. Villalta’s solution to this problem is to let beliefs restrict the alternatives in the presuppositions, but not in the comparison. See (2.55):

\[
(2.55) \ [want_c]_\theta(p)(a)(w) \text{ is defined iff } \forall q \in g(C): \text{Dox}_a(w) \cap q \neq \emptyset
\]

If defined \( [want_c]_\theta(p)(a)(w) = 1 \) iff

\[
\forall q: q \neq p \& q \in g(C): p >_{DES_{a,w}} q
\]

where \( <_{DES_{a,w}} \) is defined as follows:

a) For any \( w, w', w'' \in W, w <_{a,w} w' \text{ iff } w' \text{ is more desirable to } a \text{ in } w \text{ than } w'' \)

b) For any \( p \subseteq W, q \subseteq W, p <_{DES_{a,w}} q \text{ iff } \forall w'' \in q \exists w' \in p \text{ such that} \)

\[
w' <_{a,w} w'', \text{ and it is not the case that } \forall w'' \in q \exists w' \in p \text{ such that} \]

\[
w'' <_{a,w} w'
\]

(Villalta 2008, (32))

Because in the desirability comparison, the alternatives are not limited to doxastically accessible worlds, the invalid inference is not generated: Although in my belief alternatives, the worlds in which \( p = I \text{ teach on Tuesday and Thursday next semester} \) coincide with the worlds in which \( q = I \text{ work hard now} \), \( p \) and \( q \) are compared to each other without intersecting with the attitude holder’s doxastic alternatives. Thus, it is possible for me to want \( p \), but at the same time, do not want \( q \). (2.55) also differs from (2.52) in that \( p \) is compared to multiple alternatives. Rubinstein (2012) refuted the usefulness of multiple alternatives, but I will not get into the details of her argument.

The main aim of Villalta’s (2008) work is to explain mood selection in Spanish. She extended the analysis in (2.55) to other attitude predicates that choose subjunctive mood.
Villalta also took an important step in providing compositional, scalar semantics for these verbs. In Chapter 5, I implement comparative analysis for conjecture verbs and emotives.

2.4.2 Decomposing Attitude Verbs

Kratzer (2006, 2013) proposed a new theory of how the attitude combines with its complement. The theory consists of two proposals. One is that attitude verbs denote events, rather than quantifications over alternative worlds. The other is that the head of the embedded clause carries the modality. In other words, attitude verbs are decomposed; they still carry the eventuality, but the modality is now assigned to different heads of complement clause. Take believe for example. According to the 2013 version, believe takes two arguments; an eventuality argument s (stands for situation), and a content argument p that refers to the content of the belief. The embedded sentence is headed by a modal feature [say], which expresses content modality.

(2.56) a. Ralph believes [say] Ortcutt is a traitor

\[ \text{b. } [[\text{believe}]] = \lambda p \lambda s. (\text{believe} (s) \land p(s)) \]

\[ \text{c. } p = [[\text{say} \text{Ortcutt is a traitor}]] \]

\[ = \lambda s \ \forall w: (w \in f_{\text{content}}(s) \land c \rightarrow \exists s'(s' \leq w \land \text{traitor}(\text{Ortcutt})(s'))) \]

\[ (f_{\text{content}} \text{ maps situations that determine intentional content to the set of possible worlds that are compatible with that content.}) \]

\[ \text{d. } [[(1a)]] = \exists s(\text{blieve}(s)) \land \forall w (w \in f_{\text{content}}(s) \land c \rightarrow \exists s'(s' \leq w \land \text{traitor}(\text{Ortcutt})(s'))) \]

\[ (\text{Following from Kratzer 2013, p}42-43) \]

Decomposing the attitudes makes it possible to provide a unified treatment of the various semantic relations between an attitude head and its complement. For example:
(2.57) a. Lucy’s belief was that there are ghosts.

b. *John’s anger was that he was not chosen.

Kratzer (2006) argues that the contrast in (2.57) arises because the complementizer *that* expresses different modality in the two sentences. *Anger*, but not *belief*, requires a factive complementizer *that*, which is amount to *the fact that*. Also, Kratzer (2013) claims that subjunctive mood, covert modality in infinitives, “harmonic modals” (amount to Real E-CM’s in my definition), and null modal features heading subordinate clauses (e.g. (2.56a)) should all be treated as kin of *that*.

As the modality is attributed to the head of complementizer, the attitude verbs now receive a standard neo-Davidsonian semantics. As a consequence, the embedded proposition is evaluated in a situation rather than a world. This modification of the classical Kratzerian theory is due to Hacquard (2006; for a concise introduction, see the author’s 2011 article), which was motivated to explain the close correlation between the interaction of modals with tense and with individuals. In Chapter 5, I adopt event-relative analysis for verbs that denote discourse moves.

In spite of the innovative ideas introduced above, Kratzer’s decomposing analysis is not fundamentally different from Hintikka’s analysis of attitude ascriptions: the different modal heads still uniformly contribute universal quantification over alternative worlds. If the modal feature separated from the verb is allowed to have other quantificational forces, the neo-Davidsonian-style could be more expressive than Hintikkan semantics, and thusly has more room to add other machineries to account for more linguistic facts. In this dissertation, I take the decomposing approach as secondary option for describing the
semantics of attitude verbs. As will be seen in §5.3.2.3, I argue that verbs represented by piping ‘criticize’ should be treated as event denoting predicates.

2.5 Summary

The account I adopt for modal expressions is Kratzer’s premise semantics. To pair with it, I assume Hintikkan semantics for attitude verbs unless a more elaborated analysis is provided. However, in fact, as presented in Chapter 5, many attitudes require a more sophisticated lexical semantics in order to explain the behaviors they exhibit. In general, both modals and attitude verbs are treated as quantifiers over a set of accessible worlds (exceptions exist; see §5.3.2.3).

At this point I adopt two elaborations of Kratzer’s framework from the literature. One is Rubinstein’s analysis of weak necessity modals, and the other is Yalcin’s account of epistemic modals as anaphoric elements. Thus, I assume weak necessity modals have universal force, and epistemics in the complement of attitude verbs retrieve the quantificational domain in an anaphoric manner from the embedding attitude.

For the semantics of attitude verbs, there are two proposals that I accept as more specific than the standard Hintikkan analysis. The first is that desiderative predicates, and potentially other predicates which select for subjunctive mood, have a semantics that calls for comparison of alternatives (Villalta 2008). The second proposal is that some attitudes may have a hybrid semantics that consists of both a representative assertion and comparison of alternatives (Anand & Hacquard 2013). I also borrow the concept of verifier/falsifier from the information state-relative semantics. The decomposing approach to attitude verbs (Kratzer 2013) is considered as a possible option. Some verbs may favor a neo-Davidsonian analysis.
Complex modal expressions with degree modifications probably need a scalar analysis, but the apparatus is not implemented in my analyses presented in Chapter 5. This is mainly because the data at issue are limited to simple modal expressions.
CHAPTER 3

BACKGROUND ON ATTITUDE VERBS, MODALS, AND MODAL-UNDER-ATTITUDE CONSTRUCTIONS IN MANDARIN

3.0 Overview

This chapter sets up the background needed for the discussions of E-CM’s in the following chapters. I first outline the theoretical issues concerning embedded modals in general that are relevant to the main topic of this dissertation. Then I introduce the Mandarin attitude verbs and modal expressions selected for this study, and describe the compatibility between an attitude and different modals in their complements.

This chapter utilizes corpus-based methodologies as it addresses several subtopics. The subtopics include (i) the range of modality types associated with each of the selected modal expressions; (ii) the (semi)-automatic retrieval of attitude verbs; (iii) the distribution of senses of ambiguous attitude verbs; and lastly, (iv) the process of collecting corpus evidence of attitude-modal combinations to supplement native speaker judgments.

The rest of this chapter is organized as follows: Section 3.1 briefly summarizes previous literature on embeddibility of epistemic modals, and on special properties of embedded root modals. Section 3.2 introduces the eight modal expressions chosen for this study, and section 3.3 describes the procedure that I used to obtain the list of selected attitude verbs and how they were classified. Then in section 3.4, I discuss the distribution of selected modals in the complement of various attitude verbs.
3.1 Issues on Embedded Modality

3.1.1 Embeddability of Epistemic Modals

Among the studies of embeddability of modals, the embeddability of epistemic modals is the most well-studied subtopic. The impression that epistemic modals cannot be embedded is given as evidence supporting the view that epistemic modals do not contribute to truth conditions (Lyons 1977, Papafragou 2006). The argument is as follows: a subjective epistemic modal is odd when embedded in certain contexts (e.g. *If Alex will possibly go to the party, I will not come. I regret that Alex will possibly go to the party*).

In the non-truth-conditional view, subjective epistemics do not contribute to ordinary, truth conditional meaning, and the sentence containing such a modal does not have truth conditions. Consequently, the resulting sentence cannot appear in a context where the semantics requires a constituent with truth conditions. Thus, the limitation on embedding epistemic modals is explained.

For the argument above to be valid, it is crucial that epistemics do not appear in any context that calls for a constituent with truth conditions. This is an empirical question, and counterexamples are not hard to think of. Consider (3.1) from Portner (2009, §4.2.1):

(3.1) a. Mary believes that Max must be lonely.

b. There can’t have been a mistake. (negation scopes over modal)

Examples of this kind argue against the non-truth conditional view of epistemic modals.

Hacquard & Wellwood (2012) addresses the issue of embeddability of epistemic modals through a corpus study of English. The authors take the *New York Times* section of the English Gigaword Corpus, which consists of over 15 million sentences, as their data set. The sentences containing *might, can, must* and *have to* are annotated for modal
flavor (epistemic vs. root). The annotation results reveal that epistemic modals can be embedded in various contexts, although their distribution is indeed restricted compared to other modal types. The study confirms that epistemics are rare in if-clauses, not found in complements of certain attitude verbs (desiderative and directive, to be specific), and seldom appear in questions. It also discovered that the distribution of epistemic necessity and possibility is asymmetric. Specifically, must is absent in the complement of some emotives (fear, glad, etc.), while might is relatively frequent in the same contexts. These findings also motivate a different line of inquiry, which seeks to account for the distribution of epistemic modals in different attitude contexts, in particular, the modal force asymmetry -- the phenomenon that in some contexts, epistemic modals of existential force are allowed, but necessity epistemics are not.

Anand & Hacquard (2013) addresses the puzzles concerning the distribution of epistemic modals in attitude contexts. The article first reports the experiments carried out to determine the acceptability of epistemic modals under attitude predicates in three Romance languages (Spanish, French and Italian). The results of the experiments confirm the patterns found in English. But the authors also argue that there are “escape hatches” that make epistemic modals acceptable in environments where they are usually not licensed. According to the authors, usually an epistemic modal is relativized to the knowledge of the attitude holder (the matrix subject). But in some scenarios, an epistemic modal can escape this restriction, and be interpreted relative to a non-attitude holder perspective. Take (3.2), their (22), for example:

(3.2) Jean veut que Marie doive avoir connu son tueur.

Jean wants that Marie must-SUBJ have known her killer
‘Jean wants that in the world of the mystery novel Marie must have known her killer.’

Sentence (3.2) is acceptable, although it contains a necessity epistemic doive ‘must-SUBJ’ in the complement of a desiderative verb. In this sentence, the modal base of doive is the content of the novel, as the translation of the sentence shows. In the case of (3.2), the escape hatch reading is the only felicitous interpretation. However, in some attitude contexts, both ordinary and escape hatch reading are available for the embedded epistemic modal. Consider the “filing cabinet” scenario in Kratzer (2009):

Scenario: Nobody among us has had access to the information in this filing cabinet, but we know that it contains the complete evidence (including possibly forged evidence) about the murder of Philip Boyes and narrows down the set of suspects. We are betting on who might have killed Boyes according to the information in the filing cabinet. Harriet, who is innocent, says: I think I might have killed him.

(Kratzer 2009, p33)

In the scenario above, might is relativized to the filing cabinet’s information, rather than the attitude holder Harriet’s knowledge. Kratzer thus points out that the domain of the embedded epistemic is usually but not always provided by the attitude upstairs. In my discussions on epistemic-under-attitude constructions, I exclude the escape hatch reading.

In this dissertation, I do not intend to join the debate on whether epistemic modals contribute to truth conditions. My investigation of embedded concord modals assumes that all modals normally contribute to truth conditions, but can appear to lose their force in certain environments. In addition, my interest is not limited to whether modal types are acceptable across different attitude contexts, but also extends to how the embedded modal is actually interpreted.
3.1.2 Embedded Circumstantial Modals

To the best of my knowledge, there is not any study particularly dedicated to the embeddability of circumstantial or root modals. This is understandable, since the distribution of circumstantial modals is not noticeably restricted like that of epistemic modals. However, there are studies concerning circumstantial modals in embedded environments. Here I mention two of them that are in some way related to the theme of this dissertation. One study concerns the performativity of embedded deontic modals, and the other has to do with the actuality entailment of ability modals under perfective aspect.

3.1.2.1 Stripped-off Performativity

Ninan (2005) argues that the priority must has imperative-like meaning (also labeled as performativity; refer to Portner 2009, sect. 4.3.3) in root sentences. Consider (3.3).

(3.3) #Sam must go to confession, but he is not going to. (Ninan 2005, (4))

The discourse in (3.3) is infelicitous. According to Ninan, this is so because in addition to asserting that Sam is under the obligation to go to confession, the first conjunct of (3.3) also calls for action from the addressee to make Sam go to confession. In other words, the first conjunct of (3.3) has an imperative-like effect, while its continuation is simply assertive. So (3.3) is odd for the same reason as “Make Sam go to confession, but Sam is not going to” is a infelicitous discourse.

However, the imperative-like meaning of must is not available for some embedded occurrences (Ninan 2005). Take (3.4) for example:

(3.4) Sam believes that he must go to confession. (Ninan 2005, (26))
The imperative-like feature is “stripped off” when must occurs in the complement of believe. Sentence (3.4) does not put the addressee (or put Sam) under the obligation of making Sam go to confess.

In view of data like (3.4), a question worthwhile asking is whether the performativity property associated with deontic must is preserved when the modal is in concord with the embedding verb. For example, is must in (3.5a) performative?

(3.5) a. Mom demands that Sam must go to confession.

b. Mom believes that Sam must go to confession.

c. But he is not going to do it.

The answer seems to be “no”. Sentence (3.5a) may have a conversational implicature that asks the address to make Sam go to confession, but (3.5b) may have the same implicature as well. In addition, the at-issue meaning of (3.5a) is to report what Sam’s mother requires him to do, and thus can be continued by (3.5c). Therefore, the embedded concord modal must is not performative. The data suggest that concord cannot “rescue” the performativity of must when it is embedded in an attitude context.

3.1.2.2 Actuality Entailment

Another phenomenon concerning embedded circumstantial modal is the actuality entailment of root modals in the scope of perfective aspect (Bhatt 1999, Hacquard 2006). As shown by the following examples, in languages with imperfective vs. perfective distinctions, a perfective sentence with the logic form M-perf(p) entails that p.

(3.6) a. Yusuf havaii-jahaaz uṛaa sak-taa hai/thaa (lekin vo havaii-jahaaz

Yusuf air-ship fly can-impfv be.pres/be.pst but he air-ship
Under certain attitude, a proposition modified by a pure circumstantial modal implies its non-modalized counterpart. For example, “\(x \text{ hope can } p\)” seems to imply “\(x \text{ hope } p\)”.

Consider (3.7):

(3.7) a #John hopes that Mary can win the game tomorrow, but he does not hope that

Mary will actually win the game.
b. John believes that Mary can win the game tomorrow, but he doesn’t believe Mary will actually win the game.

The discourse in (3.7a) is infelicitous, because the first statement entails that John hopes Mary will in fact win, which obviously contradicts the second statement. Contrastively, the same implication is not available under believe, and (3.7b) forms a coherent discourse. The contrast above shows that the ability/circumstantial can contributes its normal meaning in the scope of believe, but seems redundant under hope.

I will discuss can-under-hope in Chapter 4, and argue that the ability/circumstantial modal under the desiderative verb is in fact not a real concord modal. This is because even though “x hope can p” does entail “x hope p”, but the latter does not entail the former. In other words, the two forms are not logically equivalent, thus can is not truly redundant.

In the next section, I turn to the Mandarin modal expressions investigated in this dissertation.

3.2 The Mandarin Modal Elements Involved in This Study

A set of eight modal expressions is selected for the study of this dissertation (see Table 3.1). These items are limited to adverbs and non-lexical verbs\(^{15}\); adjectives and special constructions are not included. These modals have been studied from theoretical perspective (Tsang 1981; Li, R. 2004; Ren 2009; Huang X.-Y. 2009; Lin 2012; etc.) and through annotation (Cui & Chi 2013). They also have relatively high frequencies, which

\(^{15}\) *Hui* ‘will; can’ is also a frequently used modal verb, which expresses ability and future. *Hui* is excluded because its future use seems to be dominant in the corpus I look at.
is important for statistical analysis. See Table 3.1 for basic frequency information of the modals.

<table>
<thead>
<tr>
<th>Modal</th>
<th>Frequency in CTB7</th>
<th>in Scope of Attitude Verb</th>
<th>% in Attitude Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>yiding</td>
<td>282</td>
<td>73</td>
<td>25.9</td>
</tr>
<tr>
<td>bixu</td>
<td>451</td>
<td>91</td>
<td>20.2</td>
</tr>
<tr>
<td>dei</td>
<td>299</td>
<td>40</td>
<td>13.4</td>
</tr>
<tr>
<td>yinggai</td>
<td>737</td>
<td>167</td>
<td>22.7</td>
</tr>
<tr>
<td>keneng</td>
<td>1150</td>
<td>244</td>
<td>21.2</td>
</tr>
<tr>
<td>nenggou</td>
<td>476</td>
<td>196</td>
<td>41.2</td>
</tr>
<tr>
<td>keyi</td>
<td>1539</td>
<td>236</td>
<td>15.3</td>
</tr>
<tr>
<td>neng</td>
<td>1642</td>
<td>353</td>
<td>21.5</td>
</tr>
</tbody>
</table>

Table 3.1: Target Modals: Absolute Frequencies & Frequencies in Attitude Contexts in CTB7

The rest of this section provides an overview of the syntactic and semantic properties of the eight words above. §3.1.1 focuses on which syntactic category each word belongs to, and §3.1.2 illustrates the variety of interpretations each modal can have. For the necessity modals, there will also be discussions of whether they express strong necessity or weak necessity.

3.2.1 Syntactic Category of Selected Modals

Researchers agree that the modal expressions in Table 3.1 fall into two syntactic categories: adverb and auxiliary verb, but disagree on which word belongs to which class. For example, Huang X.-Y. (2009) treats bixu, yinggai and keneng as adverbs and neng, nenggou, keyi as auxiliary heads, while Ren (2009) identifies all of them as auxiliaries.

The conflicts arise because different authors use different criteria to classify the syntactic categories of the modals. Huang adopted the criteria proposed in Tsai (2009), which claims that auxiliaries but not adverbs allow VP-fronting and VP-ellipsis. Consider (3.8-3.9):
(3.8) \[\text{[chuguo]}, \text{Zhangsan keyi/dei } t_i.\]

\text{go-abroad Zhangsan KEYI/DEI}

‘Zhangsan is permitted to/*have to go abroad.’

(3.9) A: \text{Zhangsan keyi/dei chuguo ma?}

\text{Zhangsan KEYI/DEI go-abroad SFP}

‘May Zhangsan/Does Zhangsan have to go abroad?’

B: \text{Keyi /* dei.}

‘(Yes, he) may/has to.’

Huang himself is not confident about these tests, however. He points out that the judgments on VP-fronting are not accepted by all speakers. Besides, he did not implement these tests thoroughly. For instance, as shown above, \text{dei} fails both VP-fronting and VP ellipsis. Nevertheless, it is still regarded as a modal auxiliary.

Ren (2009) compared different criteria used to distinguish main verbs, auxiliary verbs and adverbs in the previous literature, and concludes that the definitive properties of auxiliaries are the following five: (i) occurs with full verbs; (ii) does not take aspect markers; (iii) does not take direct object; (iv) can be negated by \text{bu} ‘not’; and (v) can form v-not-v questions. As claimed by Ren, the first three tests distinguish auxiliaries from main verbs, and the last two serve to separate them from adverbs.

Among the five properties, (i) and (iii) combined predict that auxiliaries only take an argument structurally at least as large as VP. However, this is true for some propositional attitude verbs as well (e.g. (3.10a) and (3.10b) are parallel). Moreover, as shown by (3.11), the morphological test (ii) cannot distinguish modals from attitude verbs either.

(3.10) a. \text{Zhangsan xiwang qu faguo/*faguo}
Zhangsan  hope  go  France/France

‘Zhangsan hopes to go to France./*Zhangsan hopes France.’

b.  Zhangsan  keyi  qu  faguo/*faguo

Zhangsan keyi  go  France/France

‘Zhangsan may go to France./*Zhangsan may France.’

(3.11) a.  Zhangsan  xiwang  *le/*guo/*zhe  chuguo.

Zhangsan  hope  LE/GUO/ZHE  go-abroad

‘*Zhangsan has hoped/used to hope/is hoping to go abroad.’

b.  Zhangsan  keyi  *le/*guo/*zhe  chuguo.

Zhangsan keyi  LE/GUO/ZHE  go-abroad

‘*Zhangsan has been /used to be /is being permitted to go abroad ’

So the concern is this: does the grammatical category of auxiliary verb really exist in Mandarin Chinese? Or is it simply that the modals are verbs with less idiosyncratic contents? Since it is not the focus of this dissertation to clarify the syntactic status of the modal elements, I will not further dig into this issue, and will make a simplification that the verb-like modals are indeed a subclass of verbs. As a matter of fact, some words in the list of auxiliaries identified by Ren’s tests seem to be typical attitude verb: e.g. xiangyao ‘would like to’, yuanyi ’be willing to’.

Now the problem reduces to how to distinguish verbs and adverbs. For this task, we have seen two tests in Huang’s article, namely VP fronting and VP ellipsis. There are also two negation tests proposed in Ren’s work. Among these four tests, I will eliminate VP-fronting, as it is claimed to be unreliable by Huang. Based on the rest three tests,
yiding, bixu, dei should belong to the class of adverbs (see (3.12)), while the others, for instance, neng in (3.13) should be verbs.

(3.12) A: Ta dei lai ma/*dei bu dei lai? (*V-not-V)

he ought come QM/ ought not ought come

‘Does he ought to come?’

B: * Ta dei. (*VP ellipsis)

he ought.

(3.13) A: Ni neng lai ma?/neng bu neng lai?

you can come QM can not can come

‘Can you come?’

B: Wo neng.

I can

‘I can.’

To conclude, I summarize the behavior of the chosen modal elements in Table 3.2.

Note that dei behaves more like an adverb contrary to the intuition that it seems similar to the modal verbs. I will respect the distribution, and treat dei as an adverb.

<table>
<thead>
<tr>
<th>Modal</th>
<th>Category</th>
<th>allow VP-ellipsis</th>
<th>negated by bu</th>
<th>form V-not-V</th>
</tr>
</thead>
<tbody>
<tr>
<td>yiding</td>
<td>Adverb</td>
<td>-</td>
<td>+(local negation)</td>
<td>-</td>
</tr>
<tr>
<td>bixu</td>
<td>Adverb</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>dei</td>
<td>Adverb</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>yinggai</td>
<td>Verb</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>keneng</td>
<td>Verb</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>nenggou</td>
<td>Verb</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>keyi</td>
<td>Verb</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>neng</td>
<td>Verb</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Table 3.2: Syntactic Behavior and Classification of Chosen Modal Elements
3.2.2 Semantic Properties of Selected Modals

This subsection lays out the intuitions about the flavor and strength of the chosen modal elements. I will first differentiate the possibility modals, and then tackle the necessity ones, which could be either strong or weak (refer to section §2.3.2 for theoretical background).

In my list, *keneng*, *nenggou*, *keyi*, and *neng* are possibility modals. *Keneng* is epistemic. *Nenggou* specializes in expressing pure circumstantial, particularly, ability readings. *Keyi* is associated with both priority and pure circumstantial uses. As the short form of *nenggou*, the usage of *neng* covers mainly circumstantial cases; its negation *bu neng*, however, is often understood relative to some salient priority. Consider the sentences below:

(3.14) a. *Mosike shengwuxue-jia faxian, zhiwu-xibao-mei-su keneng/nenggou

Moscow biologist discover plant cell enzyme keneng nenggou
/keyi/neng yizhi wenzi tinei nueyuanchong de fanzhi
keyi neng inhibit mosquito in body plasmodium DE reproduce

‘The biologists in Moscow discovered that the enzyme in plant cells can inhibit the reproduction of plasmodium in the body of mosquitos.’


America partisan warfare keneng nenggou keyi neng cause this Cl.

wenti gengjia fuza.

---

16 The examples used in this subsection are modified from sentences found in Penn Chinese Treebank 7.0.
problem more complicated

‘The US-owned enterprises in China generally worry that the partisan warfare of this election year might make the problem more complicated.’

c. Zai dui-wai-kaifang jin-yi-bu kuoda de xin xingshi xia, haiguan de prep. opening-up further widen DE new situation under custom DE zhineng bu #keneng/??nenggou/keyi/neng xueruo.

function not keneng nenggou keyi neng weaken

‘In the new situation of widened opening-up, the function of customs may not (should not) be weakened.’

Sentence (3.14a) reports a scientific finding about certain property of plant cells; the ability modal nenggou is used in the original text, and the intuition is that nenggou can be substituted by keyi and neng without changing the meaning of the sentence. Keneng is acceptable, but the sentence will mean “The biologists discovers that it is possible that the enzyme will inhibit the reproduction of plasmodium in the body of mosquitos”. This fact supports the view that keneng is epistemic not circumstantial. Example (3.14b) communicates the concerns of the entrepreneurs about the potential consequences of upcoming political events. Keneng is the original choice, which seems to be the only fit in this context. This example suggests that nenggou, keyi and neng probably can not express epistemic possibility. Sentence (3.14c) is concerned with what decision to make under new circumstances. The original text adopts bu neng, which invokes some goal of the government. In this context, neng can be substituted with keyi; nenggou does not sound natural in the same position; and keneng will noticeably change the meaning of the sentence. It indicates that bu neng, like keyi, is not limited to pure circumstantial usages.
Next turn to necessity modals. *Yinggai* expresses some sort of necessity, and receives either an epistemic or a priority interpretation. In the examples below, *yinggai* is interpreted as deontic in (3.15a), and epistemic in (3.15b).

\[(3.15)\]

a. *Genju xuexiao de guiding, xuesheng yinggai chuan xiaofu.*
according-to school DE regulation student yinggai wear school-uniform
‘According to the regulations of the school, students should wear uniforms.’

b. *Na ge ren chuan zhe xiaofu, ta yinggai shi xuesheng.*
that Cl person wear PROG school-uniform he yinggai be student
‘That person is wearing school uniform. He should be a student.’

To determine whether *yinggai* is strong or weak necessity, the simple approach is to compare its force to other necessity operators as the way von Fintel and Iatridou (2008) do. In von Fintel & Iatridou (2008), the authors use discourses shown in (3.16-3.17) to reveal the grades of necessity:

\[(3.16)\]

a. You ought to do the dishes, but you don’t have to.

b. #You must do the dishes, but you don’t have to.

\[(3.17)\]

a. You ought to wash your hands -- in fact, you have to.

b. ?You have to wash your hands -- in fact, you ought to.

(von Fintel & Iatridou 2008, pp117)

In this subsection, I will mainly depend on the pattern of (3.17) as a test for weak necessity, since (3.16) involves negation, and may bring about potential complications.

To mimic (3.17), let me first introduce another necessity modal *bixu*. *Bixu* mainly receives priority interpretation. Take (3.18) for example, *bixu* is teleological, making reference to the goal of “maintaining the (international) peace”.

81
(3.18) *Wei ci, bixu peiyang xin-xing anquan-guan, xunqiu weihu heping de*
for this BIXU develop new-type security-view look for maintain peace DE
*xin fangfa*
new method
‘Because of this, (we) need to develop a new view of security, and look for new ways to maintain peace.’

Now look at the implicature pattern of *yinggai* and *bixu* below:

(3.19) a. *Ni yinggai chuan xiaofu. Shishishang, ni bixu chuan.*
you YINGGAI wear school-uniform in fact, you BIXU wear
‘You should wear your school uniform. In fact, you must wear it.’

b. #*Ni bixu chuan xiaofu. Shishishang, ni yinggai chuan.*
you BIXU wear school-uniform in fact, you YINGGAI wear
#‘You must wear your school uniform. In fact, you should wear it.’

The discourses above seem to indicate that *yinggai* is weak, and *bixu* is strong.

Next consider *dei*. *Dei* centers on non-epistemic uses. Despite the fact that *dei* is often glossed as ‘have to’, evidence suggests that *dei* is weak, and is better glossed as ‘ought to’. Consider the discourses in (3.20):

(3.20) a. #*Xuesheng yinggai chuan xiaofu. Shishishang, tamen dei zheyang zuo.*
student YINGGAI wear school-uniform. in fact they DEI this-way do
#‘Students should wear their school uniforms; in fact they ought to do so.’

b. #*Xuesheng dei chuan xiaofu. Shishishang, tamen yinggai zheyang zuo.*
student DEI wear school-uniform. in fact they YINGGAI this-way do
#‘Students ought to wear their school uniforms; in fact they should do so.’
c. Xuesheng dei chuan xiaofu. Shishishang, tamen bixu zheyang zuo.

student DEI wear school-uniform. in fact they BIXU this-way do

‘Students ought to wear their school uniforms; in fact they must do so.’

d. #Xuesheng bixu chuan xiaofu. Shishishang, tamen dei zheyang zuo.

student BIXU wear school-uniform. in fact they DEI this-way do

#‘Students must wear their school uniforms; in fact they ought to do so.’

Both (3.20a) and (3.20b) are defective, suggesting that dei and yingai are similar in the dimension of strength. Contrastively, (3.20c) and (3.20d) are felicitous, and indicate that bixu is stronger than dei. To conclude, dei expresses weak necessity.

The strength of dei is also connected to the fact that dei as opposed to bixu does not have imperative-like force. Consider (3.21):

(3.21) Zongcai mingling: “gongcheng zu #dei/bixu liji pushe guangxian.”

CEO command construction team DEI/BIXU immediately lay cable

‘The CEO commanded: “the construction team #ought to/must lay the cable immediately’.

Dei and bixu are contained in a direct quote in (3.21); bixu is fully acceptable in the context, while dei is not. The contrast suggests that a sentence with the logic form bixu (p) can be interpreted as a command, but an utterance with the form dei(p) cannot.\(^\text{17}\)

---

\(^{17}\) I did not apply the tests that Ninan used to argue for the performativity of English must (quoted as (ia-ib)), because they are not quite applicable in Chinese. First, in a discourse parallel to (ib), a circumstantial reading of bixu would be forced. Besides, dei and bixu barely allow epistemic interpretation; therefore, (ii) is irrelevant.

(i) a. Sam should/ought to go to confession, but he’s not going to.
   b. #Sam must go to confession, but he’s not going to.

(ii) a. Sam should/ought to have gone to confession. (Deontic interpretation possible)
   b. Sam must have gone to confession. (Epistemic interpretation mandatory)
Another difference between *dei* and *bixu* lies in that *bixu* prefers a deontic interpretation, while *dei* is more neutral in terms of flavor. It can be priority or pure circumstantial. Sentence (3.22) is an example where *dei* has a pure circumstantial reading\(^\text{18}\):

\[(3.22)\] *An μuqian de wangluo midu, caituan dei pushe yi*

based on current DE network density financial group DEI lay one

\[wan gongli dei guangxian.\]

ten-thousand kilometer DE cable

‘Based on current network density, the financial group ought to lay ten thousand kilometers of cable.’

It is worthwhile mentioning that *dei* often co-occurs with *yiding* and *bixu*; and in those cases, the straightforward compositional reading is barred. Consider (3.23):

\[(3.23)\] a. *Chufa qian yiding dei ba ziji de GPS dai-shang, yi-fang-wanyi.*

departure before YIDING DEI BA self DE GPS bring-up just in case

‘Before departure, (you) necessarily ought to bring your GPS just in case.’

\[≠ ‘It must be the case that you ought to bring your GPS before departure…’\]

b. *Ruguo ni xiang fazhan, ni bixu dei jiang xinyong.*

if you would like to grow you BIXU DEI speak credit

‘If you want your business to grow, you mandatorily ought to keep your words.’

\[≠ ‘… it is required that you are required to keep your words.’\]

\(^{18}\) This example is annotated as *circumstantial* by both annotators in the annotation study reported in Cui & Chi (2013). Taken out of context, the sentence could have teleological-desiderative reading as well.
Lastly, let us look at *yiding*. *Yingding* is an adverb. It receives an epistemic interpretation when it combines with a non-modalized prejacent (e.g. (3.24a)\(^{19}\)). Yet more often, *yiding* co-occurs with another modal, and functions as the modifier of the co-occurring modal. For example, in (3.24b) *yiding* seems to be a degree modifier of the deontic modal *yao*, rather than an independent epistemic modal.


I think this *YIDING* be like training what *DE*

‘…I think this must be something like training.’

b. *Wo bu tichang ni yiding yao xuexi mingling hang*

I not advocate you *YIDING* should learn command line

‘I don’t advocate that you absolutely should learn command line.’

≠ ‘I don’t advocate that for all I know you should learn command line.’

Now let us discuss the strength of *yiding*. When stands alone as an epistemic modal, *yiding* expresses strong necessity. The paradigm in (3.25) bears out this judgment.

(3.25) a. *Li Si yinggai yijing zou le. Bu, ta yiding yijing zou le*\(^{20}\).

Li Si *YINGGAI* already leave Asp. No, he *YIDING* already leave Asp

‘Li Si probably has already left. No, he must have left already.’

b. *#Li Si yiding yijing zou le. Bu, ta yinggai yijing zou le.*

Li Si *YIDING* already leave Asp. No, he *YINGGAI* already leave Asp

\(^{19}\) It is possible that the prejacent of *yiding* in (3.24a) contains a covert epistemic modal. In this view, *yiding* is uniformly a modifier of a modal statement, which has no lexically specified range of flavor.

\(^{20}\) I used (3.16)-type test here, as the (3.17)-type test does not work well with epistemic modals. The discourse in (a) is not felicitous. To recue it, the second the statement is better embedded under a doxastic verb.

a. ??The culprit should be Alex. In fact, the culprit must be Alex.

b. The culprit should be Alex. In fact, (I believe/think/…) the culprit must be Alex.
‘Li Si must have already left. No, he probably has already left.’

Suppose in each of the discourses above, the two sentences are from the same assessor, and there is no change of context. Example (3.25a) is coherent, and (3.25b) is not. This contrast can be explained if yinggai is weak necessity, while yiding is strong necessity.

So far in this subsection, I have shown the modal force and range of flavors associated with each of modal elements chosen for this study. I will stop here, and summarize the discussion above with Table 3.3.

<table>
<thead>
<tr>
<th>Modal</th>
<th>Syntactic Category</th>
<th>Force and Possible flavors</th>
</tr>
</thead>
<tbody>
<tr>
<td>yiding</td>
<td>Adverb</td>
<td>strong necessity; epistemic &amp; priority</td>
</tr>
<tr>
<td>bixu</td>
<td>Adverb</td>
<td>strong necessity; mainly priority</td>
</tr>
<tr>
<td>dei</td>
<td>Adverb</td>
<td>weak necessity; circumstantial &amp; priority</td>
</tr>
<tr>
<td>yinggai</td>
<td>Verb</td>
<td>weak necessity; epistemic &amp; priority</td>
</tr>
<tr>
<td>keneng</td>
<td>Verb</td>
<td>possibility; epistemic</td>
</tr>
<tr>
<td>nenggou</td>
<td>Verb</td>
<td>possibility; circumstantial</td>
</tr>
<tr>
<td>keyi</td>
<td>Verb</td>
<td>possibility; circumstantial &amp; priority</td>
</tr>
<tr>
<td>neng</td>
<td>Verb</td>
<td>possibility; epistemic &amp; circumstantial &amp; priority</td>
</tr>
</tbody>
</table>

Table 3.3: The Modal Expressions Studied in This Dissertation

3.3 Attitude Verbs Involved in This Study

3.3.1 Methodology

The attitude verbs involved in this study were first automatically collected from a parsed corpus by a program, and manually picked afterwards. Ideally, in order to understand the interaction of attitude and modals, an exhaustive examination of attitude-modal combinations would be undertaken. In practical terms, however, we have to narrow down the scope to a manageable scale. There are two different strategies for downsizing. One is to focus on a small set of attitudes and explore a wider range of modals that appear in the complements of the selected modals. The other is the opposite, i.e. start with a small
number of modal expressions, and look at their behaviors in a larger set of attitude contexts. Both approaches will lead to meaningful results, but they both face the same problem: there is no pre-existing big list of modals or attitude verbs to start with. I opt for the latter approach mainly because the currently available linguistic resources make it easier to accomplish. To be specific, I can utilize syntactic information to find verbs taking clausal complement from a parsed corpus automatically, and then obtain a clean list of attitude verbs by manually screening. Contrastively, since modal expressions do not fall into a single syntactic category, more sophisticated and substantial work is required to get a relatively large set of modals.

In the rest of this subsection, I will describe the methodology adopted for obtaining the list of attitude verbs, and enumerate the chosen items by their semantic classes.

3.3.1.1 The Corpus

Since the verb-modal pairs I am interested in stand in certain syntactic relations (i.e. the modal is in the complement of the verb, and there is no other lexical heads in between), a parsed corpus is preferred for the purpose of automatic retrieve. The corpus I use is Penn Chinese Treebank 7.0 (CTB7; Xia 2000), a “segmented, part-of-speech tagged and fully bracketed corpus” of the size of about 1.2 million words and 1.9 million Chinese characters (http://www.cis.upenn.edu/~chinese/). The texts in CTB7 consist of different types of news articles from various sources, including newswire (21.7%), news magazine (21.4%), broadcast news (24%), broadcast conversation (15.4%), and newsgroup/weblogs (17.4%).

A disadvantage of CTB7 is that it is relatively small compared to unannotated corpora such as Tagged Chinese Gigaword 2.0 (over 2.8 million words) and the CCL online
corpus (over 307 million characters). CTB7 is also unbalanced in terms of genres: it contains mainly news texts, whereas the Mandarin section of CCL corpus includes novels, poems, editorials, academic articles, and so forth. Despite of these problems, however, CTB7 provides human annotated syntactic structures, and therefore, are more accurate than applying a parser on raw texts. Accuracy is the main reason why I decide to use CTB7.

3.3.1.2 The Search Tool: Tgrep2

To search structures of interest, a tool Tgrep2 (http://tedlab.mit.edu/~dr/Tgrep2/) is employed. It is a command line interface search engine designed for finding structures in a corpus of syntactic trees. It supports Boolean expressions and regular expressions, which makes it very powerful.

An example of Tgrep2 query is shown in (3.26).

(3.26) \text{TOP} \ll ( \text{VV} \ \$ \ ( \text{NP} | ^{IP}/ ))

This query matches sentences (TOP) that dominate a verb (VV) that has a sister whose part of speech is either NP or starts with IP. The “dominate” relation is expressed by “\ll”, while the “sister of” relation is represented by “\$”. The Boolean operator “|” indicates the disjunction relation, and “start with IP” is expressed by the regular expression /^IP/.

3.3.1.3 The Selection Criteria

As the first step, verbs meeting the following two criteria were retrieved automatically from CTB7: (i) can take a full CP complement; (ii) can embed one of the modal expressions introduced in the previous section. Note that in the CTB convention, the tag
CP is reserved for relative clauses, appositive clauses and adverbial clauses, and both finite clauses and infinitive clauses are labeled as IP. This fact means there is no direct way to match sentences that meet our first criterion. Therefore, as an approximation, I searched for sentences where the clausal complement of the verb has a NP subject that is not an empty category. This condition will exclude verbs (e.g. zuzhi ‘to stop’) that take only infinitive clauses, and do not take full CP complements. The corresponding Tgrep2 query is (3.27):

\[
(3.27) \quad \text{TOP} \ll (\text{\`VV} \ (\text{\`IP/ \ < \ NP-SBJ \ !<< \ -NONE- } ))
\]

Query (3.27) returns 3961 instances with 588 distinct verbs. And after filtering out verbs that occur only once, the list is reduced to 264 items.

The configurations that satisfy the second criterion are those in which a modal is contained in the complement of an attitude verb, but there is no lexical head between the verb and the modal. In other words, if the modal shows up in the relative clause, adverbial clause or complement clause of the complement of the attitude, the sentence should be excluded. Figure 3.1 provides a concrete example that should be included, while Figure 3.2 shows an example that ought to be excluded.

| (IP (FLR (CD %) (NN p w) (PN 我)) (PU ,) (NP-SBJ (PN 我)) (VP (VV 认为)) (IP-OBJ (NP-SBJ (DP (DT 这)) (NP (NN 点)))) (VP (VV 可能)) (VP (VV 值得)) (VP (VV 探讨))) | I, I think this point might worth discussion |

Figure 3.1: An Example of Included Configurations
Figure 3.2: An Example of Configurations to be Excluded

The concerns discussed above translate to query (3.28):

\[(3.28) \quad \text{TOP} \ll (\text{VV} / \sim \text{IP}=\text{foo} \ll \text{VP} \ll (\text{VV} [\sim \si


**Verbs select indirect questions**: 想想 xiangxiang ‘think over’, 问 wen ‘ask’.


**Non-Chinese word**: guarantee

### 3.3.2 Classification of the Selected Verbs

The remaining 84 verbs after filtering were classified according to their semantic properties following classifications in the previous literatures (Karttunen 1971a-b, Stalnaker 1984, 2005; Villalta 2008; Anand & Hacquard 2013; Hacquard & Wellwood 2012; Pak, Zanuttini & Portner 2004). In what follows, I will first describe the criterion

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\(^{21}\) Verbs of this group are not included because they take a clausal complement only when their subjects are evidence rather than attitude holders; therefore, in strict sense, they are not attitude verbs either.
applied to classify the verbs, then spend a little time to discuss the verbs that are ambiguous between senses belong to different semantic classes (baozheng ‘guarantee; promise’, xiang ‘think; think about; want’, and yao ‘want; require’).

3.3.2.1 The Varieties of Attitudes and Classification of Mandarin Attitude Verbs

Propositional attitudes can be classified on various grounds. It can be done on conceptual level, according to the concept expressed by specific words. The result of conceptual classification is classes labeled as doxastic (believe, suspect), directive (command, order), emotive (fear, angry), desiderative (want, wish), conjecture (guess, predict), etc. These conceptual classes are not mutually exclusive. Each class has its own core bundle of characteristics, but verbs belong to different classes might share a common property. For example, a directive verb like order probably has a communication character as well, and a conjecture verb such as guess seems to have a doxastic component too.

The classification can also be made based on logic properties. An important notion in this regard is factivity. Karttunen (1971a), for example, characterizes a factive predicate as one that “commits the speaker to the belief that the complement sentence, just by itself, is also true”. According to this definition, a verb is factive, if it carries the presupposition (in Stalnaker’s sense) that its complement is true. A handy test for factivity, therefore, is to see whether the presupposition projects under negation. Take realize for example; (3.29a) carries the presupposition that it was in fact raining; the same presupposition is found in (3.29b), the negation of (3.29a). Hence, realize seems to be factive.

(3.29) a. Mary realized that it was raining.
    b. Mary didn’t realize that it was raining.
Karttunen claims that factivity comes into degrees. Some verbs only presuppose that their complement is true under certain syntactic/semantic conditions. Consider (3.30):

(3.30) a. If I realize later that I have not told the truth, I will confess it to everyone.

b. If I regret later that I have not told the truth, I will confess it to everyone.

As the contrast between two sentences in (3.30) show, realize does not presuppose that the complement is true when it appears in the antecedent of conditionals. Sentence (3.30b) commits the speaker to the belief that s/he has not told the truth, but (3.30a) does not. Karttunen thereby identify verbs like realize as “semifactives” as opposed to factives (Karttunen 1971b).

Another perspective of classification is to group the attitudes by their pragmatic function. The notion acceptance is grounded on this kind of concern. As defined by Stalnaker (1984, 2002), “to accept a proposition is to treat it as true for some reason”, and ignores temporarily that the possibility that the proposition is false. The simplest reason to treat a proposition as true is that one believes it is true. There are many other reasons to treat a proposition to be true as well. As Stalnaker put it:

“…One may simplify or idealize in an inquiry, one may presume innocence to ensure fairness, one may make assumptions for the purpose of contingency planning, one may grant something for the purpose of an argument. In cases where communication is facilitated by accepting propositions that one or the other of the participants don’t believe, we need a notion of common ground based on a notion of acceptance that may diverge from belief…”

(Stalnaker 2002, p25)

Let us look at some concrete examples:

(3.31) a. John argues that it was not an accident but a murder.

b. John told me that it was not an accident but a murder.
The sentence (3.31a) does not imply the truth of its complement. It is even not necessary for John to believe it was in fact a murder. However, as John argues for this opinion, he treats it as true that it was a murder. Similarly, (3.31b) does not presuppose or entail there was a murder. But as John communicates the information carried by the complement, he takes it as true, although he could be lying.

The jussive group is another pragmatically-grounded class. The term jussive is originally used by Pak, Zanuttini & Portner (2004) to label the clause type that embraces imperatives, exhortatives and promissives. While the notion of acceptance is proposed to construct the common ground of a conversation, the notion jussive is needed to model the To-Do Lists (Portner 2004) component of the conversation. I will borrow this term to refer to verbs that has an illocutionary force parallel to one of the jussive clause types, such as order, promise, appeal, etc.

In sum, the classification of attitudes is non-hierarchical and multi-dimensional in nature. Conceptual semantics, logic and pragmatics all play a role. Figure 3.3 illustrates the clustering of attitudes along these dimensions. As specified by the legend, the layer of conceptual clustering is coded by different colors. The red color applies to emotive, green indicates doxastic, blue represents communication, etc. An attitude that involves a doxastic component, for example, either has green font, or is in a green-lined box. The vertical divisions (or the horizontal axis) stand for different discourse functions. The left column is reserved for jussives, the right column is for the acceptance attitudes, and all others go to the central column. The horizontal strata (or the vertical axis) correspond to

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22 The verb remember and realize are put in the semifactive as opposed to the doxastic group in the classification system of Hacquard & Wellwood (2012). I think these verbs have doxastic component in their meaning too, and thus mark them green.
the factivity aspect of the attitudes. The factive verbs are located in the top layer, the non-factives are placed in the bottom layer, and the semifactives are put in the middle layer.

<table>
<thead>
<tr>
<th>factive</th>
<th>semifactive</th>
<th>non-factive</th>
</tr>
</thead>
<tbody>
<tr>
<td>regret, enjoy, criticize, shock...</td>
<td>know, ignore, find out...</td>
<td>realize, remember...</td>
</tr>
<tr>
<td>order, permit, suggest, promise</td>
<td>fear, worry, want, wish...</td>
<td>believe, prove, say, infer...</td>
</tr>
<tr>
<td></td>
<td></td>
<td>conjecture, guess...</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>jussive</th>
<th>other</th>
<th>acceptance</th>
</tr>
</thead>
</table>

**Figure 3.3: Multi-Dimensional Classification of Attitudes**

In this set-up, the conceptual classes are the natural, basic clusters, while the acceptance and jussive are super-types that group together some conceptual classes based on their pragmatic potential. Factivity on the other hand is an independent factor that might cut across a conceptual group. Notice that directives and desideratives are separated into different columns, despite the fact that they are often grouped together in the literature. As Chapter 4 will show, they do have different behaviors in terms of whether concord modals are found in their complements.
With the schema above, I classify the selected Chinese verbs as follows. The Appendix of this chapter provides information about the frequencies of these verbs in CTB7, as well as the number and percentage of the instances where the verbs take a clausal complement.

(3.32) I. Acceptance (57)

A. Doxastic (23):

a. Factive (8): zhidao ‘know; liaojie ‘get to know; understand’; zhi ‘know’; lijie ‘understand’; mingbai ‘understand’; qingchu ‘clearly know’; shenzhi ‘well aware of’; kanchu ‘figure out’;

b. Semi-factive (3): jide ‘remember’; wangji ‘forget’; xiangdao ‘realize’;

c. Non-factive (12): renwei ‘consider; think’; kan ‘think’; xiang ‘think’; juede ‘think; feel’; xiangxin ‘believe’; ganjue ‘feel; think’; gandao ‘feel; think’; huaiyi ‘suspect’; yiwei ‘wrongly think’; rending ‘confirm’; jianxin ‘firmly believe’; shenxin ‘deeply believe’; faxian ‘find’;

B. Argumentation (16; all non-factive):

zhichu ‘point out’; tichu ‘propose’; jueding ‘decide’; qiangdiao “emphasize”; tongyi ‘agree’; jianchi ‘insist’; queding ‘confirm’;

baozheng; ‘assure’; chengren ‘admit’; jieshi ‘explain’; zhengming ‘prove’;

fouren ‘deny’; queren ‘confirm’; shengcheng ‘claim’; zhuzhang ‘propose’;

yanpan ‘investigate and decide’;

C. Communication (17):

---

23 This classification is mostly aligned with the classification of English attitude verbs in Hacquard & Wellwood (2012). Each atomic class in my scheme can be matched to a class in their system. Most verbs with similar meaning in the two languages are assigned to the same semantic class. Note that there are three words yao, baozheng and xiang that have senses belong two different classes. As a result, there are 87 tokens instead of 84.
a. **Factive (4)**: *gaozhi* ‘inform’; *xuanbu* ‘announce’; *tixing* ‘remind’; *jinggao* ‘warn’;

b. **Non-active (13)**: *shuo* ‘say’; *biaoshi* ‘convey; represent’; *jiang* ‘speak’; *jieshao* ‘introduce’; *gaosu* ‘tell’; *taolun* ‘discuss’; *cheng* ‘state’; *tidao* ‘mention’; *huida* ‘reply’; *chongshen* ‘reaffirm’; *shengming* ‘declare’; *huiyan* ‘avoid mentiong’; *anshi* ‘hint’;

**II. Jussive (7)**

A. **Permission (2):**

*pizhun* ‘approve’; *guiding* ‘regulate’;

B. **Direction/Suggestion (4):**

*yaoqiu* ‘require; demand’; *huyu* ‘appeal’; *yao2* ‘require’; ‘*jianyi*’ suggest;

C. **Commissive (1):**

*baozheng* ‘promise’;

**III. Other (23)**

A. **Emotive (3):**

a. **Non-factive (doxastic) (2):** *danxin* ‘worry’; *haipa* ‘fear’;

b. **Factive (1):** *piping* ‘criticize’;

B. **Desideraive (12):**

*yao1* ‘want’; *xiwang* ‘hope’; *qidai* ‘look forward to’; *qiwang* ‘wish’; *zhufu* ‘wish sb.(happiness)’; *qipan* ‘long for’; *zhu* ‘wish’; *zhiwang* ‘expect’;

---

24 The complement of *piping* can be either a fact or direct/indirect speech. The latter frame of *piping* shares some properties of communication verbs.

25 I don’t think this item has a conjecture component like the Spanish verb *esperar* ‘anticipate; expect’. While (i) expresses what the subject regard as probable, *zhiwang* in (ii) roughly amounts to “hope and count on”.

(i) *Women yuji baoyu hui zuzhi diren de xingdong.*
   we anticipate storm will prevent enemy DE action
count on; qidao ‘pray’; danyuan ‘wish; if only’; pan ‘long for’; xiang ‘want’.

C. Conjecture (7) and Fiction (1):

**Conjecture**: yuji ‘estimate; anticipate; guji ‘estimate; conjecture’; yuce ‘predict’; panduan ‘judge’; caice ‘conjecture’; caixiang ‘guess’;

**Fiction**: xiangxiang ‘imagine’.

### 3.3.2.2 Ambiguous Verbs

There are three verbs in (3.32) that are ambiguous, with different senses falling into different semantic classes. *Xiang* can mean ‘think; think about’, a typical doxastic attitude, or ‘want’, a typical desiderative attitude. Consider (3.33):

(3.33) a. *Wo xiang hui-jia.*

I want go-home

‘I want to go home.’

b. *Wo xiang women queshi xuyao kan yi-xia na-xie wenjian.*

I think we indeed need look one-Cl. those file

‘I think we indeed need to take a look at those files.’

Similarly, as exemplified by (3.34), *baozheng* has a commissive reading ‘promise’, and an acceptance reading ‘to assure; to guarantee’.

(3.34) a. *Wo baozheng zhi zai hao-xiao de shihou xiao.*

I promise only prep funny DE time laugh

‘We anticipate that the storm will prevent the actions of the enemy.’

(ii) *Women zhiwang baoyu hui zuzhi diren de xingdong.*

we count on storm will prevent enemy DE action

‘We count on the storm to prevent any action of the enemy.’
‘I promise I will only laugh out when it is funny.’

b. *Wo he Tu taitai you bu renshi...wo baozheng mei-you luyin.*

I and Tu Mrs. even not know I assure did-not record

‘Mrs. Tu and I even don’t know each other…I assure (that I) I did not record anything.’

*Yao* is more versatile. It is ambiguous between modal (‘need to’) and non-modal usages. As a non-modal verb, it has several senses that are evidently connected yet distinguishable. The prominent reading is ‘want’ (3.35a). Other readings include ‘be going to; will’ (3.35b) and ‘require; ask’ (3.35c).

(3.35) a. *Ni you-mei-you Gao Xingjian de hua? Wo yao shoucang a!* you have-not-have Gao Xingjian DE painting I want collect SFP

‘Do you have Gao Xingjian’s painting? I want to collect them.’

b. *Shao dai yi hui-er, women yao dai nin qu kan-zhe xiang jijiang* slightly wait one Cl. we will take you go see-see this Cl be about to *shichuan de jiyi.* distinct DE art

‘In a short while, we will take you to look at this art that is about to be lost.’

c. *Jingfang muqian suoding le yi ming Yang-xing xianfan, yao* police current locate Asp. one Cl. Yang last name suspect require *ta daoan biaoming.* he appear make-clear

‘The police have currently located a suspect whose last name is Yang, and require him to show up and make his case.’
A question arises is whether the different senses of the verbs discussed above are predictable on syntactic grounds. The answer is yes, to some degree. For baozheng, the commissive reading is only available when the complement clause is infinitival, i.e. contains no aspect head (see (3.36) below).

(3.36) a. Lao Li baozheng Xiao Wang yijing jiejue zhe ge wenti.
Lao Li baozheng Xiao Wang already solve Asp. this Cl. problem
‘Lao Li assures that Xiao Wang has already solve the problem.’
≠ ‘Lao Li promises he will make sure Xiao Wang has already solve the problem’
b. Lao Li baozheng Xiao Wang hui jiejue zhe ge wenti.
Lao Li baozheng Xiao Wang will solve this Cl. problem
‘Lao Li assures that Xiao Wang will solve the problem.’
‘Lao Li promises he will make sure Xiao Wang will solve the problem.’

Example (3.36b) is ambiguous. What Lao Li has expressed can be either a simple assertion or a promise, depending on the pragmatic setting -- the latter reading arises if Lao Li has the authority to put Xiao Wang under the obligation of solving the problem. In contrast, (3.36a) does not have this potential ambiguity; baozheng can only receive the acceptance reading.

Next turn to xiang. Xiang can appear in various syntactic frames. It can either take a NP or a sentential complement, but cannot take both at the same time. In other words, xiang forbids a structure like Harry wanted Ron to win. Look at some basic statistics from CTB7 as illustrated by the figures below:

---

26 xiang means ‘to miss’ when it takes a NP object.
Figure 3.4: Frequencies of Xiang in Various Syntactic Frames

Figure 3.5: Xiang Taking IP-OBJ, Divided by Type of Subject

Figure 3.4 shows that xiang takes an IP complement 81% (frequency=606) of time. This portion is further divided in Figure 3.5 according to the syntactic status of the subject of the embedded IP. We can see that 66% (frequency =401) of time, the IPs have a covert subject that is controlled by the matrix subject (PRO), 27% (frequency =164) of the IPs have an empty subject that is contextually determined, but not controlled (pro), and only 7% IPs have an overt NP subject.

By looking at the examples one by one, I found the following patterns: the non-control frames (i.e. the pro group + NP group) are associated with doxastic interpretation without exception, while sentences with the control frame mostly (398 out of 401) receive the
desire reading. The exceptions are sentences where the matrix clause contains an aspect (the perfective le, zhe or durative guo). In these exceptional cases the doxastic interpretation is forced. Here is an example:

(3.37) a. *Ni shi fou xiang guo zuo bie-de changshi?*

you yes neg. xiang Asp. do other attempt

‘Have you ever thought about trying something different?’

b. *Ni shi fou xiang zuo bie-de changshi?*

you yes neg. xiang do other attempt

‘Do you want to try something different?’

In sentence (3.37a), xiang co-occurs with the past perfective marker guo, and is interpreted as a doxastic verb. Contrastively, in (3.37b), where the aspect marker is removed, xiang expresses desire.

Table 3.4 summarizes the syntax-semantic alignment of xiang:

<table>
<thead>
<tr>
<th>xiang</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>IP-OBJ (PRO) (matrix has no aspect particle)</td>
<td>desiderative</td>
</tr>
<tr>
<td>IP-OBJ (PRO) (matrix has aspect particles)</td>
<td>doxastic</td>
</tr>
<tr>
<td>IP-OBJ (NP or pro)</td>
<td>doxastic</td>
</tr>
<tr>
<td>NP-OBJ IP</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 3.4: Syntax-Semantics Alignment of Xiang

The case of yao is more complicated. Let us start with an overview of the statistics:
Figure 3.6 shows that other than NP or IP complement, *yao* can also take a NP object followed by an IP (i.e. the *Harry wants Ron to win* kind of structure). Loosely speaking, this NP-OBJ IP frame corresponds to the directive reading. On the one hand, the directive reading is only available under this construction. On the other hand, although in some cases of this frame, the desire meaning of *yao* is still available, the directive sense is clearly present -- *yao* in this kind of sentences exhibits a combination of both senses.

Figure 3.7 zooms into the IP-OBJ frame of *yao* according to the status of the subject of the embedded clause. It reveals that the IP complement of *yao* has a non-control (NP or pro) subject only 5% of the time (frequency =12), while most of time, the subject is
controlled by the matrix subject. A simple annotation reveals the following tendency: when the embedded subject is free (i.e. not PRO), *yao* can only have the desiderative reading; while with a controlled embedded subject, *yao* can have either the desiderative reading or the aspectual (‘be going to’) reading. The aspectual interpretation is not syntactically distinguishable from the desiderative reading. Table 3.5 summarizes the syntax-semantics correspondence of *yao*:

<table>
<thead>
<tr>
<th>Syntax</th>
<th>Semantics</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP-OBJ (PRO)</td>
<td>desiderative or aspectual</td>
</tr>
<tr>
<td>IP-OBJ (NP or pro)</td>
<td>desiderative</td>
</tr>
<tr>
<td>NP-OBJ IP</td>
<td>jussive</td>
</tr>
</tbody>
</table>

Table 3.5: Syntax-Semantic Alignment of *Yao*

One might also ask how the desire readings of *xiang* and *yao* are distinguished from each other. A noticeable difference is that *xiang* is limited to the subject control construction; therefore, it cannot be used to express what the subject wants other people to do. *Yao* in contrast is capable of expressing this kind of desire. In addition, *yao* expresses a more motivated desire. This explains why “A *yao VP*” in many cases not only conveys that A wants to do something, but also that A is actually going to it. These analyses need to be tested by further annotation-based study.

I will stop here the introduction of the selected attitude verbs. In next section, I will describe the acceptability of different modals in the complement of various attitudes.

### 3.4 Compatibility of Modals and Embedding Attitudes

This section investigates which modals are allowed in the complement of each attitude. I pay particular attention to the force asymmetry first discussed by Anand & Hacquard (2013) (see also §2.3.2.2) as exemplified by sentences in (3.38):
(3.38) a. John fears that Mary may/#must have known her killer.

b. The general demands that the soldiers must/*may leave.

In (3.38a), an possibility epistemic modal is acceptable under fear, but the necessity epistemic is not. Similarly, in (3.38b) the deontic necessity must is allowed under demand, yet the deontic possibility may is not. Force asymmetry is worth attention because it seems to roughly align with concord. For example, in (3.38b) demand is in concord with the deontic necessity modal in its complement, and simultaneously, it disallows the deontic possibility modal. In other words, at least in some cases of force asymmetry, the one compatible with the embedded attitude is also in concord with the attitude. In light of this correlation, one may ask whether the asymmetry of modal force allowed in an attitude environment always goes hand-in-hand with concord. As will be revealed in the next chapter, the answers is “no”. But before looking at the counterexamples, let us first find the asymmetries in the combination matrix of attitudes and modals.

The rest of this section is organized as follows: subsection 3.4.1 to 3.4.3 examines respectively the acceptability of epistemic modals, priority modals, and pure circumstantial modals in various attitude contexts.

3.4.1 Embedding of Epistemic Modals

3.4.1.1 Material

To make the data comparable to the experimental results on the same issue in Romance languages, I evaluate the acceptability of sentences based on materials that are parallel to those used by Anand & Haquard (2013). Frame (3.39) is the template that generates the relevant sentences:

(3.39) Lao Li (person A) VERB Xiao Wang (person B) MODAL VP
The VERB block is substituted by the verbs introduced in the previous section. MODAL is replaced by one of the three epistemic modal expressions *keneng* ‘might’\(^{27}\), *yinggai* ‘should’ and *yiding* ‘definitely’; and VP is substituted by one of the three constituents in (3.40):

\[(3.40) \quad \text{a. zhidao xiongshou shi shui le} \]

know culprit be who Asp.

‘knows who is the culprit’

b. *shi xiongshou*

be culprit

‘is the culprit’

c. *chu-shi le*

have accident Asp.

‘have had an accident’

Examples in (3.41) are a sample of generated sentences. Note that in contrast to previous studies, I consider a three way distinction of modal strength.

\[(3.41) \quad \text{a. Lao Li xiangxin Xiao Wang keneng zhidao xiongshou shi shui le.} \]

Lao Li believe Xiao Wang might know culprit be who Asp.

‘Lao Li believes that Xiao Wang might know who is the culprit.’

b. *Lao Li huaiyi Xiao Wang yinggai shi xiongshou.*

Lao Li suspect Xiao Wang should be culprit

‘Lao Li suspects that Xiao Wang should be the culprit.’

\(^{27}\) Remember that *neng*, *nenggou* and *keyi* may have epistemic use too. I do not use them to investigate the distribution of epistemic possibility here because they are circumstances in most cases, while *keneng* is specialized in expressing epistemic modality.
c. Lao Li rending Xiao Wang yiding chu-shi le.

Lao Li affirm Xiao Wang definitely have accident Asp.

‘Lao Li affirms that Xiao Wang must have had an accident.’

3.4.1.2 Procedure

In determining acceptability of a attitude-modal pair, I combine two kinds of evidence: native speaker judgments on the sentences generated by the frame introduced above (for convenience of reference, I will call them test sentences), and occurrence of relevant usages in CTB7 and/or CCL online corpus. As a principle, judgment outweighs the corpus findings. In cases where I am not sure about the acceptability of the test sentence, I search for corpus examples, and consult other native speakers. If there are at least 2 usages found in the two corpora that the informants judge as acceptable, I mark the attitude-modal pair as acceptable. Otherwise, I mark it as not acceptable. Note that the escape hatch readings (refer section 3.1 for discussion), the reading in which epistemic modals are not relative to the mental state of the matrix subject, are excluded.

The reason I give judgment more weight is because corpus is not noise free, especially if it contains transcriptions of conversations, texts of tweets, blogs, text messages, etc. The mere fact that one instance is attested in the corpus does not guarantee the acceptability of the construction under discussion. Here is a concrete example. There is one instance of keneng-under-xiwang construction found in CTB7 (see (3.42) below):

(3.42). Wo danyuan ni, xiwang ni nabian keneng you, ni hai meiyou kan guo ta.

I wish you hope you there might have you yet have not see Asp. it

‘I wish you, I hope, you might have it there, but you haven’t seen it yet.’
The sentence is not unintelligible. What the speaker intends to convey is that he or she prefers the possibility that the addressee actually has the object under discussion to the possibility that he does not have it. However, there is an obvious contrast of the degree of acceptance between keneng-under-xiwang and keneng under some other attitude, say an emotive verb danxin ‘worry’:

(3.43) a. Wo danxin mingtian keneng xiayu.
I worry tomorrow might rain
‘I worry that it might rain tomorrow.’

b. ??Wo xiwang mingtian keneng xiayu.
I hope tomorrow might rain
‘I hope that it might rain tomorrow.’

Based on the examples like (3.43), I determine that xiwang ‘hope’ does not allow the epistemic possibility modal keneng in its complement.

3.4.1.3 Results

- Epistemic possibility

As far as the license of epistemic possibility is concerned, Mandarin exhibits an overall picture similar to English and the Romance languages (the relevant summary of the patterns in these languages is in Table 3.6; Table 3 of Anand & Hacquard (2013)).

<table>
<thead>
<tr>
<th>Attitude</th>
<th>might</th>
<th>must</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doxastic</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Argumentation</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Semi-factives</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Desideratives</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Directives</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
The doxastic verbs show a unified behavior in licensing epistemic possibility; but the other subclasses all have exceptions. Among verbs of argumentation, baozheng ‘assure; guarantee’ resists keneng (shown by 3.44a); and jueding ‘decide’ only seems to be compatible with the circumstantial use of keneng (see 3.44b).

(3.44) a. #Lao Li baozheng Xiao Wang keneng zhidao xiongshou shi shui le.

Lao Li assure Xiao Wang might know culprit be who Asp.
‘Lao Li assures that Xiao Wang might have known who the murderer is.’

b. Kanning’an yi jueding jin-nian dongtian bu/you keneng

Cunningham already decide this year winter not/have possible jinxing dadan de zhanyi.
carry out bold DE battle
‘Cunningham already decided that it is impossible/possible to have any bold battle this winter.’

#‘Cunningham already decided that it is incompatible/compatible with what he knows to have a bold battle this winter.’

(Examples from CCL)

Unlike its English counterpart, example (3.44a) is not acceptable. To rescue it, keneng should be either eliminated or replaced by a strong necessity modal such as yiding.
‘definitely’. Example (3.44b) is not acceptable without the negation *bu* or the existence verb *you*; and both *bu-keneng* and *you-keneng* receive circumstantial/ability readings.

The quirky member of the class of communication verbs is *taolun* ‘discuss’. The verb *taolun* requires its sentential complement to be an embedded question (cf. 3.45a-b). The question may contain *keneng*, but I do not to include *taolun* in my discussion, because this study focuses on configurations where the complement clause denotes a proposition.

(3.45) a. *Lao Li taolun le Xiao Wang keneng zhidao xiongshou shi shui le.*

Lao Li discuss Asp. Xiao Wang might know culprit be who Asp.

‘Lao Li discussed that Xiao Wang might have known who is the culprit.’

b. *Lao Li taolun le Xiao Wang shi-fou keneng zhidao xiongshou shi shui le.*

Lao Li discuss Asp. Xiao Wang be-not might know culprit be who Asp

‘Lao Li discussed whether Xiao Wang might have known who is the culprit.’

In addition to the acceptance verbs, doxastic-emotives (3.46a) also license *keneng* in their complements. In contrast, desideratives (3.46b), directives (3.46c) and factive-emotive piping (3.46d) do not allow *keneng* in their scope. These patterns all follow from the predictions of previous literatures.

(3.38) a. *Lao Li danxin Xiao Wang keneng chu-shi le.*

Lao Li worry Xiao Wang might have accident Asp.

‘Lao Li worries that Xiao Wang might have had an accident.’

b. #*Lao Li yao Xiao Wang keneng chu-shi le.*

Lao Li want Xiao Wang might have accident Asp.

‘Lao Li wants it to be the case that it is compatible with what he knows that Xiao Wang had an accident.’
c. #Lao Li yaoqiu Xiao Wang keneng chu-shi le.

Lao Li demand Xiao Wang might have accident Asp.

‘Lao Li demands that Xiao Wang might had an accident.’

d. #Lao Li piping Xiao Wang keneng feng-le.

Lao Li criticize Xiao Wang might mad Asp.

‘Lao Li criticized Xiao Wang, saying he might have gone mad.’

As illustrated by (3.46b-c), keneng is not allowed under desiderative and directive verbs. Example (3.46d) shows that keneng is not licensed under a factive-emotive either.

Figure 3.8-3.9 summarize the patterns discussed above. Figure 3.8 visualizes the co-occurrence patterns of the attitude-keneng pairs in CTB7. Each node (circles filled with colors) represents a word. The node in the center represents the modal keneng, attitudes are scattered around the modal, and clustered according to semantic classes distinguished by colors. The size of each node is proportioned to the logarithm of frequency of that word in CTB7. The edge connecting an attitude and keneng indicates that the combination is attested in the corpus. The weight of each line is scaled to the frequency of the co-occurrences.

Figure 3.9 incorporates information of native speaker judgments on top of Figure 3.8. An attitude is connected to keneng if it licenses the modal in its complement based on native speaker intuition. The thicker lines indicate that the corresponding usage is found in CTB7. A triangle is used to mark the constructions that are attested in the corpus but which I do find acceptable. Red circles mark out the exceptions that have been discussed in this subsection.
Figure 3.8: Distribution of *Keneng* under Attitudes in CTB7
Figure 3.9: Acceptability of Keneng in Various Attitude Contexts

- Epistemic necessity

Recall that as shown in Table 3.6, there is a distributional asymmetry of might and must in attitude environments. This asymmetry of epistemic possibility and necessity is found in Chinese as well. Epistemic necessity has narrower distribution than epistemic
possibility. In addition, epistemic weak necessity and strong necessity have slightly different behavior as well.

Among the verbs that license epistemic possibility keneng, the doxastic-emotives (danxin ‘worry’, haipa ‘fear’), and the semi-factive wangji ‘forget’ do not allow epistemic necessities. Wangji only accepts “escape hatch” readings of epistemic yinggai ‘should’ and yiding ‘definitely’. In contrast, another doxastic semi-factive jide ‘remember’ can embed epistemic necessities with normal readings\(^\text{28}\). Compare (3.47a-b):

\[(3.47)\ a. \text{Lao Li wangji le } xiongshou yinggai/yiding \text{ shi Xiao Wang.} \]
\[
\begin{align*}
\text{Lao Li forget Asp. culprit} & \quad \text{should definitely be Xiao Wang} \\
\text{‘Lao Li forgot that the culprit should be/is definitely Xiao Wang.’} \\
\approx & \text{Lao Li forgot that for all we know the culprit is Xiao Wang.} \\
\# & \text{Lao Li forgot that for all Lao Li knows the culprit is Xiao Wang.}
\end{align*}
\]

\[
\begin{align*}
\text{Lao Li jide} & \quad xiongshou yinggai/yiding \text{ shi Xiao Wang.} \\
\text{Lao Li remember culprit} & \quad \text{should definitely be Xiao Wang} \\
\text{‘Lao Li remembers that the culprit should be/is definitely Xiao Wang.’} \\
\approx & \text{Lao Li remembers that for all he knows the culprit is Xiao Wang.}
\end{align*}
\]

*Huaiyi* ‘suspect’ allows an epistemic necessity modal only when the attitude is negated. Note that (3.48b) is infelicitous. While *huaiyi* licenses the strong necessity yiding, it does not accept the weak necessity yinggai in its compelment (3.48a).

\[(3.48)\ a. \text{Lao Li hao-bu huaiyi xiongshou yiding/#yinggai shi Xiao Wang.} \]

\[^{28}\text{The different epistemic licensing pattern between remember and forget is not unique to Chinese. English seems to show a parallel pattern:}
\]
\[\begin{align*}
a. & \text{John remembers that Mary must have done the dishes.} \\
b. & \text{John forgot that #(we said/decided/… that) Mary must have done the dishes.}
\end{align*}\]

\[^{29}\text{Some informants point out that yiding is noticeably less acceptable than yinggai under jide ‘remember’.}\]
Lao Li not at all suspect culprit definitely should be Xiao Wang
‘Lao Li does not suspect at all that the culprit is definitely Xiao Wang.’
(=Lao Li believes that the culprit is definitely Xiao Wang.)

b. Lao Li huaiyi xiongshou yiding shi Xiao Wang.
Lao Li suspect culprit definitely be Xiao Wang
‘Lao Li suspects that the culprit is definitely Xiao Wang.’

Xuanbu ‘announce’ and shengming ‘declare’ are two other exceptional cases within
the acceptance group. Epistemic necessity modals in the complement of these modals are
not perfectly acceptable. Consider example (3.49) from CCL:

(3.49) Ying zhengfu xuanbu yi ming huanzhe keneng/yingga/yiding
       Britain government announce one Cl patient might should definitely
       yin shu-xue er ganran keyashi-zheng siwang
       because transfusion and infect Creutzfeldt-Jakob Disease die
‘The British government announced that one patient might/should/definitely
have died of CJD caused by infection during transfusion.’

The original text of example (3.41) contains keneng. If the epistemic possibility is
replaced by an epistemic necessity modal, the sentence becomes awkward.

Next turn to baozheng ‘assure; guarantee’. Baozheng allows strong necessity yiding,
but is not compatible with the weak necessity yinggai (see (3.50)). This fact is also
evidence for distinguishing different strengths among necessity modals.

(3.50) Lao Li baozheng xiongshou yingga/yiding shi Xiao Wang.
Lao Li assure culprit definitey should be Xiao Wang
‘Lao Li assures that the culprit is definitely Xiao Wang.’

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Intended with *yinggai*: ‘Lao Li assures that it follows from what he knows plus some other non-public assumptions that the culprit is Xiao Wang.’

Except for the items discussed so far, verbs that license epistemic possibility modals also allow epistemic necessities in their complement. In addition, desideratives and jussives, which do not license *keneng* in their complements, fail to allow *yinggai* and *yiding* as well. But *yiding* under the factive-emotive *piping* turns out to be acceptable, while *yinggai* in the same context is pragmatically awkward. Consider (3.51):

(3.51) *Lao Li piping Xiao Wang yiding/#yinggai shi feng le.*

Lao Li criticize Xiao Wang definitely be mad Asp.

‘Lao Li criticized Xiao Wang, saying he has definitely/#should have gone mad.’

It is worthwhile mentioning that *yiding* can co-occur with the jussive use of *baozheng* ‘promise’, and the directive verb *yaoqiu* ‘demand; require’ (see (3.52-3.53)). However, it is questionable whether *yiding* in these usages is indeed epistemic.

(3.52) *Lao Li baozheng mingtian #keneng/#yinggai/yiding canjia wuhui.*

Lao Li promise tomorrow might should definitely attend party

‘Lao Li promised that he #might/#should/will definitely attend the party tomorrow.’

≈ ‘According to Lao Li’s promise, he will definitely attend the party tomorrow.’

(3.53) a. *(Xiawu hui xiayu.) Yiding dai san.*

afternoon will rain definitely bring umbrella

‘It will rain in the afternoon. (You should) definitely bring an umbrella.’
b. Lao Li yaoqiu Xiao Wang yiding dai san.

Lao Li demand Xiao Wang definitely bring umbrella
‘Lao Li demanded that Xiao Wang bring an umbrella without fail.’
≠ Lao Li demanded that in the worlds compatible with what the weather forecast says Xiao Wang brings an umbrella.
≠ Lao Li demanded that in the worlds compatible with his information state/belief Xiao Wang brings an umbrella.

Epistemic modals are generally not acceptable under directive verbs unless with an escape hatch reading. Yiding in (3.53b) is clearly not relative to anybody’s knowledge or a body of information (say, the weather forecast). Instead, yiding is circumstantial, in concord with the embedding verb; its ordering source contains priorities such as preference to stay dry in rain. The case of (3.52) is trickier. The embedded proposition is true if Lao Li goes to the party in all worlds where Lao Li keeps his promise. I think the sentence is inherently ambiguous. Its flavor depends on the perspective of view: if the promise is viewed as a source of information like rumors, news reports, and so on, then yiding is epistemic; but if the promise is considered as some kind of rule one ought to act in accord to, then yiding has a priority flavor.

To sum up, in general the distribution of epistemic modals in the complement of attitude verbs is similar to the patterns found in English and Romance languages. The acceptance verbs and conjecture verbs mostly license epistemic modals regardless of modal force; desideratives and jussives do now allow epistemics of any force; and the doxastic-emotives only accept epistemic possibility in their complements. Yet there are some exceptions and unique cases. Factive-emotive piping shows a pattern that is not
documented in relevant literature. It licenses strong necessity \textit{yiding}, but epistemic weak necessity and possibility in its complement are not acceptable. \textit{Baozheng} ‘guarantee’ only licenses strong epistemic necessity, a behavior not reported in previous studies. In contrast to \textit{baozheng}, \textit{wangji} ‘forget’, \textit{huaiyi} ‘suspect’, \textit{xuanbu} ‘announce’ and \textit{shengming} ‘declare’ allow epistemic possibility, but are awkward with an embedding epistemic necessity. The generalizations above are summarized in Table 3.7.

<table>
<thead>
<tr>
<th>Class</th>
<th>keneng ‘might’</th>
<th>yinggai ‘should’</th>
<th>yiding ‘definitely’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptance</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Doxastic</td>
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<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>\textit{jide} ‘remember’</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>\textit{wangji} ‘forget’</td>
<td>✓</td>
<td>#</td>
</tr>
<tr>
<td></td>
<td>\textit{huaiyi} ‘suspect’</td>
<td>✓</td>
<td>#</td>
</tr>
<tr>
<td>Argumentation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>\textit{jueding} ‘decide’</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>\textit{baozheng} ‘guarantee’</td>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>Communication</td>
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<td>✓</td>
</tr>
<tr>
<td></td>
<td>\textit{xuanbu} ‘announce’</td>
<td>✓</td>
<td>#</td>
</tr>
<tr>
<td></td>
<td>\textit{shengming} ‘declare’</td>
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<td>#</td>
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<td>Conjecture</td>
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<td>#</td>
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<td>#</td>
</tr>
<tr>
<td>Desiderative</td>
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<td>#</td>
</tr>
<tr>
<td>Jussive</td>
<td>#</td>
<td>#</td>
<td>#</td>
</tr>
</tbody>
</table>

Table 3.7: Epistemic Modals under Attitudes -- General Patterns & Exceptions

Figure 3.10 and Figure 3.11 visualizes the attitude-\textit{yinggai} combinations and attitude-\textit{yiding} combinations attested in CTB7 respectively. Note that both \textit{yinggai} and \textit{yiding} are ambiguous between epistemic and priority flavors. Because of the limit of time, I did not annotate the modality type for the retrieved sentences; therefore, the two graphs just show if the modal word is found in the complement of an attitude verb.
Figure 3.10: Attitude-\textit{Yinggai} Combinations Attested in CTB7
3.4.2 Embedding of Piority Modals

According to Hacquard & Wellwood (2012), the distribution of root modals in attitude contexts is not restricted to certain classes like epistemics. However, since their work collapses the priority and pure circumstantial usages into one class, the separate distributional pattern for each subtype of root modals is not clear. So there will be no comparison to other languages in this subsection and following subsection.
3.4.2.1 Materials

The frame (3.54) generates the materials used to study the acceptability of priority modals in attitude contexts:

(3.54) Lao Li (person A) VERB Xiao Wang (person B) MODAL VP

MODAL is substituted by one of keyi ‘may’, yinggai ‘should’ and bixu ‘must, have to’. VP is replaced by one of (3.55a-b).

(3.55) a. jiejue zhe ge wenti
    solve this Cl. problem
    ‘solve this problem’

b. zhu zai zheli
    live prep. here
    ‘live in here’

Some generated examples are provided in (3.56):

(3.56) a. Lao Li zhidao Xiao Wang keyi zhu zai zheli.
    Lao Li know Xiao Wang may live prep. here
    ‘Lao Li knows that Xiao Wan may live here.’

b. Lao Li jianyi Xiao Wang yingai jiejue zhe ge wenti.
    Lao Li suggest Xiao Wang should solve this Cl. problem
    ‘Lao Li suggest that Xiao Wang should solve this problem.’

c. Lao Li danxin Xiao Wang bixu jiejue zhe ge wenti.
    Lao Li worry Xiao Wang have to solve this Cl. problem
    ‘Lao Li worries that Xiao Wang has to solve this problem.’
3.4.2.2 Patterns

Although the distribution of priority modals in attitude contexts is not as restricted as epistemics, there are several verbs that are sensitive to the force of the embedded modal. The generalizations are as follows:

- All acceptance verbs license priority modals.
- Doxastic-emotives accept priority modals of regardless of modal force in their complements; the factive-emotive piping ‘to criticize’ only allows the negation of weak necessity.
- Desideratives are in generally compatible with all priority modals in their scope; but often the salient reading of the possibility modal keyi is an ability/circumstantial reading, rather than a priority one.
- The behavior of jussive verbs is diverse:
  - Huyu ‘to appeal’ and yaoqiu ‘require; demand’ do not allow priority possibility.
  - pizhun ‘to approve’ allows priority (mainly deontic) possibility, but resists the necessity modals.
  - jianyi ‘suggest’ and guiding ‘to regulate’ license both necessity and possibility priority modals.
  - The commissive use of baozheng ‘promise’ only accepts yiding

The exception of the acceptance verbs is taolun ‘discuss’, which requires an indirect question as its complement, and thusly disallows a declarative modal statement. The unusual behavior of the factive-emotive piping ‘criticize’ is illustrated by (3.57): (3.57a) is perfectly acceptable, but it is hard to make sense of (3.57b).
(3.57) a. Ta dajiao zhe piping Jinni bu yinggai rang qiu tuoli ta-de zhangwo

He yell ZHE criticize Ginny not should let ball get out of her control
‘He yelled to Ginny, criticizing she should not have lost control of the ball’.

b. #Ta piping Jinni bixu/yinggai/keyi zhangwo hao qiu.

He criticize Ginny must should may control well ball
‘He criticized Ginny must/should/may have kept control of the ball.’

The sentence in (3.58) provides an example in which keyi prefers a pure circumstantial reading to a priority one.

(3.58) Wo xiwang zhe ci women keyi kuanghuan yi-xia

I hope this time we may have a wild joy a while
‘I hope this time we may have a wild celebration.’

The more salient interpretation of (3.58) is “I hope this time we are able to have a celebration”. However, the sentence can also be interpreted as “I hope this time we will be permitted to have a wild celebration”, where keyi is clearly deontic.

Example (3.59) illustrates that the permissive verb pizhun ‘permit; approve’ is compatible with possibility deontic but not with necessity deontic.

(3.59) a. 1981 nian guojia ji-wei jiu pizhun

1981 year nation State Development Planning Commission already approve keyi/#yinggai/#bixu zhuoshou kaizhan er qi gongcheng de zhunbei may should must hands-on launch 2nd-stage construction DE preparation
‘The SDPC has already approved as early as in 1981 that the preparation for second-stage construction may/should/must be launched.’
b. The SDPC has already approved as early as in 1981 the proposal that the preparation for second-stage constructions must be launched.

c. *Guojia jiwei pizhun le guanyu yaoqiu zhuoshou kaizhan er qi*
   
   SDPC approve Asp. about demand hand-on launch 2\textsuperscript{nd}-stage construction DE proposal

In theory, with a necessity deontic modal in place of the possibility one, the sentence (3.59a) could mean (3.59b), a permission of obliging something. However, I don’t think the configuration is capable of expressing the intended meaning, even with the right scenario. We have to utilize a different syntactic configuration such as (3.59c) for that purpose.

*Guiding* and *jianyi* pattern together in terms of licensing priority modality. The difference is that *guiding* forces deontic interpretation of the embedded modal, while *jianyi* is compatible with other priorities as well.

(3.60) a. *Gandaofu jianyi ta bixu tigao jingjue, bu yao kou-wu-zhelan*\textsuperscript{30}
   
   Gandalf suggest he must increase alertness not should talk carelessly
   
   ‘Gandalf suggested him to be more alert; that he should not talk carelessly.’

b. *Lao Li guiding Xiao Wang bixu zhu zai zheli.*
   
   Lao Li specify Xiao Wang must live *prep.* here
   
   ‘Lao Li specifies (as a command) that Xiao Wang must live here.’

\textsuperscript{30} The sentence is found in CCL. I believe this is from the Chinese translation of *The Lord of Rings*, but the provided translation is made by myself, rather than from the original text.
In sentence (3.60a), *bixu* receives a teleological reading, with the goal of surviving the journey to Mount Doom as the ordering source. *Bixu* in example (3.60b), on the other hand, is relativized to the commands of Lao Li, the boss, and cannot receive teleological/bouletic reading.

Lastly, let us turn to *baozheng*. The acceptance use of *baozheng* as ‘assure’ embeds priority modals without problem; however, it is difficult for the commissive use of the verb to do so. Consider the examples below:

(3.61) a. *Lao Li baozheng Xiao Wang hui jiejue zhe ge wenti.*

Lao Li baozheng Xiao Wang will solve this Cl. problem

‘Lao Li assures that Xiao Wang will solve the problem.’

‘Lao Li promises he will make sure Xiao Wang will solve the problem.’

b. *Lao Li baozheng Xiao Wang bixu jiejue zhe ge wenti*

Lao Li baozheng Xiao Wang must solve this Cl. problem

‘Lao Li assures that Xiao Wang must solve the problem.’

≠ ‘Lao Li promises he will make sure Xiao Wang must solve the problem.’

Example (3.61a) is repetition of (3.36b), which is ambiguous between the report of an argumentation and the report of a promise. Example (3.61b) uses a deontic modal in place of the future modal *hui*. In the resulted sentence, *baozheng* can only receive the acceptance reading. The ‘promise’ reading of *baozheng* cannot be forced in (3.61b), even with the assumption that Lao Li has the right authority to manipulate the rules so that it is necessary for Xiao Wang to solve the problem.

To sum up, priority modals are accepted in most attitude contexts regardless of modal force, but are disallowed in several exceptional cases. The factive-emotive *piping* ‘criticize’ puts certain pragmatic requirements on its complement, and it turns out that
only *bu-yinggai* ‘should not’ is allowed in its complement. The other exceptions are all jussive verbs. *Huyu* ‘appeal’ and *yaoqiu* ‘demand; require’ are only compatible with priority necessity, *pizhun* ‘approve’ only accepts priority possibility, while neither are acceptable under *baozheng* ‘promise’. Table 3.8 provides an overview of these generalizations. Figure 3.12 shows the attitude-*keyi* ‘may’ combinations found in CTB7. Figure 3.13 and Figure 3.4 visualizes respectively the distribution of *bixu* ‘*must*’ and *dei* ‘should’ in various attitude contexts. Note that *keyi* can express pure circumstantial force as well, but the examples of *keyi* are not annotated for modal type.

<table>
<thead>
<tr>
<th>Class</th>
<th><em>keyi</em> ‘may’</th>
<th><em>yinggai</em> ‘should’</th>
<th><em>bixu</em> ‘must’</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acceptance</strong></td>
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<tr>
<td>Conjecture</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td><strong>Emotive</strong></td>
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<td>✓</td>
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<tr>
<td>Factive</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Jussive</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*yaoqiu* ‘demand’ | # | ✓ | ✓ |
*huyu* ‘appeal’ | # | ✓ | ✓ |
*pizhun* ‘approve’ | ✓ | # | # |
*jianyi* ‘suggest’ | ✓ | ✓ | ✓ |
*guiding* ‘regulate’ | ✓ | ✓ | ✓ |
*baozheng* ‘promise’ | # | #³¹ | # |

Table 3.8: Priority Modals under Attitudes -- General Patterns & Exceptions

³¹ Modals under jussive *baozheng* could be simply ungrammatical, assuming the modals are functional heads like aspects. By focusing on the semantics side, I oversimplified the syntactic issues of the modal elements.
Figure 3.12: Attitude-\textit{Keyi} Combinations Attested in CTB7
Figure 3.13: Attitude-\textit{Bixu} Combinations Attested in CTB7
Figure 3.14: Attitude-Dei Combinations Attested in CTB7
3.4.3 Embedding of Pure Circumstantial Modals

3.4.3.1 Materials

The frame used to create sentences of pure circumstantial modal under attitudes is given in (3.62) below:

(3.62) Lao Li VERB PROPOSITION

PROPOSITION:  *Xiao Wang nenggou dedao na fen gongzuo*

Xiao Wang can get that Cl. job

‘Xiao Wang can get the job’

*zhe zhong yao neng zhiliao ganyan*

this kind medication can treat hepatitis

‘this kind of medication can treat hepatitis’

Some examples generated by the frame (3.62) are provided in (3.63):

(3.63) a. *Lao Li zhichu zhe zhong yao neng zhiliao ganyan*

Lao Li point out this Cl medication can treat hepatitis

‘Lao Li pointed out that this kind of medication can treat hepatitis.’

b. *Lao Li caice Xiao Wang nenggou de-dao na fen gongzuo*

Lao Li guess Xiao Wang can get that Cl job

‘Lao Li guesses that Xiao Wang can get the job.’

It is worthwhile to note that pure circumstantial modals do not exhibit the same three-way distinction of strengths as other types of modals do. Pure circumstantial modal falls into one force that expresses some sort of possibility but is stronger than the modal logic existential (Portner 2009, §4.4). In Mandarin Chinese, this force can be expressed by
auxiliary verbs such as neng, nenggou, keyi. The potential complement construction, as
illustrated in (3.64), expresses this force as well:

(3.64) Zhe zhong yao zhi de hao ganyan.

this kind medication treat DE2 good hepatitis

‘This kind of medication can cure hepatitis.’

3.4.3.2 Patterns

Pure circumstantial modals are acceptable under all classes of attitudes except for jussive
verbs. A jussive verb either rejects pure circumstantial modal because the resulting
sentence is awkward, or requires an inanimate subject when a pure circumstantial modal
is in its complement. Consider the examples below:

(3.65) #Lao Li jianyi/pizhun Xiao Wang neng dedao na fen gongzuo.

Lao Li suggest/approve Xiao Wang be able to get that Cl job

‘#Lao Li suggested/approved that Xiao Wang can get the job.’

(3.66) M jie de jiaotong hen zaogao, zhe/#Lao Li yaoqiu siji neng

M Street de traffic very bad this/Lao Li conj. require driver be able to

zuochu kuaisu de fanying

make quick DE. reaction

‘The traffic on M Street is terrible, which requires the drivers to be able to react
quickly.’

# ‘The traffic on M Street is terrible, so Lao Li requires the drivers to be able to
react quickly.’
Example (3.65) is grammatical, but has a meaning that does not make sense. Whether the person Xiao Wang has the ability or chance to get a job is not under his control, and is not something one can suggest or approve other people to do. Example (3.66) illustrates that yaoqiu ‘require; demand’ is possible to take a pure circumstantial modal in its complement when it has an inanimate subject.

A pure circumstantial modal under the factive-emotive verb piping ‘criticize’ is often awkward. But it is possible to think of examples that are acceptable:

(3.67) a. Lao Li piping Xiao Wang #(mei) neng dedao na fen gongzuo.
   Lao Li criticize Xiao Wang neg.-past be able to get that Cl job
   ‘Lao Li criticized Xiao Wang for not being able to get the job.’

b. Lao Li piping Xiao Wang neng tuoyan.
   Lao Li criticize Xiao Wang can procrastinate
   ‘Lao Li criticized Xiao Wang for being able to procrastinate.’

To conclude, as summarized in Table 3.9, pure circumstantial modals are disallowed under jussives unless the subject is inanimate, but are acceptable in other attitude contexts.

<table>
<thead>
<tr>
<th>Class</th>
<th>neng/nenggou ‘can’</th>
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</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td>Acceptance</td>
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<td>General pattern</td>
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<td>Doxastic</td>
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</tr>
<tr>
<td>Desiderative</td>
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</tr>
<tr>
<td>Jussive</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.9: Pure Circumstantial Modals Under Attitudes -- General Patterns
Figure 3.15 and Figure 3.16 below illustrates what attitude-\textit{neng/nenggou} combinations are attested in CTB7.

![Figure 3.15: Attitude-\textit{Neng} Combinations Attested in CTB7](image-url)
Figure 3.16: Attitude-Nenggou Combinations Attested in CTB7

3.4.4 Conclusion

This section has described the distribution of different modals under various attitude verbs. The goal was to find the combination gaps, the modal-under-attitude constructions
that are not acceptable. Particular attention was given to the verbs that are sensitive to modal force. For example, danxin ‘worry’ licenses epistemic possibility, but disallows epistemic necessity in its complement; yaoqi ‘demand; require’ allows priority necessities, but rejects priority possibility modal in its scope. This gap-finding project is a necessary step to make clear the correlation between force asymmetry and modal concord. These gaps are like windows, through which we can peek inside the meaning of the attitude verbs.

Table 3.10 provides an overview of the findings in this section. The force asymmetry cases are shaded. The column names composed of a capital letter and a lowercase letter stand for different modals; the uppercase letter indicates the quantificational force and lowercase letter the flavor type of the modal. For example, P_e represents epistemic possibility modal, which is most often expressed by the auxiliary verb keneng in Mandarin. I will show how this picture aligns with the embedded concord modals in the following section.

<table>
<thead>
<tr>
<th>Class</th>
<th>P_e</th>
<th>W_e</th>
<th>N_e</th>
<th>P_p</th>
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</tr>
<tr>
<td>Emotive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doxastic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>general pattern</td>
<td>✓</td>
<td>#</td>
<td>#</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Factive</td>
<td>pipi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘criticize’</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

135
Table 3.10: Compatibility Matrix: Full Pattern

<table>
<thead>
<tr>
<th>Desiderative</th>
<th>general pattern</th>
<th>#</th>
<th>#</th>
<th>#</th>
<th>✓</th>
<th>✓</th>
<th>✓</th>
<th>✓</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jussive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>#</td>
<td>✓</td>
<td>✓</td>
<td>#</td>
</tr>
<tr>
<td>yaoqiú 'demand'</td>
<td></td>
<td>#</td>
<td>#</td>
<td>#</td>
<td></td>
<td>#</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>huyu 'appeal'</td>
<td></td>
<td>#</td>
<td>#</td>
<td>#</td>
<td>#</td>
<td>✓</td>
<td>✓</td>
<td>#</td>
</tr>
<tr>
<td>pizhun 'approve'</td>
<td></td>
<td>#</td>
<td>#</td>
<td>#</td>
<td>✓</td>
<td>#</td>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>jianyi 'suggest'</td>
<td></td>
<td>#</td>
<td>#</td>
<td>#</td>
<td>✓</td>
<td>✓</td>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>baozheng 'promise'</td>
<td></td>
<td>#</td>
<td>#</td>
<td>#</td>
<td>#</td>
<td>#</td>
<td>#</td>
<td>#</td>
</tr>
</tbody>
</table>

3.5 Conclusion

This chapter has builds up the foundation for the exploration in the following chapters. To start out, section 3.1 described how the phenomenon of E-CM is connected to other issues surrounding modal embedding. Then section 3.2 and 3.3 together specified the empirical scope of this dissertation. This portion introduced the Mandarin modal expressions and attitude verbs selected for this study, and reported the methodologies applied to obtain these elements. Section 3.4 investigated the distribution of different modal types in the complement of selected attitude verbs. The steps for investigation were as follows: first, take the vector of modal expressions, and the vector of attitude verbs; next, create a matrix of Attitude × Modal combinations. Then each attitude-modal pair was judged for whether the modal-under-attitude configuration is acceptable.

The task reported in section 3.4 had a particular focus, namely finding the combination “gaps”, the unacceptable modal-under-attitude constructions. Gaps are interesting because they are puzzling in nature. From an impressionist view, combination gaps seem to be correlated with the E-CM cases. To be specific, when an embedded modal is concord, its dual is not acceptable under the same attitude. This matching effect is also
found in conical modal concord as we have seen in Chapter 1. Thus, it is worth asking whether matching is a common property of E-CM’s as well. The full answer to this question will be revealed in the end of the following chapter, but the short answer is this: it is “no”, if all cases meet the descriptive definition of modal concord are concerned; it is “yes”, if “matching” is defined as the requirements put on the flavor and force of the embedded modal by the embedding attitude. In addition, it is clarified that although force asymmetry often goes hand-in-hand with matching, the two do not mutually entail each other.
### Appendix: Frequency Information of Selected Attitude Verbs in CTB7

<table>
<thead>
<tr>
<th>Verb</th>
<th>Gloss</th>
<th>Freq.</th>
<th>IP/CP Comp.</th>
<th>% IP/CP Comp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>认为 renwei</td>
<td>consider</td>
<td>1165</td>
<td>1075</td>
<td>92.3%</td>
</tr>
<tr>
<td>看 kan</td>
<td>think; look at</td>
<td>960</td>
<td>117</td>
<td>12.2%</td>
</tr>
<tr>
<td>知道 zhidao</td>
<td>know</td>
<td>837</td>
<td>459</td>
<td>54.8%</td>
</tr>
<tr>
<td>觉得 juede</td>
<td>think; feel</td>
<td>501</td>
<td>414</td>
<td>82.6%</td>
</tr>
<tr>
<td>发现 faxian</td>
<td>find</td>
<td>442</td>
<td>239</td>
<td>54.1%</td>
</tr>
<tr>
<td>了解 liaojie</td>
<td>know</td>
<td>270</td>
<td>36</td>
<td>13.3%</td>
</tr>
<tr>
<td>相信 xiangxin</td>
<td>believe</td>
<td>261</td>
<td>188</td>
<td>72.0%</td>
</tr>
<tr>
<td>感到 gandao</td>
<td>think; feel</td>
<td>155</td>
<td>94</td>
<td>60.6%</td>
</tr>
<tr>
<td>感觉 ganjue</td>
<td>think; feel</td>
<td>112</td>
<td>66</td>
<td>58.9%</td>
</tr>
<tr>
<td>记得 jide</td>
<td>remember</td>
<td>104</td>
<td>74</td>
<td>71.2%</td>
</tr>
<tr>
<td>知 zhi</td>
<td>know</td>
<td>85</td>
<td>42</td>
<td>49.4%</td>
</tr>
<tr>
<td>怀疑 huaiyi</td>
<td>suspect</td>
<td>73</td>
<td>54</td>
<td>74.0%</td>
</tr>
<tr>
<td>理解 lijie</td>
<td>understand</td>
<td>71</td>
<td>14</td>
<td>19.7%</td>
</tr>
<tr>
<td>以为 yiwei</td>
<td>wrongly think</td>
<td>62</td>
<td>52</td>
<td>83.9%</td>
</tr>
<tr>
<td>明白 mingbai</td>
<td>understand</td>
<td>40</td>
<td>19</td>
<td>47.5%</td>
</tr>
<tr>
<td>清楚 qingchu</td>
<td>clearly know</td>
<td>37</td>
<td>15</td>
<td>52.9%</td>
</tr>
<tr>
<td>忘记 wangji</td>
<td>forget</td>
<td>35</td>
<td>6</td>
<td>17.1%</td>
</tr>
<tr>
<td>认定 rending</td>
<td>firmly believe</td>
<td>34</td>
<td>18</td>
<td>60.0%</td>
</tr>
<tr>
<td>看出 kanchu</td>
<td>figure out</td>
<td>33</td>
<td>23</td>
<td>69.7%</td>
</tr>
<tr>
<td>想到 xiangdao</td>
<td>realize</td>
<td>30</td>
<td>7</td>
<td>23.3%</td>
</tr>
<tr>
<td>坚信 jianxin</td>
<td>firmly believe</td>
<td>10</td>
<td>6</td>
<td>75.0%</td>
</tr>
<tr>
<td>深信 shenxin</td>
<td>deeply believe</td>
<td>8</td>
<td>6</td>
<td>75.0%</td>
</tr>
<tr>
<td>深知 shenzhi</td>
<td>clearly know</td>
<td>4</td>
<td>3</td>
<td>75.0%</td>
</tr>
</tbody>
</table>

Table 3.11: Frequency Information of Selected Doxastic Verbs

<table>
<thead>
<tr>
<th>Verb</th>
<th>Gloss</th>
<th>Freq.</th>
<th>IP/CP Comp.</th>
<th>% IP/CP Comp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>指出 zhichu</td>
<td>point out</td>
<td>686</td>
<td>636</td>
<td>92.0%</td>
</tr>
<tr>
<td>提出 tichu</td>
<td>propose</td>
<td>495</td>
<td>88</td>
<td>17.8%</td>
</tr>
<tr>
<td>决定 jueding</td>
<td>decide;</td>
<td>321</td>
<td>257</td>
<td>80.1%</td>
</tr>
<tr>
<td>强调 qiangdiao</td>
<td>emphasize</td>
<td>276</td>
<td>210</td>
<td>76.1%</td>
</tr>
<tr>
<td>同意 tongyi</td>
<td>agree</td>
<td>242</td>
<td>141</td>
<td>62.9%</td>
</tr>
<tr>
<td>坚持 jianchi</td>
<td>insist</td>
<td>167</td>
<td>59</td>
<td>35.3%</td>
</tr>
<tr>
<td>确定 queding</td>
<td>confirm</td>
<td>149</td>
<td>48</td>
<td>32.2%</td>
</tr>
<tr>
<td>承认 chengren</td>
<td>admit</td>
<td>111</td>
<td>65</td>
<td>58.6%</td>
</tr>
<tr>
<td>解释 jieshi</td>
<td>explain</td>
<td>103</td>
<td>32</td>
<td>31.1%</td>
</tr>
<tr>
<td>证明 zhengming</td>
<td>prove</td>
<td>101</td>
<td>62</td>
<td>61.4%</td>
</tr>
<tr>
<td>否认 fouren</td>
<td>deny</td>
<td>70</td>
<td>25</td>
<td>35.7%</td>
</tr>
<tr>
<td>确认 queren</td>
<td>confirm</td>
<td>51</td>
<td>26</td>
<td>51.0%</td>
</tr>
<tr>
<td>声称 shengcheng</td>
<td>claim</td>
<td>48</td>
<td>42</td>
<td>87.5%</td>
</tr>
<tr>
<td>主张 zhuuzhang</td>
<td>propose</td>
<td>48</td>
<td>36</td>
<td>75.0%</td>
</tr>
<tr>
<td>Verb</td>
<td>Gloss</td>
<td>Freq.</td>
<td>IP/CP Comp.</td>
<td>% IP/CP Comp.</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td>-------</td>
<td>-------------</td>
<td>---------------</td>
</tr>
<tr>
<td>说</td>
<td>shuo</td>
<td>4513</td>
<td>3385</td>
<td>75.0%</td>
</tr>
<tr>
<td>表示</td>
<td>biaoshi</td>
<td>1359</td>
<td>1123</td>
<td>82.6%</td>
</tr>
<tr>
<td>宣布</td>
<td>xuanbu</td>
<td>313</td>
<td>263</td>
<td>75.4%</td>
</tr>
<tr>
<td>讲</td>
<td>jiang</td>
<td>277</td>
<td>52</td>
<td>18.8%</td>
</tr>
<tr>
<td>介绍</td>
<td>jieshao</td>
<td>205</td>
<td>17</td>
<td>8.3%</td>
</tr>
<tr>
<td>告诉</td>
<td>gaosu</td>
<td>201</td>
<td>123</td>
<td>61.2%</td>
</tr>
<tr>
<td>讨论</td>
<td>taolun</td>
<td>189</td>
<td>31</td>
<td>16.4%</td>
</tr>
<tr>
<td>称</td>
<td>cheng</td>
<td>173</td>
<td>123</td>
<td>71.1%</td>
</tr>
<tr>
<td>提到</td>
<td>tidao</td>
<td>104</td>
<td>29</td>
<td>27.9%</td>
</tr>
<tr>
<td>提醒</td>
<td>tixing</td>
<td>72</td>
<td>55</td>
<td>76.4%</td>
</tr>
<tr>
<td>回答</td>
<td>huida</td>
<td>68</td>
<td>8</td>
<td>11.8%</td>
</tr>
<tr>
<td>重申</td>
<td>chongshen</td>
<td>52</td>
<td>38</td>
<td>73.1%</td>
</tr>
<tr>
<td>警告</td>
<td>jinggao</td>
<td>40</td>
<td>16</td>
<td>40.0%</td>
</tr>
<tr>
<td>声明</td>
<td>shengming</td>
<td>17</td>
<td>10</td>
<td>58.9%</td>
</tr>
<tr>
<td>讳言</td>
<td>huiyan</td>
<td>15</td>
<td>12</td>
<td>80.0%</td>
</tr>
<tr>
<td>告知</td>
<td>gaozhi</td>
<td>15</td>
<td>8</td>
<td>53.3%</td>
</tr>
<tr>
<td>暗示</td>
<td>anshi</td>
<td>14</td>
<td>13</td>
<td>92.9%</td>
</tr>
</tbody>
</table>

Table 3.12: Frequency Information of Selected Argumentation Verbs

<table>
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<tr>
<th>Verb</th>
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<th>Freq.</th>
<th>IP/CP Comp.</th>
<th>% IP/CP Comp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>担心</td>
<td>jide</td>
<td>127</td>
<td>83</td>
<td>65.4%</td>
</tr>
<tr>
<td>批评</td>
<td>piping</td>
<td>77</td>
<td>32</td>
<td>41.6%</td>
</tr>
<tr>
<td>害怕</td>
<td>wangji</td>
<td>39</td>
<td>13</td>
<td>33.3%</td>
</tr>
</tbody>
</table>

Table 3.13: Frequency Information of Selected Communication Verbs

<table>
<thead>
<tr>
<th>Verb</th>
<th>Gloss</th>
<th>Freq.</th>
<th>IP/CP Comp.</th>
<th>% IP/CP Comp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>呼吁</td>
<td>huyu</td>
<td>171</td>
<td>161</td>
<td>94.2%</td>
</tr>
<tr>
<td>要求</td>
<td>yaoqiu</td>
<td>410</td>
<td>362</td>
<td>88.3%</td>
</tr>
<tr>
<td>批准</td>
<td>pizhun</td>
<td>117</td>
<td>20</td>
<td>17.1%</td>
</tr>
<tr>
<td>规定</td>
<td>guiding</td>
<td>114</td>
<td>77</td>
<td>67.5%</td>
</tr>
<tr>
<td>建议</td>
<td>jianyi</td>
<td>103</td>
<td>87</td>
<td>84.5%</td>
</tr>
</tbody>
</table>

Table 3.14: Frequency Information of Selected Emotive Verbs

<table>
<thead>
<tr>
<th>Verb</th>
<th>Gloss</th>
<th>Freq.</th>
<th>IP/CP Comp.</th>
<th>% IP/CP Comp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>研判</td>
<td>yanpan</td>
<td>11</td>
<td>9</td>
<td>81.8%</td>
</tr>
</tbody>
</table>

Table 3.15: Frequency Information of Selected Jussive Verbs
<table>
<thead>
<tr>
<th>Verb</th>
<th>Gloss</th>
<th>Freq.</th>
<th>IP/CP Comp.</th>
<th>% IP/CP Comp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>希望  xiwang</td>
<td>hope</td>
<td>618</td>
<td>604</td>
<td>97.7%</td>
</tr>
<tr>
<td>期待    qidai</td>
<td>look forward to</td>
<td>48</td>
<td>18</td>
<td>40.0%</td>
</tr>
<tr>
<td>期望    qiwang</td>
<td>wish</td>
<td>25</td>
<td>19</td>
<td>76.0%</td>
</tr>
<tr>
<td>祝福    zhufu</td>
<td>wish happiness</td>
<td>21</td>
<td>11</td>
<td>52.4%</td>
</tr>
<tr>
<td>期盼    qipan</td>
<td>long for</td>
<td>16</td>
<td>9</td>
<td>56.3%</td>
</tr>
<tr>
<td>祝      zhu</td>
<td>wish (for sb.)</td>
<td>16</td>
<td>15</td>
<td>93.8%</td>
</tr>
<tr>
<td>指望    zhiwang</td>
<td>expect</td>
<td>13</td>
<td>9</td>
<td>69.2%</td>
</tr>
<tr>
<td>祈祷    qidao</td>
<td>pray</td>
<td>10</td>
<td>3</td>
<td>30.0%</td>
</tr>
<tr>
<td>但愿    danyuan</td>
<td>wish; if only</td>
<td>9</td>
<td>4</td>
<td>44.4%</td>
</tr>
<tr>
<td>盼      pan</td>
<td>long for</td>
<td>7</td>
<td>5</td>
<td>71.4%</td>
</tr>
</tbody>
</table>

Table 3.16: Frequency Information of Selected Desiderative Verbs

<table>
<thead>
<tr>
<th>Verb</th>
<th>Gloss</th>
<th>Freq.</th>
<th>IP/CP Comp.</th>
<th>% IP/CP Comp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>预计    yuji</td>
<td>forecast</td>
<td>188</td>
<td>157</td>
<td>83.5%</td>
</tr>
<tr>
<td>估计    guji</td>
<td>estimate</td>
<td>91</td>
<td>68</td>
<td>74.7%</td>
</tr>
<tr>
<td>预测    yuce</td>
<td>predict</td>
<td>57</td>
<td>28</td>
<td>49.1%</td>
</tr>
<tr>
<td>想象    xiangxiang</td>
<td>imagine</td>
<td>48</td>
<td>19</td>
<td>39.6%</td>
</tr>
<tr>
<td>判断    panduan</td>
<td>judge</td>
<td>40</td>
<td>16</td>
<td>40.0%</td>
</tr>
<tr>
<td>猜测    caice</td>
<td>conjecture</td>
<td>23</td>
<td>14</td>
<td>60.9%</td>
</tr>
<tr>
<td>猜想    caixiang</td>
<td>guess</td>
<td>5</td>
<td>4</td>
<td>80.0%</td>
</tr>
</tbody>
</table>

Table 3.17: Frequency Information of Selected Conjecture & Fiction Verbs

<table>
<thead>
<tr>
<th>Verb</th>
<th>Gloss</th>
<th>Freq.</th>
<th>IP/CP Comp.</th>
<th>% IP/CP Comp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>要      yao</td>
<td>want; require</td>
<td>2728</td>
<td>358</td>
<td>13.1%</td>
</tr>
<tr>
<td>想      xiang</td>
<td>think</td>
<td>798</td>
<td>609</td>
<td>76.3%</td>
</tr>
<tr>
<td>保证    baozheng</td>
<td>guarantee</td>
<td>122</td>
<td>73</td>
<td>59.8%</td>
</tr>
</tbody>
</table>

Table 3.18: Frequency Information of Selected Ambiguous Verbs (All Senses Collapsed)
CHAPTER 4
EMBEDDED CONCORD MODALS IN MANDARIN

4.0 Overview

The evidence for E-CM’s is not hard to find. For example, Kratzer (2013) lists a number of such constructions — *ought to* under *desirable, must* under *require, should* under *suggest*, to name a few. However, to better understand the phenomenon, more empirical questions need to be asked. This chapter focuses on the following inquiries concerning E-CM’s: How to diagnose whether a modal is an E-CM? Is the concord effect derived from one single mechanism or from different sources? If E-CM’s form a homogenous class, what are the logical properties shared by all the members. If E-CM’s have different origins, how to characterize the sub-variations?

In what follows, section 4.1 starts with a narrow definition of E-CM that attributes the redundancy of the modal \( M \) to the semantic equivalence of “*an Attitude M p*” and “*an Attitude p*”. I label the modals follow from this definition as Real E-CM, and those do not follow from it but meet the descriptive definition as Pseudo E-CM. In addition, two diagnostic tests, namely the Deletion Test and the Assertion Test, are proposed to assist in identifying attitude-modal pairs that are in concord. Section 4.2 applies the diagnostic two tests to the attitude-modal combinations introduced in Chapter 3, screen out the pairs that stand in concord relation, and sort them into different subclasses. Section 4.3 aligns the results of 4.2 with the combination patterns found in Chapter 3, and discusses the relation between modal concord, force asymmetry, and the matching of modal flavor/force. Then in section 4.4, I compare the concord phenomenon to the anaphoric behavior of epistemic modals, which also renders nonstraightforwardly-compositional
interpretations of the embedded modal. Lastly, section 4.5 concludes the chapter and highlights the core facts to be explained in Chapter 5.

4.1 The Formal Definition of E-CM and the Diagnostic Tests to Detect E-CM’s

Before starting the search for specific instances of E-CM’s, it is necessary to make clear exactly what kind of attitude-modal pairs we are looking for, and how to determine whether a given combination falls into the class. To start out, let us revisit our working definition of modal concord:

- **Working definition**: modal concord is the phenomenon where the semantics of a sentence with two co-occurring modal elements seems to contain only one modal operator.

In the core of this descriptive definition is the effect that two modal operators behave as if one. The question is: Is the effect caused by a unique mechanism, or can it be traced back to different sources? As we do not have further evidence, it is safe to assume for now that modal concord is derived via various routes. At this point it is hard to list out all the possible routes by which the concord effect is arrived, so I take a heuristic approach. I begin with a possibility that is easy to think of: a modal $M$ will be in concord with the matrix verb *Attitude*, if (4.1) holds.

(4.1) “$x \text{ Attitude } M \, p$” is equivalent to “$x \text{ Attitude } p$” in every model.

I distinguish attitude-pairs that posses the property above from other instances, and give the modals in these combinations a special status, and call them **Real E-CM’s**.

(4.2) **Real Embedded Concord Modal**: a modal $M$ is a Real E-CM with respect to an attitude predicate *Attitude*, if and only if “$x \text{ Attitude } M \, p$” and “$x \text{ Attitude } p$” are equivalent in every model.
Based on (4.1-4.2), I motivate two tests to help diagnosing Real E-CM’s. It follows from (4.1) that (4.3a-b) are both true:

(4.3) a. \( x \text{ Attitude } M \ p \models x \text{ Attitude } p \)
   
b. \( x \text{ Attitude } p \models x \text{ Attitude } M \ p \)

When (4.3a) is true, a discourse of the form (4.4a) will be contradictory. Similarly, if (4.3b) holds, (4.4b) will be a contradiction as well. For brevity, I name (4.4a) the **Deletion Test**, and (4.4b) the **Insertion Test**.

(4.4) a. \( x \text{ Attitude } M \ p \& \neg x \text{ Attitude } p \) (deletion test)
   
b. \( x \text{ Attitude } p \& \neg x \text{ Attitude } M \ p \) (insertion test)

If a discourse of the scheme (4.4a) or (4.4b) is judged contradictory, then I will say the test result on the attitude-modal pair is **negative**. If the discourse is coherent, then the test result is **positive**.

A modal is diagnosed to be an E-CM, if both the Deletion Test and the Insertion Test on the modal-attitude combination have negative results. If just one test has negative result, the tested modal is not an E-CM. Look at a concrete example:

(4.5) a. *Lao Li xiangxin xiongshou keneng shi Xiao Wang, dan ta reng bu xiangxin*
   
   Lao Li believe culprit might be Xiao Wang, but he still not believe *xiongshou shi Xiao Wang.*

   culprit be Xiao Wang

   ‘Lao Li believes that the culprit might be Xiao Wang, but he is still not convinced that the culprit is Xiao Wang.’
b. #Lao Li xiangxin xiongshou shi Xiao Wang, dan ta bu xiangxin

Lao Li believe culprit be Xiao Wang, but he not believe xiongshou keneng shi Xiao Wang.

culprit might be Xiao Wang

‘Lao Li believes that the culprit is Xiao Wang, but he does not believe that the culprit might be Xiao Wang.’

The two statements of (4.5a) are logically compatible, so the whole discourse is coherent (i.e. the result of the Deletion Test is positive). In contrast, it is not hard for a native speaker to judge (4.5b) to be contradictory, so the result of the Insertion Test is negative. Since only one test turned negative, I do not diagnose keneng as an E-CM under xiangxin.

Note that both tests may appear negative even when “x Attitude M p” and “x Attitude p” are not semantically equivalent. Here is a concrete example where the Deletion Test is contradictory in a normal context, but is coherent given some particular situations:

(4.6) a. I hope John can win the game, but I don’t hope John will win the game.

b. I hope John CAN win the game, but I don’t hope John WILL win the game.

Discourse (4.6a) sounds contradictory at first glance. Normally, when people hope something can happen, they want it to become real. However, suppose I hate John a lot, so I simply want John to have a good chance to win, but lose eventually, because it will make him more upset. In this scenario, (4.6a) is actually coherent. This reading becomes more obvious in (4.6b), with contrastive focus on can and will.

The example above reminds us the importance of taking into various possible situations in running the diagnostic tests. Yet the more important point (4.6) shows is that some embedded modals like can under hope does feel redundant by naive judgment. It
suggests the earlier assumption that E-CM is a multiple-source phenomenon is correct. There exists E-CM’s that fall out of the class of Real E-CM, but follow from the descriptive definition of modal concord. I will call this class of concord modals **Pseudo E-CM**’s. As will be presented in §5.2, Pseudo E-CM is a heterogeneous group too. *Can*-under-*hope* represents a subtype of Pseudo E-CM, whose distinctive logical property is expressed as (4.7a). As (4.7a) gives rise to concord, it is natural to conjecture that property (4.7b) will have the same effect. Indeed, Pseudo E-CM’s posses the property (4.7b) are detected (See §4.2.3 for details). We will encounter more variations as the discussion goes along.

\[
\begin{align*}
(4.7) & \quad \text{a. } \text{“}x \text{ Attitude } M p \text{” ENTAILS } \text{“} x \text{ Attitude } p \text{” } \& \text{ “} x \text{ Attitude } p \text{” IMPLICATES } \text{“} x \text{ Attitude } p \text{”} \\
& \quad \text{b. } \text{“} x \text{ Attitude } p \text{” ENTAILS } \text{“} x \text{ Attitude } M p \text{” } \& \text{ “} x \text{ Attitude } M p \text{” IMPLICATES } \text{“} x \text{ Attitude } p \text{”}
\end{align*}
\]

In conclusion, I showed in this section that E-CM is a multiple-source phenomenon. The effect that two modal operators appear to be one can be derived from different combinations of semantic/pragmatic conditions. I provided a formal definition for Real E-CM, which requires mutual entailment between “x Attitude M p” and “x Attitude p” in every world or situation. Also, I proposed two diagnostic tests, namely the Deletion Test and the Insertion Test, to assist in determining E-CM’s. If the two tests, each is a discourse composed of two simple propositions, are invariably contradictory through out all possible scenarios, then the tested modal is a Real E-CM. Otherwise, if the two tests are both negative in part of the possible worlds, then the tested modal is a Pseudo E-CM.
4.2 An Incomplete Catalogue of E-CM’s by the Class of Attitude Verbs

This section applies the diagnostic tests introduced in the previous section to the attitude-modal combinations introduced in the previous chapter. To limit the discussion to a manageable scale, I will focus on the pairs that are in concord, and set aside those that are not in concord. I assume for now the non-concord combinations have uniform behavior, and will come back to this issue in section 4.4. To further streamline the discussion so that the main patterns can be better presented, I will talk about only a subset of the verbs in the full list: the items that represent the typical behavior of their classes, and the members that have exceptional behaviors with respect to the majority of the class. Below is the enumeration of selected verbs for each semantic class:

A. Acceptance verbs

I investigate the interpretation of modals under acceptance verbs in subsection 4.2.1. The two representative verbs of the doxastic class are xiangxin ‘believe’ and renwei ‘think’. The representative verbs of the communication/argumentation class are shuo ‘say’ and queding ‘confirm’. I also discuss huaiyi ‘suspect’ and wangji ‘forget’, which are incompatible with necessity epistemics, and baozheng ‘assure’ which disallows both possibility epistemics and weak necessity epistemcis.

B. Conjecture and fiction

Conjecture and fiction verbs are discussed in 4.2.2. The representative member is caice ‘guess’.

C. Emotive

Emotive verbs are examined in 4.2.3. The verbs discussed include the factive-emotive piping ‘criticize’ and the doxastic-emotive danxin ‘worry’.
D. Desiderative

Subsection 4.2.4 is dedicated to desiderative verbs represented by *xiwang* ‘hope’.

E. Jussive

Jussive verbs are very diverse in licensing of modals in their complements. In subsection 4.2.5, I discuss four verbs: *yaoqi* ‘demand’, *jianyi* ‘suggest’, *pizhun* ‘approve’ and *guiding* ‘make a regulation’.

4.2.1 Acceptance Verbs

First, consider the doxastic verbs of the acceptance class. Most members of this class are in real concord with an epistemic modal. Some verbs are in concord with the strong necessity epistemic *yiding* (e.g. *jianxin* ‘firmly believe’), some are in concord with the weak necessity epistemic *yinggai* (e.g. *renwei* ‘think’), and *huaiyi* ‘suspect’, which only accepts possibility epistemic in its complement, makes the possibility epistemic modal *keneng* a Real E-CM. Some doxastic verbs do not stand in concord relation with any modal, *xiangxin* ‘believe’ belongs to this sub-group. Consider the diagnostic tests below:

\[(4.8) a. \text{Lao Li xiangxin xiongshou }\check{\text{yinggai}⁄yiding} \text{ shi Xiao Wang, dan ta reng bu xiangxin xiongshou shi Xiao Wang.}\\
\text{Lao Li believe culprit should must be Xiao Wang but he still not xiangxin xiongshou shi Xiao Wang.}\\
\text{believe culprit be Xiao Wang}\\
\text{‘Lao Li believes the culprit should be/is definitely Xiao Wang, but he still does not believe the culprit is Xiao Wang.’}\\
b. \text{Lao Li xiangxin xiongshou shi Xiao Wang, dan ta bu xiangxin xiongshou}\\
\text{Lao Li believe culprit be Xiao Wang but he not believe culprit}\\
\]
#yinggai/✓yiding shi Xiao Wang.

should must be Xiao Wang

‘Lao Li thinks the culprit is Xiao Wang, but he does not think the culprit should be/is definitely Xiao Wang.’

(4.9) a. Lao Li renwei xiongshou #yinggai/#yiding shi Xiao Wang, dan ta reng bu

Lao Li think culprit should must be Xiao Wang but he still not
renwei xiongshou shi Xiao Wang.

think culprit be Xiao Wang

‘Lao Li thinks the culprit should be/is definitely Xiao Wang, but he still does not think the culprit is Xiao Wang.’

b. Lao Li renwei xiongshou shi Xiao Wang, dan ta bu renwei xiongshou

Lao Li think culprit be Xiao Wang but he not think culprit
#yinggai/✓yiding shi Xiao Wang.

should definitely be Xiao Wang

‘Lao Li thinks the culprit is Xiao Wang, but he does not think the culprit should be/is definitely Xiao Wang.’

As illustrated by (4.8a), the Deletion Test on yinggai under xiangxin is coherent (yinggai is marked by✓). Thus, yinggai is not concord with xiangxin. Similarly, in (4.8b) yiding receives a ✓, indicating that the Insertion Test on yiding under xiangxin is coherent. Therefore, yiding is not an E-CM in the complement of xiangxin either.

In contrast, as (4.9a-b) show, both tests on yinggai under renwei are negative. Also, I cannot think of a possible scenario in which either of the discourses is coherent, so I diagnose yinggai as a Real E-CM in the complement of renwei. As for yiding, like in
(4.8b), inserting yinggai to the complement of renwei will render an assertion stronger than the original one; so yiding is obviously not a concord modal under renwei.

Next look at jianxin ‘firmly believe’ and huaiyi ‘suspect’. As the diagnostic tests in (4.10-4.11) all turn out negative, and I cannot think of a scenario in which any of the discourses is coherent. So I identify both yiding under jianxin and keneng under huaiyi to be Real E-CM. Note that a weak necessity epistemic and a possibility epistemic in the complement of jianxin will both receive Escape Hatch readings. Similarly, necessity epistemics under huaiyi are forced to have Escape Hatch interpretation as well.

(4.10) a. #Lao Li jianxin xiongshou yiding shi Xiao Wang, dan ta Lao Li firmly believe culprit must be Xiao Wang but he bu jianxin xiongshou shi Xiao Wang. not firmly believe culprit be Xiao Wang

‘Lao Li believes the culprit must be Xiao Wang, but he still does not believe the culprit is Xiao Wang.’

b. #Lao Li jianxin xiongshou shi Xiao Wang, dan ta bu jianxin Lao Li firmly believe culprit be Xiao Wang but he not firmly believe xiongshou #yiding shi Xiao Wang.
culprit must be Xiao Wang

‘Lao Li firmly believes the culprit is Xiao Wang, but he does not firmly believe the culprit must be Xiao Wang.’

(4.11) a. #Lao Li huaiyi xiongshou keneng shi Xiao Wang, dan ta bu huaiyi Lao Li suspect culprit might be Xiao Wang but he not suspect xiongshou shi Xiao Wang.
culprit be Xiao Wang.
‘Lao Wang suspects that the culprit might be Xiao Wang, but he does not suspect that the culprit is Xiao Wang.’

b. #Lao Li huaiyi xiongshou shi Xiao Wang, dan ta bu huaiyi xiongshou

Lao Li suspect culprit be Xiao Wang but he not suspect culprit

keneng shi Xiao Wang.

might be Xiao Wang

‘Lao Wang suspects that the culprit is Xiao Wang, but he does not suspect that the culprit might be Xiao Wang.’

The last verb of the doxastic class that I discuss in this subsection is wangji ‘forget’.

Wangji resists necessity epistemics in positive environments. The possibility epistemic keneng ‘might’ is allowed, but not in concord with the verb:

(4.12) a. #Lao Li wangji le xiongshou keneng shi Xiao Wang. Ta mei wangji

Lao Li forget Asp. culprit might be Xiao Wang he not forget

xiongshou shi Xiao Wang.

culprit be Xiao Wang

‘Lao Wang forgot that the culprit might be Xiao Wang. He did not forget that the culprit was Xiao Wang.’

b. Lao Li wangji le xiongshou shi Xiao Wang. Ta mei wangji xiongshou

Lao Li forget Asp. culprit be Xiao Wang he not forget culprit

keneng shi Xiao Wang.

might be Xiao Wang

‘Lao Li forgot that the culprit was Xiao Wang. He did not forget that the culprit might be Xiao Wang.’
As (4.12) shows, *keneng* is not in concord with *wangji*. Although the Deletion Test on *keneng*-under-*wangji* (that is, (4.12a)) turns out contradictory; the Insertion Test (4.12b) is coherent: Because the verb *wangji* ‘forget’ is semi-factive, and the first assertion of (4.12b) is positive, it is true that the culprit was Xiao Wang. So it is compatible with Lao Li’s current beliefs that the culprit is not Xiao Wang. Lao Li did not forget that the culprit might be Xiao Wang, so it follows that he believes the possibility of the culprit being Xiao Wang. Therefore, the two assertions of (4.12) are compatible with each other.

The table below is an interim summary of the discussions above. The last row is added to make the picture complete.

<table>
<thead>
<tr>
<th></th>
<th>xiangxin ‘believe’</th>
<th>renwei ‘think’</th>
<th>jianxin ‘firmly believe’</th>
<th>huaiyi ‘suspect’</th>
<th>wangji ‘forget’</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>yiding</em> ‘definitely’</td>
<td>not concord</td>
<td>not concord</td>
<td><strong>Real Concord</strong></td>
<td><strong>Escape Hatch</strong></td>
<td>N/A</td>
</tr>
<tr>
<td><em>yinggai</em> ‘should _epi’</td>
<td>not concord</td>
<td><strong>Real Concord</strong></td>
<td><strong>Escape Hatch</strong></td>
<td><strong>Escape Hatch</strong></td>
<td>N/A</td>
</tr>
<tr>
<td><em>keneng</em> ‘might’</td>
<td>not concord</td>
<td>not concord</td>
<td><strong>Escape Hatch</strong></td>
<td><strong>Real Concord</strong></td>
<td>not concord</td>
</tr>
<tr>
<td>Circumstantial</td>
<td>not concord</td>
<td>not concord</td>
<td>not concord</td>
<td>not concord</td>
<td>not concord</td>
</tr>
</tbody>
</table>

Table 4.1: E-CM’s with Doxastic Verbs

Next turn to the verbs of argumentation and communication. Consider the communication verb *shuo* ‘say’ first. To make the comparison parallel, I confine the discussion to constructions in which the complement of *shuo* is an indirect speech -- not direct or mixed-quotation (Maier 2009, 2010). Epistemic modals in the scope of *shuo* interact with the matrix verb in a way different from how they behave under doxastic verbs. (4.13) show that both diagnostic tests on necessity epistemic under *shuo* turn out perfectly coherent. In fact, replacing *yinggai/yiding* with any modal expression won’t
alter the test results. These facts suggest that \textit{shuo} probably has a neo-Davisonian semantics as Kratzer’s (2013) analysis: It simply denotes a speaking event with content, but does not introduce quantification over possible worlds itself.

\begin{equation}
\text{(4.13) a. Lao Li, shuo ta, yinggai/yiding jian guo Xiao Wang, dan Lao Li, mei shuo Lao Li say he should definitely meet Asp. Xiao Wang but Lao Li not say ta, jian guo Xiao Wang.}
\end{equation}

Lao Li say he should definitely meet Asp. Xiao Wang but Lao Li not say he meet Asp. Xiao Wang

‘Lao Li said he (=Lao Li) he should have met Xiao Wang before, but Lao Li did not say that he had met Xiao Wang before.’

\begin{equation}
\text{a. Lao Li, shuo ta, jian guo Xiao Wang, dan Lao Li, mei shuo ta, yinggai}
\end{equation}

Lao Li say he meet Asp. Xiao Wang but Lao Li not say he should/yiding jian guo Xiao Wang.

definitely meet Asp. Xiao Wang

‘Lao Li said he (=Lao Li) he should have met Xiao Wang before, but Lao Li did not say that he should/definitely had met Xiao Wang before.’

Now look at the argumentation verb \textit{zhuzhang} ‘propose’ and see whether it behaves the same as the communication verb \textit{shuo} ‘say’. The diagnostic tests presented in (4.14) suggest that \textit{zhuzhang} does not pattern with \textit{shuo} but rather has similar behavior as \textit{renwei} ‘think’: the Deletion Tests on both \textit{yiding} and \textit{yinggai} under \textit{zhuzhang} turn out negative, but only the Insertion Test on \textit{zhuzhang-yinggai} has negative result. \textit{Yiding} strengthens the non-modalized statement, thus makes the Insertion Test coherent.

\begin{equation}
\text{(4.14) a. Lao Li zhuzhang xiongshou #yinggai/#yiding shi Xiao Wang, ta meiyou Lao Li propose culprit should definitely be Xiao Wang he not}
\end{equation}

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zhuzhang xiongshou shi Xiao Wang.

propose culprit be Xiao Wang.

‘Lao Wang proposed that the culprit should be/is definitely Xiao Wang, he did not propose that the culprit is Xiao Wang.’

b. Lao Li zhuzhang xiongshou shi Xiao Wang, ta meiyou zhuzhang xiongshou

Lao Li suspect culprit be Xiao Wang but he not suspect culprit

#yinggai/yiding shi Xiao Wang.

should definitely be Xiao Wang

‘Lao Wang proposed that the culprit is Xiao Wang; he did not propose that the culprit should be/is definitely Xiao Wang.’

Lastly, turn to baozheng ‘assure’. Baozheng, like jianxin ‘firmly believe’, disallows both possibility and weak necessity epistemics (unless the modal receives an Escape Hatch reading), and is in Real Concord with the strong necessity epistemic yiding.

Consider the diagnostic test in (4.15):

(4.15) a. #Lao Li baozheng xiongshou yiding shi Xiao Wang. Lao Li bing-meiyou

Lao Li assure culprit definitely be Xiao Wang Lao Li not

baozheng xiongshou shi Xiao Wang.

assure culprit be Xiao Wang

‘Lao Li assured that the culprit was definitely Xiao Wang. Lao Li did not assure that the culprit was Xiao Wang.’

b. #Lao Li baozheng xiongshou shi Xiao Wang. Lao Li bing-meiyou baozheng

Lao Li assure culprit be Xiao Wang Lao Li not assure
culprit definitely be Xiao Wang.
‘Lao Li assured that the culprit was Xiao Wang. Lao Li did not assure that
the culprit was definitely Xiao Wang.’

As (4.15a-b) demonstrate, both the Deletion Test and Insertion Test applied on yiding-
under-baozheng returned negative results. Also, both tests are invariably negative with
respect to different scenarios I can think of, so I diagnose yiding as a Real E-CM under
baozheng. It is worth pointing out that removing yiding does not make the statement
“weaker” as it does under some other verbs (e.g. renwei ‘think’; “x renwei yiding p” is
stronger than “x renwei p”, in the sense that the former asymmetrically entail the other).
There is an intuition that baozheng itself expresses a strong commitment to the
complement proposition, and yiding echoes this property of the attitude verb.

Table 4.2 below summarizes the E-CM’s in the complement of verbs of
communication and argumentation.

<table>
<thead>
<tr>
<th></th>
<th>shuo ‘say’</th>
<th>zhuzhang ‘propose’</th>
<th>baozheng ‘assure’</th>
</tr>
</thead>
<tbody>
<tr>
<td>yiding ‘definitely’</td>
<td>not concord</td>
<td>not concord</td>
<td>Real Concord</td>
</tr>
<tr>
<td>yinggai ‘should_epi’</td>
<td>not concord</td>
<td>Real Concord</td>
<td>Escape Hatch</td>
</tr>
<tr>
<td>keneng ‘might’</td>
<td>not concord</td>
<td>not concord</td>
<td>Escape Hatch</td>
</tr>
<tr>
<td>Circumstantial</td>
<td>not concord</td>
<td>not concord</td>
<td>not concord</td>
</tr>
</tbody>
</table>

Table 4.2: E-CM’s with Communication & Argumentation Verbs
To conclude, acceptance verbs are quite diverse in terms of involving in concord relation with modal expressions in their complements. Some verbs are not in concord with any modal, some are in concord with epistemic modals of different modal force. The strong necessity epistemic yiding is a Real E-CM in the complement of jianxin ‘firmly believe’ and baozheng ‘assure’; under renwei ‘think’ and zhuzhang ‘propose’, the weak necessity epistemic yinggai is a Real E-CM; and the possibility epistemic keneng is a Real E-CM with respect to huaiyi ‘suspect’.

4.2.2 Conjecture and Fiction Verbs

Conjecture verbs are in general stand in Real Concord relation with the weak necessity epistemic yinggai. The possibility epistemic modal keneng is a Pseudo E-CM in the complement of the conjecture verbs. Take caice ‘guess’ for illustration.

(4.16) a. #Lao Li caice xiongshou yinggai shi Xiao Wang. Lao Li bing-fei caice

Lao Li guess culprit should be Xiao Wang. Lao Li not guess xiongshou shi Xiao Wang.

culprit be Xiao Wang

‘Lao Li guesses that the culprit should be Xiao Wang. It is not the case that Lao Li guesses the culprit is Xiao Wang’

b. #Lao Li caice xiongshou shi Xiao Wang. Lao Li bing-fei caice

Lao Li guess culprit be Xiao Wang. Lao Li not guess xiongshou yinggai shi Xiao Wang.

culprit should be Xiao Wang

‘Lao Li guesses that the culprit is Xiao Wang. It is not the case that Lao Li guesses the culprit should be Xiao Wang.’
The results of both the Deletion Test (4.16a) and the Insertion Test (4.16b) on yinggai-under-caice are both negative regardless of scenarios (Note that “negation lowering” is forced; i.e. the negation of “x caice p” is “x caice neg. p” instead of “x neg. caice p”).

The test results suggest that yinggai in the complement of caice is a Real E-CM.

When not carrying any focus, the epistemic possibility keneng seems to be in concord with caice as well. Both (4.17a-b) are contradictory in normal circumstances.

(4.17) a.#Lao Li caice gongsi keneng caiyuan, dan ta caice gongsi
Lao Li guess company might layoff but he guess company
but hui caiyuan.
not will layoff
‘Lao Li guesses that the company might layoff employees, but he
guesses that the company will not layoff employees.’

b.#Lao Li caice gongsi hui caiyuan, dan ta caice gongsi bu
Lao Li guess company will layoff but he guess company not
keneng caiyuan.
might layoff
‘Lao Li guesses that the company will layoff employees, but he guesses that
the company might not layoff employees.’

However, suppose the scenario is such that Lao Li conjectures that layoff is a possible but
not likely action the company is going to take. In such a context, (4.17a) is perfectly
coherent. The dialogue in (4.18) makes this point clearer:

(4.18) A: Wo caice keneng you caiyuan.
I guess might have layoff
'I guess there might be a layoff.'

B: O, ni cai hui caiyuan a.

oh you guess will layoff SFP

‘Oh, you guess a layoff will a layoff in foce.’

A: Wo zhi-shi shuo you keneng.

I only say have possibility

‘I only said it is possible.’

In the dialogue, speaker B paraphrases speaker A’s utterance, but the interpretation gets rejected by speaker A, although that is what people normally assume in hearing that sentence. This data point shows that keneng is a Pseudo E-CM, rather than a Real E-CM under the conjecture verb caice.

In contrast with conjecture verbs, the fiction verb xiangxiang ‘imagine’ is not in concord with any modal in its complement. As shown in (4.19), the results of the diagnostic tests on xiangxiang-EPISTEMIC combinations pattern with the tests results on xiangxin (‘believe’)-EPISTEMIC pairs: keneng and yinggai receive check mark in the Deletion Test, and yiding in the Insertion Test. None of them makes both diagnostic tests turn out negative, and all are not E-CM relative to xiangxiang.

(4.19) a. Li Bai ceng xiangxiang diqiu ✓keneng✓yinggai/#yiding shi yuan-de, dan

Li Bai used to imagine earth might should definitely be round but

ta meiyou xiangxiang diqiu shi yuan-de.

he not imagine earth be round

‘Li Bai used to imagine that the earth might be/should be/is definitely round; but he did not imagine that the earth is round.’
b. Li Bai ceng xiangxiang diqiu shi yuan-de, dan ta meiyou xiangxiang diqiu

Li Bai used to imagine earth be round but he not imagine earth

might should definitely be round

‘Li Bai used to imagine that the earth might be/should be/is definitely round;

but he did not imagine that the earth is round.’

Table 4.3 summarizes the discussions of this subsection:

<table>
<thead>
<tr>
<th>xiangxiang ‘imagine’</th>
<th>Modal</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>all</td>
<td>not concord</td>
</tr>
<tr>
<td>yinggai ‘should’epi’</td>
<td>Real Concord</td>
<td></td>
</tr>
<tr>
<td>keneng ‘might’</td>
<td>Pseudo Concord</td>
<td></td>
</tr>
<tr>
<td>other</td>
<td>not concord</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3: E-CM’S under Conjecture & Fiction Verbs

4.2.3. Emotive Verbs

The priority impossibility bu yinggai ‘should not’ under piping ‘criticize’ is a Real E-CM.

Consider (4.20):

(4.20) #a. Lao Li piping wo bu yinggai tuoyan. Ta mei piping wo tuoyan.

Lao Li criticize I not should procrastinate he not criticize I procrastinate

‘Lao Li criticized me, saying I should not have procrastinated. He didn’t criticize me for procrastinating.’

#b. Lao Li piping wo tuoyan. Ta mei piping wo bu yinggai tuoyan.

Lao Li criticize I procrastinate he not criticize I not should procrastinate

‘Lao Li criticized me for procrastinating, he did not criticize me, saying I should not have procrastinated.’
Both the Deletion Test (4.20a) and the Insertion Test (4.20b) are contradictory, and the judgments on the felicity of (4.20a-b) do not vary in different scenarios. Therefore, I identify *bu yinggai* as a Real E-CM relative to *piping*.

As demonstrated by (4.21), certain usages of the ability/circumstantial modal *neng* is apparently in concord the matrix verb *piping*:

(4.21) #a. Lao Li piping wo *neng tuoyan*. Ta mei piping wo tuoyan.

Lao Li criticize I can procrastinate he not criticize I procrastinate

‘Lao Li criticized me, saying I tend to procrastinated. He didn’t criticize me for procrastinating.’

#b. Lao Li piping wo tuoyan. Ta mei piping wo *neng tuoyan*.

Lao Li criticize I procrastinate he not criticize I can procrastinate

‘Lao Li criticized me for procrastinating, he did not criticize me, saying I tend to procrastinated.’

However, in cases like (4.21a-b), the complement with an overt modal (i.e *wo neng tuoyan* ‘I tend to procrastinate’) and the complement without one (i.e. *wo tuoyan* ‘I procrastinate’) are equivalent even in root environment. The modal *neng* in *wo neng tuoyan* ‘I tend to procrastinate’ does not express circumstantial possibility, but rather generic tendency. Likewise, *wo tuoyan* ‘I procrastinate’ is a generic statement as well. Since in *neng*-under-*piping*, the embedding attitude is not responsible for the redundancy of *neng*, we should not identify the configuration as a concord construction. Rather, the ability/circumstantial modal *neng* is interpreted independent of the embedding attitude, and “*x piping neng p*” has a straightforward compositional reading.
Next turn to the other subclass of emotive verbs, the namely doxastic-emotives. The possibility epistemic keneng is in concord with verbs of this group. Take danxin ‘worry’ for instance:

(4.22) #a. Lao Li danxin Xiao Wang keneng chu-shi le. Lao Li bu danxin
Lao Li worry Xiao Wang might have-accident Asp. Lao Li not worry
Xiao Wang chu-shi le.
Xiao Wang have-accident Asp.
‘Lao Li worries that Xiao Wang might have had an accident. Lao Li does not worry that Xiao Wang had an accident.’

#b. Lao Li danxin Xiao Wang chu-shi le. Lao Li bu danxin
Lao Li worry Xiao Wang have-accident Asp. Lao Li not worry
Xiao Wang keneng chu-shi le.
Xiao Wang might have-accident Asp.
‘Lao Li worries that Xiao Wang had an accident. Lao Li does not worry that Xiao Wang might have had an accident.’

The result of the Deletion Test (4.22a) and the result of the Insertion Test (4.22b) are both negative, and they stay negative again various scenarios. These facts indicate keneng is a Real E-CM under danxin.

An ability/circumstantial modal like neng is a Pseudo E-CM under danxin ‘worry’. Consider (4.23):

(4.23) #a. Lao Li danxin Xiao Wang neng faxian ta-de mimi. Lao Li bu danxin Xiao
Lao Li worry Xiao Wang can discover his secret Lao Li not worry Xiao
Wang faxian ta-de mimi.

Wang discover his secret

‘Lao Li worries that Xiao Wang can discover his (=Lao Li) secret. Lao Li does not worry Xiao Wang will discover his secret.’

?b. Lao Li danxin Xiao Wang faxian ta-de mimi. Lao Li bu danxin Xiao

Lao Li worry Xiao Wang discover his secret Lao Li not worry Xiao

Wang neng faxian ta-de mimi.

Wang can discover his secret

‘Lao Li worries that Xiao Wang can discover his (=Lao Li) secret. Lao Li does not worry Xiao Wang will discover his secret.’

The Deletion Test (4.23a) is uncontroversially contradictory. The Insertion Test (4.23b) seems contradictory in normal scenarios as well. However, (4.23b) can be coherent in some particular contexts. Imagine the scenario as follows: Lao Li protects his secret very well, and he believes Xiao Wang is not smart enough to figure it out. In this context, Lao Li does worry that Xiao Wang will actually know his secret, but he does not worry Xiao Wang is able to discover it by himself; and because of this, (4.23b) is coherent.32 As (4.23b) is only negative in some but not all scenarios, thus neng is a Pseudo (rather than Real) E-CM under danxin.

Table 4.4 is a summary of E-CM’s under emotive verbs.

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32 Note that the modalized complement and the non-modalized complement have different contextual alternatives. The alternatives of “Xiao Wang can discover Lao Li’s secret” is propositions such as “Lao Li reveals the secret to Xiao Wang by accident”, “Lao Li’s mortal enemy discovers the secret and reveals it to Xiao Wang”, etc.
Table 4.4: Concord and Pseudo Concord Modals under Emotive Verbs

4.2.4 Desiderative Verbs

A pure circumstantial modal is a Pseudo E-CM under desiderative verbs. Take *xiwang* ‘hope’ for illustration.

(4.24) #a. *Lao Li xiwang Xiao Wang ying, dan Lao Li bu xiwang Xiao Wang neng ying.*

Lao Li hope Xiao Wang win but Lao Li not hope Xiao Wang can win

‘Lao Li hopes that Xiao Wang will win, but Lao Li does not hope Xiao Wang can win.’

#b. *Lao Li xiwang Xiao Wang neng ying, dan Lao Li bu xiwang Xiao Wang ying.*

Lao Li hope Xiao Wang can win but Lao Li not hope Xiao Wang win

‘Lao Li hopes that Xiao Wang can win, but Lao Li does not hope Xiao Wang will win.’

The result of Insertion Test (2.24b) is invariably negative. This is expected, because in all worlds where \( p \) is realized, the circumstances are such that it is possible for \( p \) to realize. In the case of (4.24), if Lao Li wants Xiao Wang to win, he also wants the circumstances are such that Xiao Wang is able to win. The Deletion Test (4.24a), however, is not contradictory in all scenarios. Imagine the following one: Lao Li hates Xiao Wang personally. It is desirable for Lao Li if Xiao Wang loses the game. But Lao Li thinks that Xiao Wang would feel even worse if he is defeated in spite of all the favorable conditions.
In this setting, “Xiao Wang can win” is more desirable for Lao Li than “Xiao Wang cannot win”, and as a result, (4.24b) is coherent. The Deletion Test reveals that “x xiwang p” is not an entailment of “x xiwang neng p”, but a conversational implicature of it. The canceling of the implicature is clearer in examples like (4.25):

(4.25) Women xiwang zhe zhong wuqi nenggou cuihui zhengge chengshi, dan
we hope this kind weapon can destroy whole city but
women bing bu xiwang ta zhen-de cuihui renhe chengshi.
we and not hope it actually destroy any city
‘We do hope this kind of weapon is able to destroy a city as a whole, but we do not hope it would actually destroy any city.’

The discourse (4.25) is perfectly coherent. In consideration of national security, it makes sense for people to want powerful weapons that has the potential to destroy a whole city. However, this does not imply that anybody wants to actually put the weapon to use.

4.2.5 Jussive Verbs

Jussive verbs are diverse in terms of involving in concord with embedded modals. Let us start with a relatively simple case, pizhun ‘permit; approve’. This verb only accepts priority possibility keyi in its complement, and is in Real Concord with keyi. It is clear to me that both the Deletion Test (4.26a) and the Insertion Test (4.26b) on the pizhun-keyi combination have negative results in all possible scenarios I can think of. Thus, I decide that keyi under pizhun is a Real E-CM.

(4.26) a. #Lao Li pizhun Xiao Wang likai. Lao Li mei pizhun Xiao Wang keyi likai.
Lao Li approve Xiao Wang leave Lao Li not approve Xiao Wang may leave
'Lao Li approved Xiao Wang to leave. Lao Li did not approve Xiao Wang to leave optionally.'

b. "Lao Li pizhun Xiao Wang keyi likai. Lao Li mei pizhun Xiao Wang likai.
Lao Li approve Xiao Wang leave Lao Li not approve Xiao Wang may leave
‘Lao Li approved Xiao Wang to leave optionally. Lao Li did not approve Xiao Wang to leave.’

Next turn to yaoqiu ‘demand; require’, which only allows necessity priority modal in its complement. The strong necessity modal bixu is in Real Concord with the matrix verb yaoqiu, but the weak necessity modal yinggai always expresses its own force. Imagine the following scenario: Lao Li is a senior engineer of our company, who has been worked with us for almost fifteen years. Recently, he is suspected to have violated the company’s regulations on confidentiality. I am the head of human resource department. At the end of a meeting with me, the CEO concluded that we must fire Lao Li, and said to me:

(4.27) Mashang citui Lao Li.
immediately fire Lao Li
‘Fire Lao Li immediately.’

In the context described above, (4.28b) seems to express the same meaning as (4.28a), as (4.29a-b) are both clearly contradictory.

(4.28) a. Laoban yaoqiu wo citui Lao Li.
boss demand I fire Lao Li
‘The boss demand I fire Lao Li.’

b. Laoban yaoqiu wo bixu citui Lao Li
boss demand I must fire Lao Li
‘The boss demand that I must fire Lao Li.’

c. Laoban yaoqiu wo yinggai citui Lao Li.

boss demand I should fire Lao Li

‘The boss r that I should fire Lao Li.’

(4.29) a. #Laoban yaoqiu wo bixu citui Lao Li, buguo ta mei yaoqiu wo citui Lao Li.

boss demand I must fire Lao Li but he not demand I fire Lao Li

‘The boss demanded I must fire Lao Li, but he did not demand I fire Lao Li.’

b. #Laoban yaoqiu wo citui Lao Li, buguo ta mei yaoqiu wo bixu citui Lao Li.

boss demand I fire Lao Li but he not demand I must fire Lao Li

‘The boss demanded I fire Lao Li, but he did not demand I must fire Lao Li.’

In contrast, (4.28c) is only marginally acceptable unless the priority with respect to which the embedded modal yinggai is relativized to is explicitly expressed in the sentence (e.g.(4.30)). In fact, because yinggai under yaoqiu needs the support of such information, it always expresses its own modality, and is not in concord with the matrix verb.

(4.30) Laoban yaoqiu wo wei-le fangzhi zai ci xiemi yinggai citui Lao Li.

boss demand I for prevent again Cl. leak of secret should fire Lao Li

‘The boss demanded that in order to prevent further leak of secret, I should fire Lao Li.’

Next look at the suggestive verb jianyi ‘suggest’. Jianyi allows both necessity and possibility priority modals in its complement. It is clear that the strong necessity bixu is not in concord with jianyi, because it functions to strengthen the original statement. As shown in (4.31), the Deletion Test on jianyi-bixu (4.31a) turns out perfectly coherent, while the Insertion Test (4.31b) is contradictory.
(4.31) a. Yisheng jianyi Lao Li jie kafei, meiyou jianyi ta bixu jie kafei.

doctor suggest Lao Li quit coffee did not suggest he must quit coffee

‘The doctor suggested Lao Li to stop drinking coffee, (she) did not must that

he should stop drinking coffee’

#b. Yisheng jianyi Lao Li bixu jie kafei, meiyou jianyi ta jie kafei.

doctor suggest Lao Li must quit coffee did not suggest he quit coffee

‘The doctor suggested that Lao Li must stop drinking coffee, (she) did not

suggest him to stop drinking coffee’

Now apply the tests to the weak necessity modal yinggai under jianyi:

(4.32) #a. Yisheng jianyi Lao Li jie kafei, meiyou jianyi ta yinggai jie kafei.

doctor suggest Lao Li quit coffee did not suggest he should quit coffee

‘The doctor suggested Lao Li to stop drinking coffee; (she) did not suggest

that he should stop drinking coffee’

#b. Yisheng jianyi Lao Li yinggai jie kafei, meiyou jianyi ta jie kafei.

doctor suggest Lao Li should quit coffee did not suggest he quit coffee

‘The doctor suggested that Lao Li should stop drinking coffee; (she) did not

suggest him to stop drinking coffee’

(4.32a-b) are both negative, and the results do not vary with contexts, thus yinggai is a

Real E-CM with respect to jianyi.
Possibility priority modal *keyi* is in concord with *jianyi* as well. As (4.33a-b) show, both the Deletion Test and the Insertion Test on *jianyi-keyi* are contradictory in normal scenarios.

(4.33) a. *Yisheng jianyi Lao Li keyi jie kafei, meiyou jianyi ta jie kafei.*  
   doctor suggest Lao Li could quit coffee did not suggest he quit coffee  
   ‘The doctor suggested that Lao Li could stop drinking coffee; (she) did not suggest him to stop drinking coffee’

   b. *Yisheng jianyi Lao Li jie kafei, meiyou jianyi ta keyi jie kafei.*  
   doctor suggest Lao Li quit coffee did not suggest he could quit coffee  
   ‘The doctor suggested Lao Li to stop drinking coffee; (she) did not suggest that he could stop drinking coffee’

The question is: Can *keyi* ever express its own force given the right context? It is really hard to construct such a context. (4.34) is an approximation:

(4.34) *Scenario:* Lao Li has been suffering from sleeping problems for a while. Last time, the doctor suggested him to stop drinking coffee, but he failed. So the next the doctor prescribed some medication, and said:

   *Yisheng jianyi Lao Li keyi shishi chi yao, dan qishi ta bu jianyi*  
   doctor suggest Lao Li may try eat medicine but in fact he not suggest  
   *Lao Li chi yao.*

   Lao Li eat medicine

   ‘The doctor suggested Lao Li may try take some medication, but in fact he does not suggest Lao Li to take any medication.’

---

33 Note that unlike English *suggest*, the Chinese verb *jianyi* does not have the sense “state or express indirectly”. Therefore, “*x jianyi keyi p*” does not have the reading that “*x raises the possibility that p*”.

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Based on examples like (4.34), I conclude that “x jianyi keyi p” is not semantically equivalent as “x jianyi p”, so keyi is a Pseudo E-CM under jianyi. Another indirect argument for this treatment is: jianyi-yinggai is a Real Concord pair, if jianyi-keyi is in Real Concord as well, then it follows that “x jianyi yinggai p” and “x jianyi keyi p” are semantically equivalent. This conclusion is disturbing, as yinggai and keyi are duals of each other, and are not supposed to have the same semantic contribution.

Lastly, consider guiding ‘make a regulation’. Like jianyi, guiding also allows both necessity and possibility priority modals in its complement. The difference is: “x jianyi keyi p” implies “x jianyi p”, but “x guiding keyi p” does not imply “x guiding p”. Therefore, keyi is obviously not in concord with guiding. Also, different from yaoqiu ‘demand; require’, the weak necessity modal yinggai does not need the support of expressions of priorities with respect to which the modal is interpreted. Consider a concrete example:

(4.35) Gongsi guiding yuangong bixu/yinggai chuan zhifu.

company make regulation employee must should wear uniform

‘The company makes it a regulation that the employees must/should wear uniform.’

(4.35) is perfectly acceptable regardless of the strength of the embedded modal. When the complement is modified by bixu, the sentence means that wearing uniform is forced whatsoever; when yinggai is used, it is understood that exceptional cases are taken into consideration.
Although \textit{bixu} and \textit{yinggai} are equally acceptable, \textit{guiding} is in concord with only the weak necessity modal \textit{yinggai} ((4.37a-b) are both contradictory). The strong necessity modal \textit{bixu} renders a stronger claim, thus the Insertion Test (4.36b) is coherent.

(4.36) a. \#\textit{Gongsi guiding yuangong bixu chuan zhifu; dan meiyou} company make regulation employee must wear uniform but not \textit{guiding yuangong chuan zhifu}.

make regulation employee wear uniform

‘The company regulation says that the employees must wear uniform; but it does not require the employees to wear uniform.’

b. \textit{Gongsi guiding yuangong chuan zhifu; dan meiyou} company make regulation employee wear uniform but did not \textit{guiding yuangong bixu chuan zhifu}.

make regulation employee must wear uniform

‘The company regulation requires the employees to wear uniform; but it does not specify that the employees must wear uniform.’

(4.37) a. \#\textit{Gongsi guiding yuangong bixu chuan zhifu; dan meiyou} company make regulation employee must wear uniform but not \textit{guiding yuangong chuan zhifu}.

make regulation employee wear uniform

‘The company regulation says that the employees should wear uniform; but it does not require the employees to wear uniform.’

b. \#\textit{Gongsi guiding yuangong chuan zhifu; dan meiyou} company make regulation employee wear uniform but did not
The company regulation requires the employees to wear uniform; but it does not specify that the employees should wear uniform.

Table 4.5: Interpretation of Priority Modals Under Jussive Verbs

<table>
<thead>
<tr>
<th>pizhun ‘approve’</th>
<th>keyi ‘may’</th>
<th>yinggai ‘should’</th>
<th>bixu ‘must’</th>
</tr>
</thead>
<tbody>
<tr>
<td>jianyi ‘suggest’</td>
<td>?Real E-CM</td>
<td>Real Concord</td>
<td>not concord</td>
</tr>
<tr>
<td>yaoqi ‘demand; require’</td>
<td>--</td>
<td>?!/not concord</td>
<td>Real Concord</td>
</tr>
<tr>
<td>guiding ‘make regulation’</td>
<td>not concord</td>
<td>Real Concord</td>
<td>not concord</td>
</tr>
</tbody>
</table>

4.2.6 Summary

Table 4.6 provides an overview of the interpretation of modals in various attitude contexts. The names of columns to the right of column Verb indicate different modal force and flavor combinations; for instance, P_e refers to possibility force epistemic flavor. The double dash “--” indicates that the combination is disallowed; C stands for concord; P-C stands for pseudo-concord. Otherwise, the cell is left blank. The force-asymmetry cases (§3.4) are indicated by thick solid borders (e.g. baozheng ‘guarantee’ allows epistemic strong necessity, but resists epistemic possibility and weak necessity).

The table shows: (i) Verbs that license epistemic modals in their complements are either not in concord with any embedded modal, or stand in Real Concord with an epistemic modal. (ii) Epistemic modals and priority modals of all forces can be Real E-CM’s. (iii) A pure circumstantial modal can only be a Pseudo E-CM.
<table>
<thead>
<tr>
<th>Class</th>
<th>Verb</th>
<th>P_e keneng</th>
<th>W_e yinggai</th>
<th>N_e yiding</th>
<th>P_p keyi</th>
<th>W_p yinggai</th>
<th>N_p bixu</th>
<th>P_c neng/nenggou</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doxastic</td>
<td>renwei ‘think’</td>
<td>R.C.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>xiangxin ‘believe’</td>
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<tr>
<td></td>
<td>huaiyi ‘suspect’</td>
<td>R.C.</td>
<td>--</td>
<td>--</td>
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<tr>
<td></td>
<td>wangji ‘forget’</td>
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<tr>
<td>Communication-Argumentation</td>
<td>shuo ‘say’</td>
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<tr>
<td></td>
<td>zhuzhang ‘propose’</td>
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<tr>
<td></td>
<td>baozheng ‘guarantee’</td>
<td>--</td>
<td>--</td>
<td>R.C.</td>
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<tr>
<td></td>
<td>shengming ‘declare’</td>
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<tr>
<td>Conjecture</td>
<td>caice ‘guess’</td>
<td>P.C.</td>
<td>R.C.</td>
<td></td>
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<tr>
<td>Emotive-factive</td>
<td>piping ‘criticize’</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>R.C neg.</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doxastic-emotive</td>
<td>danxin ‘worry’</td>
<td>R.C.</td>
<td>--</td>
<td>--</td>
<td>P.C.</td>
<td></td>
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<tr>
<td>Desiderative</td>
<td>xiwang ‘hope’</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>P.C.</td>
<td></td>
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<tr>
<td>Jussive</td>
<td>jianyi ‘suggest’</td>
<td>--</td>
<td>--</td>
<td>P.C.</td>
<td>R.C.</td>
<td>--</td>
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<tr>
<td></td>
<td>yaoqiu ‘demand; require’</td>
<td>--</td>
<td>--</td>
<td>?</td>
<td>R.C.</td>
<td>--</td>
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<tr>
<td></td>
<td>pizhun ‘approve’</td>
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<td>R.C.</td>
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<tr>
<td></td>
<td>guiding ‘make a regulation’</td>
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<td>R.C.</td>
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</table>

Table 4.6: Interpretation of Modals in Attitude Contexts

4.3 Concord, Matching and Force Asymmetry

In the previous literature, matching in flavor and force is considered as an important constraint on canonical modal concord (§1.2). Recall the examples (1.6a-b) discussed in Chapter 1, repeated below as (4.36a-b).

(4.38) a. You **may** (epistemic; ⬤) **possibly** (epistemic; ⬤) have read my little
monograph upon the subject.

b. Power carts **must** (deontic; □) **mandatorily** (deontic; □) be used on cart paths where provided.

(Geurts & Huitink 2006, §1(1))

The two modals of (4.38a) are both possibility epistemics, while both modals in (4.38b) are necessity deontics. Geurts & Huitink propose that concord may only happen when the two modals match in both modal type and quantificational force. One of the subtopics of this dissertation is to verify whether matching is required for a concord modal and the embedding attitude.

Consider the matching of modal type first. It is not easy to decide whether a modal and an attitude verb have the same flavor in many cases. The attitude verbs have more concrete lexical meanings than the modal expressions, and are often composed of multiple semantic components. Therefore, it is often hard to determine which semantic category the attitude belongs to. For example, it is relatively clear that *xiangxin* ‘believe’ and *huaiyi* ‘suspect’ have doxastic/epistemic components in their meaning; but what about *wangiji* ‘forget’? This verb does not seem to have a deontic or teleological flavor, but does it have a doxastic flavor? Also think about *piping* ‘criticize’. This verb seems to have a normative component (certain standards of evaluation are implied), so it should be deontic/teleological. But in the meantime, “*a piping* x P” presupposes that x P is actual and the matrix subject knows that. From this perspective, *piping* seems to have a doxastic/epistemic component as well.

Next consider the matching of quantificational force. The question of whether the matrix verb and the embedded modal match in force is only meaningful when the attitude
verbs are quantifiers over possible worlds. Although I do not assume that all attitude verbs have Hintikkan style semantics, I do adopt lexical entries involving quantifications for most of the attitude verbs (refer to §5.2-5.3 for details). The question of whether force matching between an E-CM and the matrix verb is a generally constraint cannot be answered without examining the concord pairs one by one. I will return to this issue in §5.4, and provide a full answer there. Here I will just put the conclusion: Yes. All Real Concord attitude-modal pairs match in their quantificational force in some way.

Besides matching, as shown in Chapter 3 (also reflected in Table 4.6 in the previous section), force asymmetry companies E-CM’s in many instances. For instance, huaiyi ‘suspect’ is compatible with epistemic possibility, but resists epistemic necessity. Pizhun ‘approve’ allows deontic possibility, but disallows deontic necessity. The question arises is: Is force asymmetry an indicator of E-CM? This question can be answered now based on the patterns summarized in Table 4.6: No. There is no perfect correlation between the two. Some attitude verbs restrict the force of modals in their complement, but the modal allowed in the context is not an E-CM (Asymmetric-but-not-Concord). For example, wangji ‘forget’ allows epistemic possibility but disallows epistemic necessity. However, keneng ‘might’ is not in concord with wangji. The opposite case exists as well. Some modals are in concord with the embedding attitude, but the attitude is not sensitive to modal force (Concord-but-not-Asymmetric). Take guiding ‘regulate’ for example; a deontic yinggai ‘should’ under guiding is a Real E-CM, but a deontic possibility keyi is compatible with the verb as well. Although there exist instances of both Concord-but-not-Asymmetric and Asymmetric-but-not-Concord combinations, in most cases, an attitude verb that licenses an E-CM in its complement also exhibits force asymmetry. Concrete
examples of the Concord-and-Asymmetric group include epistemic strong necessity
*yiding* under *baozheng* ‘guarantee’, the epistemic possibility *keneng* under huaiyi
‘suspect’, deontic impossibility *bu-yinggai* under *piping* ‘criticize’, etc.

In conclusion, there is no easy way to answer whether an E-CM and the matrix verb
match in modal type and modal force, because attitude verbs do not necessarily have a
simple Hintikkan style semantics. I will leave the final answer to this question in Chapter
5, after analyzing the individual concord attitude-modal pairs. As for the relation between
concord and force asymmetry, the alignment of the judgment data from the previous and
current chapter shows that force asymmetry is neither a necessary nor a sufficient
condition of modal concord.

### 4.4 Restrictions on the Interpretation of Modal by the Embedding Verb

In §4.2, I made the assumption that all non-concord combinations are all interpreted in
the straightforwardly compositional manner. The goal of this section is to show that this
uniform view is incorrect. The interpretation of some non-concord modals is more
restricted than others.

#### 4.4.1 Anaphoric Behavior of Epistemic Modals

In Chapter 2 I have introduced the theory that epistemic modals are anaphoric in nature
(§2.3.2). Below I repeat the crucial evidence and argument of the theory below.

Yalcin (2007) reports that the conjunctions in (4.39a-b) are defective. He refers to
instances like these as *epistemic contradictions*. Yalcin further shows that epistemic
contradictions are not even “supposable” (see (4.40)):

\[(4.39) \begin{align*}
&a. \text{It is raining and it might not be raining.} & \phi \& \lozenge \neg \phi \\
&b. \text{It is not raining and it might be raining.} & \neg \phi \& \lozenge \phi
\end{align*}\]
(Yalcin 2007, (1), (3))

(4.40) 

#a. Suppose it is raining and it might not be raining.

#b. Suppose it is not raining and it might be raining.

(Yalcin 2007, (7), (8))

The facts as illustrated by (4.39-4.40) lead Yalcin to propose a domain semantics for epistemic modals, which is formalized as (4.41).

(4.41) \[ \langle \Diamond \phi \rangle_{S,w}^{c} \text{ is true iff } \exists w' \in S: \langle \phi \rangle_{S,w'}^{c} \]

\( (s \text{ is the information state; an epistemic modal is interpreted relative to a } s) \)

(4.41) explains the epistemic contradiction as follows: If the speaker knows that it is raining, all worlds in S by the time of uttering “it might not be raining” will be raining worlds (formally, \( \forall w \in S: \llbracket \text{It is raining} \rrbracket^w \)). Thus it is contradictory to assert that some worlds in S are non-raining worlds (\( \exists w \in S: \neg \llbracket \text{It is raining} \rrbracket^w \)).

The domain semantics with the form (4.41) is complemented by the analyses of attitude verbs as sketched out in (4.42a) to account for the unacceptability of epistemic contradictions in embedded contexts (i.e. examples like (4.40)). The key point of (4.42a) is this: The attitude verbs are able to shift the S parameter of the embedded epistemic modal, and replace it with the set of worlds compatible with the agent’s attitude.

(4.42) 

a. \[ \llbracket \text{imagine } \phi \rrbracket_{S,w}^{c} \text{ is true iff } \forall w' \in S_{x}^{w}: \langle \phi \rangle_{S_{w}^{w'},w'}^{c} \]

b. \[ \llbracket \text{imagine might } \phi \rrbracket_{S,w}^{c} \text{ is true iff } \forall w' \in S_{x}^{w}: \langle \text{might } \phi \rangle_{S_{w}^{w'},w'}^{c} = \]

\[ \forall w' \in S_{x}^{w}: \exists w'' \in S_{x}^{w}: \langle \phi \rangle_{S_{w}^{w'},w''} = \exists w'' \in S_{x}^{w}: \langle \phi \rangle_{S_{w}^{w'},w''} \]

\( (S_{x}^{w} \text{ is defined as the set of worlds not excluded by what } x \text{ supposes in } w) \)

(Yalcin 2007, (7), (8))
As (4.42b) demonstrates, the domain of *might* (originally *S*) is now shifted by *suppose* ($S^w_x$, the set of worlds compatible with what *x* supposes in *w*), so the two quantifiers range over the set of worlds, namely $S^w_x$. Consequently, the quantification contributed by the verb ends up trivial, and the whole sentence appears to contain only one modal operator, which inherits the domain from *suppose*, and force from *might*. Schematically, the embedding attitude (■) and the epistemic modal (◊) interact as follows: ■◊φ ↔ ◆φ (Yalcin 2007: p997). In other words, the interaction of the two operators yields the dual of the attitude verb.

If Yalcin’s is right, then the interpretation of constructions like ‘*x suppose might p*’ is indeed not predicted by straightforward composition based on a standard semantics. The straightforward composition would allow the embedded modal to have a domain different from the embedding attitude (for example, the *might* in ‘*x suppose might p*’ could have a Escape Hatch reading, in which the modal is relative to, say, the contents of the documents in a filing cabinet). However, the salient interpretation of “*x suppose might p*” is in fact the highly restricted one, in which the domain of the modal is set by the embedding attitude. This mechanism is analogous to the way reflexive pronouns find their antecedents within a syntactic domain; thus epistemic modals should be viewed as anaphoric, and the relation between an embedded epistemic and the embedding attitude is a binding relation in broad sense.

In light of the facts discussed above, one may ask: How is binding related to concord? The following subsection addresses this question.
4.4.2 Binding and Concord

First, let us compare the binding relation between an attitude verb and the epistemic modal in its complement to the relation between an E-CM and the matrix verb.

There are several possible relations between binding and concord as illustrated by the Venn diagrams in Figure 4.1: (a) the two are two different phenomena with some intersecting cases; (b) they are independent phenomena with no intersection at all; (c) one is a subcase of the other; (d) they are actually identical.

![Venn diagrams]

Figure 4.1 Possible Relation between Biding and Concord

As far as the core pattern of each concept is concerned, binding and concord are not identical (i.e. option (d) should be crossed out). In the binding relation, though the modal does not have an “independent” modal base, its modal force is still recognizable on the surface. In contrast, in the concord relation, the modal behaves as if it carries an “Ignore me” flag. For example, might in (4.43) is bound by believe but is not in concord with the verb:

(4.43) Vann believes that Bob might be in his office. (Yalcin 2007, (19))
That said, binding and concord are not completely separate either. From a theoretical point of view, if the modal has the same force as the attitude, a bound reading would produce an instance of modal concord. The data point in (4.44) provides a concrete example of this kind:

(4.44) a. Vann believes that Bob must be in his office.
        b. Vann believes that Bob is in his office.
        c. # Vann believes that Bob must be in his office, but Venn does not believe Bob is in his office.
        d. #Vann believes that Bob is in his office, but Venn does not believe Bob must be in his office.

(4.44c-d), the diagnostic tests for E-CM’s are both contradictory, indicating that believe and must are in concord. In the mean time, (4.44c-d) can also be explained by Yalcin’s anaphoric analysis of epistemic modals: the domain of must is set by believe, and the matrix verb turns out to contribute a vacuous layer of quantification over the doxastic alternatives of Vann. Therefore, (4.44) shows that binding-and-concord cases do exist.

So far, we have seen both (i) instances that are binding-but-not-concord (4.43), and (ii) instances that are binding-and-concord (4.44), but have not seen (iii) concord-but-not-binding cases yet. Now there left two live possibilities: either concord is a subset of binding, if (iii) does not exist, or concord is an independent phenomenon that shares some intersection with binding, if (iii) is attested.

Concord-but-not-binding means that the concord reading cannot be explained by the mechanism of domain binding. I have argued in §4.1-4.2 that E-CM is a heterogeneous phenomenon, and the concord effect may be derived by different mechanisms. Therefore,
it is expected that domain binding cannot account for all subtypes of E-CM’s. For example, the xiwang (‘hope’) - neng (‘can’) combination is in Pseudo Concord, and the concord effect of this pair is jointly caused by the entailment from “x xiwang p” to “x xiwang neng p”, and the implicature from “x xiwang neng p” to “x xiwang p”. Domain binding does not play a role in this subtype of E-CM. In conclusion, concord-but-not-binding cases do exist, which indicates that binding and concord are two different phenomena that have an intersection.

Even though concord is not a subset of binding, can we derive all the Real E-CM’s based on domain binding? I will present in Chapter 5 how far Yalcin’s idea of domain shifting can be extended to explain the Real Concord instances. The short answer is: Binding plays a role in Real Concord, as far as the matrix verb has a quantificational semantics.

4.5 Conclusion

This chapter is devoted to look for the sub-variations and individual instances of E-CM’s in Mandarin. Since we do not know in advance what subtypes are there under the umbrella of E-CM, I adopted a heuristic approach. To start out, I defined Real E-CM based on semantic equivalence (repeated as (4.45)), and call attitude-modal combinations that satisfy the descriptive definition, but do not follow from the definition (4.45) as Pseudo Concord pairs. In addition, two diagnostic tests, namely the Deletion Test (repeated below as (4.46a)) and the Insertion Test ((4.46b)) to assist in identifying the instances for the two subclasses. If both tests turn out contradictory (negative result) in all scenarios, the attitude-modal pair is in Real Concord; if the two tests are contradictory in
some but not all contexts, then the attitude-modal pair is in Pseudo Concord; otherwise the pair is not in concord.

(4.45) **Real Embedded Concord Modal:** a modal M is a Real E-CM with respect to an attitude predicate Attitude, if and only if “x Attitude M p” and “x Attitude p” are equivalent in every model.

(4.46) a. \( x \) Attitude Mod \( p \) & \(~ x \) Attitude \( p \) (Deletion Test)  

b. \( x \) Attitude \( p \) & \(~ x \) Attitude Mod \( p \) (Insertion Test)

Aligning the judgments on E-CM’s to the attitude-modal compatibility matrix from Chapter 3, I show that there is no perfect correlation between the **force asymmetry** (for a given modal type, the attitude is compatible with one quantificational force but not others) and modal concord. I also show that more careful examinations of the semantics of attitude verbs are needed to determine whether matching of modal flavor and force is a common property of E-CM’s.

Lastly, I distinguish two kinds of non-concord interpretations. In addition to the basic straightforward compositional interpretation, there is a phenomenon of **binding**, where the embedding attitude restricts the quantificational domain of the embedded modal. The prototypical example of this kind is “x believe might p”, in which the matrix verb and the embedded epistemic modal behaves as if one operator -- the dual of believe. Then I discussed the relationship between binding and concord, and concluded that the two are independent phenomena, and in the intersection of the two are some Real Concord instances.

I stop here for the empirical discussions of embedded concord modals in Mandarin. Although the data are from a specific language, I consider the conclusions drawn from the descriptions as part of a general theory: (i) Concord effect can be derived from...
different mechanisms. (ii) Acceptance verbs are in concord with epistemic modals, priority modals are E-CM’s under attitudes with normative components, and ability/circumstantial modals can only be Pseudo E-CM’s. (iii) Real Concord is closely related to the biding of modal domain by the matrix verb, while implicature plays a role in Pseudo Concord. In the following chapter, I provide formal analyses for the E-CM’s discovered in this chapter.
5.0 Overview

The previous chapter distinguished two subgroups of E-CM’s and labeled them **Pseudo E-CM** and **Real E-CM** respectively. This chapter will provide formal analyses for them. Because the subvariations within E-CM’s are not indentified, efforts are made to explain both varieties uniformly in the previous literature. For example, Cui (2013) proposes a collostructional approach toward concord constructions, which claims that the concord interpretation is the conventionalized meaning associated with the constructions that contain E-CM’s. In Section 5.1, I will introduce the argument of this view in detail, and refute it.

Section 5.2 analyzes two sub-patterns of Pseudo E-CM’s. The first class shares the logical pattern (5.1a), where \( X \leadsto Y \) represents \( X \) implicates \( Y \). The second class has the logical property (5.1b), which is similar to (5.1a) but differs in the direction of entailment and implicature.

\[(5.1) \text{a. } \text{“a Att } p \text{” } \models \text{ “a Att Mod } p \text{” and “a Att Mod } p \text{” } \leadsto \text{ “a Att } p \text{”}
\]

\[\text{b. } \text{“a Att Mod } p \text{” } \models \text{ “a Att } p \text{” and “a Att } p \text{” } \leadsto \text{ “a Att Mod } p \text{”}
\]

Both (5.1a-b) contain an entailment and a **strengthening implicature** between two propositions. I will derive the entailments from the semantics of the attitude verbs, and account for the implicatures by invoking the principle of informativeness (Atlas & Levinson 1981). The specific examples studied are listed in Table 5.1. I will leave the
The analyses of Real E-CM’s are presented in Section 5.3. In this section, I first discuss the E-CM’s that have epistemic flavor, and then the ones with priority flavor. The central idea I borrow to account for the Real E-CM’s is domain shifting (Yalcin 2007): The quantificational domain of the embedded modal is bound by the matrix attitude verb in an anaphoric manner. Since the attitude and the modal have the same domain, the quantification contributed by the attitude becomes trivial. As a result, concord effect arises when the force of the modal is identical to the force of the attitude. Schematically, □□p⇔□p or ◊◊p⇔◊p. The specific examples that will be discussed in this section are summarized in Table 5.2:

<table>
<thead>
<tr>
<th>Representational Example</th>
<th>Logical Property</th>
</tr>
</thead>
<tbody>
<tr>
<td>a huaiyi ('suspect') keneng ('might') p</td>
<td>“a Att p” ≡ “a Att Mod p”</td>
</tr>
<tr>
<td>a danxin ('worry') keneng ('might') p</td>
<td>“a Att Mod p” ⇔ “a Att p”</td>
</tr>
<tr>
<td>a renwei ('think') yinggai ('should_epi') p</td>
<td>“a Att p” ⇔ “a Att Mod p”</td>
</tr>
<tr>
<td>a caice ('guess') yinggai ('should_epi') p</td>
<td>“a Att p” ⇔ “a Att Mod p”</td>
</tr>
<tr>
<td>a baozheng ('assure') yiding ('definitely') p</td>
<td>“a Att p” ⇔ “a Att Mod p”</td>
</tr>
<tr>
<td>a jianxin ('firmly believe') yiding ('definitely') p</td>
<td>“a Att p” ⇔ “a Att Mod p”</td>
</tr>
</tbody>
</table>

Table 5.2 Real E-CM’s: Summary
Lastly, Section 5.4 concludes the chapter and the whole dissertation. I also discuss what is the function of modal concord, and why human languages have E-CM’s.

### 5.1 Non-compositional Approach to Modal Concord

In my earlier work (Cui 2013) I propose the hypothesis that modal concord between an embedded modal and the embedding attitude verb is not compositional, and that the concord reading is an idiomatic usage of the construction as a whole. For convenience of reference, I label this view as the *non-compositional approach*.

First let us look at the empirical observations based on which the non-compositional hypothesis is made. Cui (2013) studies two aspects of modal-under-attitude configurations. One is whether these configurations receive a concord interpretation or not. The other aspect is the statistical association between an attitude and the modal in its complement. Aligning the judgments and the statistical results, the combined data show that the concord attitude-modal pairs exhibit significant attraction to each other. The hypothesis that concord reading is idiomatic was proposed on the basis of this correlation.

Below I cite the table that summarizes the core data of the work.

<table>
<thead>
<tr>
<th></th>
<th>xiangxin ‘believe’</th>
<th>xiwang ‘hope’</th>
<th>yaoqiu ‘require’</th>
</tr>
</thead>
<tbody>
<tr>
<td>N_{a,p}</td>
<td>4.19</td>
<td>-1.30</td>
<td>0.44</td>
</tr>
<tr>
<td>N_{p}</td>
<td>0.06</td>
<td>3.20</td>
<td>2.82</td>
</tr>
<tr>
<td>N_{a,p,d}</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>W_{a,p}</td>
<td>0.77</td>
<td>4.03</td>
<td>0.31</td>
</tr>
<tr>
<td>N_{p,d}</td>
<td>0.64</td>
<td>6.71</td>
<td>0.60</td>
</tr>
<tr>
<td>W_{p,d}</td>
<td>2.27</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>P_{a,e,d}</td>
<td>0.11</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>P_{e}</td>
<td>1.77</td>
<td>2.96</td>
<td>-1.99</td>
</tr>
<tr>
<td>PMI</td>
<td></td>
<td>3.75</td>
<td>4.94</td>
</tr>
<tr>
<td>χ²</td>
<td></td>
<td></td>
<td>2.30</td>
</tr>
<tr>
<td>judgment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>yiding</td>
<td>√</td>
<td>✓</td>
<td>✓</td>
</tr>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
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<td>dei</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Table 5.3: PMI and χ² Values of Attitude-Modal Pairs
How do the empirical data above lead to the non-compositional hypothesis? The logic is like this: the strong attraction between the attitude and the modal needs to be explained. A likely reason why they co-occur surprisingly often is that it is a convention of the language to use them together to express certain not-fully-compositional meanings, just like in the cases of collocations/idioms. For example, the statistical association between *strong* and *coffee* is stronger than the association between *powerful* and *coffee*; this is because it is the convention of English to use *strong coffee* rather than *powerful coffee* to refer to coffee with excessive amount of caffeine. Similarly, *chip* attracts *blue* significantly more often than other color words, because *blue chip* has a non-compositional meaning that is conventionalized to that expression. Analogously, the reason why those attitude-modal pairs co-occur more often than expected in Att-IP constructions (the construction where an attitude verb takes a sentential complement) is possibly that the modal-under-attitude configurations are associated with certain not-fully-compositional meanings. This idea coincides with the fact that the significant combinations are all judged as concord pairs. Therefore, it seems reasonable to further hypothesize that modal concord is a non-compositional meaning associated with the corresponding modal-under-attitude configuration. This proposal can potentially explain both the quantitative results and the qualitative judgments: a modal-attitude pair is more frequent than expected because it is not fully compositional; to be specific, the modal force is expressed only once.

Note that since the non-compositional hypothesis ties together the strong attraction and concord interpretation, the following predictions should hold:
(i) The attitude verb and embedded modal in a concord relation will have significantly frequent\textsuperscript{34} co-occurrence in the Att-IP construction.

\textit{Reason:} If concord reading is due to non-compositionality, and the statistical property of non-compositional expressions is surprisingly high frequency of co-occurrence, then the occurrence of a concord attitude-modal pair is expected to be significantly frequent.

(ii) The attitude-modal combinations with high significance of attraction are likely to be concord.

\textit{Reason:} There could be other reasons why the attraction is strong, but many of them should be due to non-compositionality.

From the predictions we can tell that the non-compositional hypothesis is a very strong claim, and its validity is not hard to test on empirical grounds. We can apply the same statistical analysis to a larger set of data (as was suggested in the original talk), and see whether the predictions are borne out. In the rest of this section, I will describe the details of the statistical methodology for measuring attraction between attitude-modal pairs, and apply it to the attitude-modal pairs involved in this project. I refute my original proposal based on the experimental results, and discuss other problems with the analysis.

\textbf{5.1.1 Collostruc\textit{tional Analysis}}

\textit{5.1.1.1 Terminologies}

The methodology adopted for the statistical study in Cui (2013) is a variation of collostruc\textit{tional analysis proposed by Gries & Stefanowitsch (2004a, 2004b).}

\footnote{Significantly frequent means the observed frequency is surprisingly high with respect to the expected frequency. Usually a statistical test such as the $\chi^2$ test is applied to examine the statistical significance of the distribution.}
**Collostruction**, as a kin of collocation (frequent words within a given window span around the node word), refers to co-occurrence of lexical items and a grammatical construction. Consider the examples below:

(5.2) a. He gave Evelyn a Valentine’s Day card.  (ditransitive construction)

        b. He tricked me into employing him.  (into-causative construction)

Sentence (5.2a) is an instance of ditransitive construction (V-O\textsubscript{1}-O\textsubscript{2}); give- O\textsubscript{1}-O\textsubscript{2}, the co-occurrence of verb give and the syntactic construction V-O\textsubscript{1}-O\textsubscript{2}, is an instance of collostruction. Lexical items significantly associated with a specific slot of the construction, e.g. give in ditransitive construction, are often called **collexemes**.

The example (5.2b) is an instance of into-causative construction (V-into-Ving). Both trick-into-Ving and V-into-employing are collostructions, and trick-into-employing is a collostruction as well. The collexeme in the V (cause predicate) slot and Ving (result predicate) slot of the into-causative construction may show high co-variation. The **co-varying** collexemes (i.e. co-occur significantly more frequent than expected) such as bounce-accept (Gries & Stefanowitsch 2004b, Table 4) are subject to linguistic explanation. In other words, we need to explain why these collexemes co-vary.

5.1.1.2 Collostructional Analysis for Single Collexeme

Collostructional analysis as an extension of the analysis of collocation investigates the interaction between a particular grammatical construction and words (collexemes) that appear in a particular slot of the construction. Specifically, it looks at the frequency of the collexemes, and tests whether a collexeme occurs significantly more frequent than expected. Take xi\textsubscript{wang} ‘hope’ for illustration.
As presented by Table 5.4, the absolute frequency of *xiwang* ‘hope’ in CTB7 is 618, among which 604 instances appear in Att-IP construction. The frequency of Att-IP construction regardless of the specific attitude verb is 12947, and the sum of all attitude verbs in all contexts is 21876. The boldfaced numbers can be drawn directly from the corpus, and numbers in other cells of the table can be calculated based on the boldfaced ones.

<table>
<thead>
<tr>
<th></th>
<th><em>xiwang</em> ‘hope’</th>
<th>other attitude verbs</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Att-IP</td>
<td><strong>604</strong></td>
<td><strong>12343</strong></td>
<td><strong>12947</strong></td>
</tr>
<tr>
<td>E₁₁ =</td>
<td><strong>618</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>other contexts</td>
<td><strong>14</strong></td>
<td><strong>8915</strong></td>
<td><strong>8929</strong></td>
</tr>
<tr>
<td>Totals</td>
<td><strong>618</strong></td>
<td></td>
<td><strong>21258</strong></td>
</tr>
<tr>
<td>N =</td>
<td><strong>21876</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.4: Distribution of *Xiangxin* ‘believe’ in Att-IP Constructions and Other Contexts

Based on the distribution in Table 5.4, we can calculate how much the observed frequency of *xiangxin* in Att-IP deviates from the expectation, and test whether the deviation is statistically significant. For the first purpose, **pointwise mutual information** (PMI) may be applied; for the second task, the appropriate test is **Fisher’s exact test** (I will explain shortly why this is so).

The formula for PMI is given in (5.3). It measures the logarithm of the ratio of observed frequency over expected frequency. As (5.4) shows, the PMI of *xiwang*-IP is 0.502. The figure is positive, indicating *xiwang*-IP is more frequent than expected.

\[
(5.3) \quad \text{PMI} = \log_2 \left( \frac{\text{observed frequency}}{\text{expected frequency}} \right) = \log_2 \left( \frac{O_{11}}{ (Pr(\text{Att-IP}) \ast Pr(xiangxin) \ast N) } \right) = \log_2 \left( \frac{O_{11}}{ ( \frac{012 + 011}{N} \ast \frac{021 + 011}{N} \ast N) } \right) = \log_2 \left( \frac{O_{11}}{ \frac{(012 + 011) \ast (021 + 011)}{N} } \right)
\]
Similarly, the PMI of modal *neng* in Att-IP construction can be calculated on the basis of the distribution given in Table 5.5. As presented in (5.5), the PMI of Att-IP(*neng*) is -1.013. This is a negative value, which indicates that Att-IP(*neng*) is less frequent than expectation.

\[
(5.4) \quad \text{PMI}_{\text{xiwang-IP}} = \log_2 \left( \frac{604}{ \frac{12947 \times 618}{21876} } \right) \approx 0.502
\]

\[
(5.5) \quad \text{PMI}_{\text{Att-IP}(\text{\textit{neng})}} = \log_2 \left( \frac{353}{ \frac{12947 \times 1642}{21876} } \right) \approx -1.013
\]

The advantage of PMI is that its interpretation is intuitively clear. If the value is negative, it means the observed frequency is lower than expectation, and if positive, higher than expectation, and the absolute value indicates the degree of deviation.

However, PMI does not tell us how (un)likely the value is in terms of statistics. The significance test appropriate for collostructional analysis is Fisher’s exact test. This is because a large number of collexemes occurring in any given constructions tend to have a low absolute frequency in that construction. Fisher’s exact test does not make any specific distributional assumptions (in contrast to, for example, the normal distribution assumed for Student’s *t* test), and thus it does not put requirement on the size of any particular sample.

The *p*-values of Fisher’s test computed on the distributions in Table 5.4 and Table 5.5 are *p* = 5.240595e-118 and *p* = 4.884654e-230 respectively. These values are both

\[35\text{ When the complement does not contain an overt modal operator, it is assumed that there is a null one.}\]
exceptionally small. The p values combined with the corresponding PMI values tell us that xiwang ‘hope’ occurs significantly more often than expected, and neng ‘can’ occurs significantly less often than would be expected, given a random distribution of the two words in Att-IP construction.

5.1.1.3 Co-varying Collexeme Analysis

We have just seen the collostructional analysis for single collexeme, but the interest of this project is the co-occurring pattern of two collexemes, namely the modal and the embedding attitude. The same methodology described above can be extended to test whether two collexemes in the Att-IP construction co-occurrence significantly often.

Take the xiwang-neng combination for example:

<table>
<thead>
<tr>
<th></th>
<th>neng ‘can’</th>
<th>other modals</th>
<th>Row Sums</th>
</tr>
</thead>
<tbody>
<tr>
<td>xiwang ‘hope’-IP</td>
<td>O₁₁= 93</td>
<td>O₁₂= 511</td>
<td>604</td>
</tr>
<tr>
<td></td>
<td>E₁₁ = 604 * 353 / 21876 ≈ 9.746</td>
<td></td>
<td></td>
</tr>
<tr>
<td>other Att-IP</td>
<td>O₂₁= 260</td>
<td>O₂₂= 21012</td>
<td>21272</td>
</tr>
<tr>
<td>Column Sums</td>
<td>353</td>
<td>21253</td>
<td>N = 21876</td>
</tr>
</tbody>
</table>

Table 5.6: Xiwang (‘hope’)-Neng (‘can’) Combination in Att-IP Construction

As Table 5.6 presents, the two collexemes co-occur 93 times in Att-IP construction. We already know that the frequency of xiwang taking an IP is 604, and the frequency of neng in the complement of any attitude verb is 353, and the total number of Att-IP construction is 21876. Given this distribution, the expected frequency of xiwang-neng pair in Att-IP construction is 9.746, around one tenth of the observed frequency. The p-value resulting from the Fisher’s exact test on this distribution is p = 1.891543e-64. The value is extremely small, indicating that there is a significant attraction between xiwang and neng. Therefore, xiang and neng are co-varying collexemes of Att-IP construction.
(5.6) a. \[ \text{PMI}_{\text{Att-IP(neng)}} = \log_2 \left( \frac{93}{21876} \times \frac{504}{353} \right) \approx 2.256 \]

b. Fisher exact test, \( p = 1.891543 \times 10^{-64} \)

### 5.1.2 Data and Conclusion

The analysis introduced in 5.1.1.2 is applied to all the 87×8 attitude-modal pairs in our data set. Pairs occurring less frequently than expected are excluded, as the goal is to identify combinations with strong attraction. The most significant collexeme combinations in the Att-IP construction are presented in Table 5.7 below. Boldfaced combinations are in concord, and pseudo concord pairs are underlined.

<table>
<thead>
<tr>
<th>COLLEXEME\textsubscript{1} Attitude</th>
<th>COLLEXEME\textsubscript{2} Modal</th>
<th>Absolute Frequency</th>
<th>( P ) \text{ Fisher-Exact}</th>
</tr>
</thead>
<tbody>
<tr>
<td>xiwang ‘hope’</td>
<td>neng ‘can’</td>
<td>89</td>
<td>1.40E-78</td>
</tr>
<tr>
<td>xiwang ‘hope’</td>
<td>nenggou ‘can’</td>
<td>93</td>
<td>5.59E-57</td>
</tr>
<tr>
<td>renwei ‘think’</td>
<td>yingai ‘should’</td>
<td>41</td>
<td>4.78E-15</td>
</tr>
<tr>
<td>xiangxin ‘believe’</td>
<td>yiding ‘definitely’</td>
<td>14</td>
<td>2.59E-14</td>
</tr>
<tr>
<td>\textit{huaiyi} ‘suspect’</td>
<td>keneng ‘might’</td>
<td>13</td>
<td>2.71E-13</td>
</tr>
<tr>
<td>danxin ‘worry’</td>
<td>keneng ‘might’</td>
<td>15</td>
<td>3.56E-13</td>
</tr>
<tr>
<td>guiding ‘regulate’</td>
<td>bixu ‘must’</td>
<td>9</td>
<td>1.82E-10</td>
</tr>
<tr>
<td>renwei ‘think’</td>
<td>keneng ‘might’</td>
<td>40</td>
<td>6.04E-09</td>
</tr>
<tr>
<td>\textit{juede} ‘feel;think’</td>
<td>yinggai ‘should’</td>
<td>19</td>
<td>1.13E-08</td>
</tr>
<tr>
<td>yaoqiu ‘demand’</td>
<td>bixu ‘must’</td>
<td>13</td>
<td>3.49E-08</td>
</tr>
<tr>
<td>yanpan ‘investigate and decide’</td>
<td>keneng ‘might’</td>
<td>5</td>
<td>5.41E-08</td>
</tr>
<tr>
<td>guji ‘estimate’</td>
<td>keneng ‘might’</td>
<td>9</td>
<td>3.40E-07</td>
</tr>
<tr>
<td>guiding ‘regulate’</td>
<td>dei ‘should’</td>
<td>5</td>
<td>7.51E-07</td>
</tr>
<tr>
<td>xiangxin ‘believe’</td>
<td>keyi ‘may’</td>
<td>12</td>
<td>7.61E-06</td>
</tr>
<tr>
<td>anshi ‘hint’</td>
<td>keneng ‘might’</td>
<td>4</td>
<td>2.18E-05</td>
</tr>
<tr>
<td>caice ‘guess’</td>
<td>keneng ‘might’</td>
<td>4</td>
<td>3.02E-05</td>
</tr>
</tbody>
</table>

Table 5.7: Most Significant Attitude-Modal Combinations in Att-IP Construction
The results in Table 5.7 show that not all attitude-modal pairs whose frequency is significantly high are in real or pseudo concord relation. The data in Table 5.8 below show that not all concord attitude-modal pairs co-occur significantly more often than expected in the Att-IP construction. The two points put together suggest that there is no perfect correlation between co-variation of the attitude-modal collexemes and the concord (no matter real or pseudo) interpretation.

<table>
<thead>
<tr>
<th>COLLEXEME&lt;sub&gt;1&lt;/sub&gt; Attitude</th>
<th>COLLEXEME&lt;sub&gt;2&lt;/sub&gt; Modal</th>
<th>Absolute Frequency</th>
<th>P&lt;sub&gt;Fisher-Exact&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>yaoqi ‘demand’</td>
<td>yinggai ‘should’</td>
<td>2</td>
<td>0.778</td>
</tr>
<tr>
<td>baozheng ‘assure’</td>
<td>yiding ‘definitely’</td>
<td>1</td>
<td>0.258</td>
</tr>
<tr>
<td>jianyi ‘suggest’</td>
<td>yinggai ‘should’</td>
<td>2</td>
<td>0.195</td>
</tr>
<tr>
<td>danxin ‘worry’</td>
<td>neng ‘can’</td>
<td>2</td>
<td>0.680</td>
</tr>
</tbody>
</table>

Table 5.8: Insignificant Concord Attitude-Modal Combinations in Att-IP Construction

Recall that the non-compositional approach makes the following predictions:

(i) The attitude verb and embedded modal in concord relation will have significantly frequent co-occurrence in Att-IP construction.

(ii) The attitude-modal combinations with high significance are likely to be concord.

The results in Table 5.8 do not bear out the first prediction, and the data in Table 5.7 do not lend strong support to the second prediction. Therefore, the non-compositional hypothesis should be rejected as a general explanation of concord and strong attraction. That said, the hypothesis could still be correct for particular combinations, for example, the attitude-modal pairs studied in Cui (2013)<sup>36</sup>.

<sup>36</sup> There are two more non-trivial problems with this work. One problem is that the judgments were not reliable, because no diagnostic tests were employed. For example, bixu ‘must’, rather than yinggai ‘should’ was judged to be the E-CM under yaoqi ‘require’. The other problem is about the significance test chosen for the study. Due to data sparsity, the $\chi^2$ test used in Cui (2013) is not appropriate for the analysis of co-varying collexemes.
To conclude, in this section I introduced and refuted the non-compositional view of modal concord, which claims that modal concord is due to idiomatic usage of the modal-under-attitude construction. The hypothesis is made on the observation that the attitude-modal combinations judged as concord according to the working definition all turn out to co-occur significantly more often than expected. I tested this hypothesis against a data set of larger scale. Based on the results of co-variation analysis on attitude-modal collexemes in Att-IP construction, I rejected the hypothesis as a general explanation for modal concord. In the following sections, I will sketch out semantic-pragmatic analyses for Pseudo E-CM’s and Real E-CM’s respectively. We will see that collocationality may still play a role in particular Pseudo Concord pairs.

5.2 Pseudo Concord Constructions

5.2.0 Basic Data

In this section focus on three instances of Pseudo E-CM’s: *keneng* ‘might’ under *caice* ‘guess’, *neng* ‘can ’ under *xiwang* ‘hope’ and *neng* ‘can’ under *danxin* ‘worry’. The first two are characterized by property (5.7a), while the third has the property (5.7b).

(5.7) a. “a Att p” ⇔ “a Att Mod p” and “a Att Mod p” ↔ “a Att p”

b. “a Att Mod p” ⇔ “a Att p” and “a Att p” ↔ “a Att Mod p”

The puzzling aspect of Pseudo Concord is better understood in comparison with non-concord combinations. For example, *keneng* ‘might’ exhibits split behavior under doxastic verbs and under conjecture verbs. In root environments, a non-modalized sentence (5.8a) neither entails nor follows from the modalized sentence (5.8b) with the
schema \textit{might} \( p \). Also, asserting \textit{might} \( p \) usually does not implicate \( p \), although it is possible for it to in particular context.

(5.8) a. \textit{Xiongshou shi Xiao Wang}.

\[ \text{culprit be Xiao Wang} \]

‘The culprit is Xiao Wang.’

b. \textit{Xiongshou keneng shi Xiao Wang}.

\[ \text{culprit might be Xiao Wang} \]

‘The culprit might be Xiao Wang.’

When embedded, some interesting inference patterns arise. Firstly, for both doxastic and conjecture verbs, “\textit{a Att} \( p \)” entails “\textit{a Att} \textit{might} \( p \)”. Take (5.9-5.10) for example. It is clear that (5.9b) is entailed by (5.9a), and (5.10b) follows from (5.10a).

(5.9) a. \textit{Lao Li renwei xiongshou shi Xiao Wang}.

\[ \text{Lao Li think culprit be Xiao Wang} \]

‘Lao Li thinks the culprit is Xiao Wang.’

b. \textit{Lao Li renwei xiongshou keneng shi Xiao Wang}.

\[ \text{Lao Li think culprit might be Xiao Wang} \]

‘Lao Li thinks the culprit might be Xiao Wang.’

(5.10) a. \textit{Lao Li caice xiongshou shi Xiao Wang}.

\[ \text{Lao Li guess culprit be Xiao Wang} \]

‘Lao Li guesses the culprit is Xiao Wang.’

b. \textit{Lao Li caice xiongshou keneng shi Xiao Wang}.

\[ \text{Lao Li guess culprit might be Xiao Wang} \]

‘Lao Li thinks the culprit might be Xiao Wang.’
Secondly, under conjecture verbs, “x Att p” is implicated by “x Att might p”. Consequently, (5.10b) is often received as meaning (5.10a). In contrast, this effect is not available with doxastic verbs. In fact, normally, asserting (5.9b) implicates (5.9a) is false. Again, remember that there is no embedded implicature in (5.10b) -- might p does not implicate p in root environment. The implicature is triggered by the combination of the conjecture verb and the epistemic modal.

The ability/circumstantial modal behaves differently under doxastic verbs than under desiderative verbs as well. In the root environment, p entails neng (‘can’) p, but normally is not implicated by neng p. Thus (5.11a) entails (5.11b), but is not implicated by (5.11b) in normal cases (unless the language allows “actuality entailment” (§3.1.2.2)). However, with a desiderative verb, “x Att neng p” implicates “x Att p”. (5.12) is a concrete example. In normal cases, when (5.12b) is asserted, the proposition (5.12a) seems to be true as well:

The attitude holder Lao Li not just hopes the circumstances allow Xiao Wang to attend the party, but wants Xiao Wang to actually come to the party. In contrast, in doxastic contexts, “x Att p” is not implicated by “x Att neng p”. Take (5.13), we do not infer from the fact that Lao Li thinks Xiao Wang is able to come given the circumstances that Lao Li thinks Xiao Wang will actually come.

(5.11) a. Xiao Wang lai wuhui.

Xiao Wang come dancing party

‘Xiao Wang comes to the dancing party.’

b. Xiao Wang neng lai wuhui.

Xiao Wang can come dancing party

‘Xiao Wang can come to the dancing party.’
(5.12) a. Lao Li xiwang Xiao Wang lai wuhui.
Lao Li hope Xiao Wang come dancing party
‘Lao Li hopes Xiao Wang will come to the dancing party.’
b. Lao Li xiwang Xiao Wang neng lai wuhui.
Lao Li hope Xiao Wang can come dancing party
‘Lao Li hopes Xiao Wang can come to the party.’

(5.13) a. Lao Li renwei Xiao Wang hui lai wuhui.
Lao Li hope Xiao Wang will come dancing party
‘Lao Li thinks Xiao Wang will come to the dancing party.’
b. Lao Li renwei Xiao Wang neng lai wuhui.
Lao Li think Xiao Wang can come dancing party
‘Lao Li thinks Xiao Wang can come to the dancing party.’

A negative attitude like danxin ‘worry’ flips the direction of inference. Specifically, (5.11a) entails (5.11b) in root environment, and in desiderative contexts. When embedded under danxin, (5.14a) is entailed by (5.14b). Also, under danxin, “x Att p” implicates “x Att neng p”. Thus, (5.14b) is implicated by (5.14a).

(5.14) a. Lao Li danxin Xiao Wang lai wuhui.
Lao Li worry Xiao Wang come dancing party
‘Lao Li worries Xiao Wang will come to the dancing party.’
b. Lao Li danxin Xiao Wang neng lai wuhui.
Lao Li worry Xiao Wang can come dancing party
‘Lao Li worries Xiao Wang can come to the dancing party.’
Starting to work towards an explanation, there are two noteworthy points concerning the facts outlined above. One is that I assume there is a distinction between *generalized* vs. *particularized* conversational implicatures (refer to Simons 2011 for introduction). Generalized implicatures can be identified in the absence of any particular information about a context of utterance, but particularized implicatures can not (refer to §5.2.1.1 for concrete examples). The other point is that the implicatures involved in Pseudo Concord belong to the class of *strengthening implicature* (Atlas & Levinson 1981). This is evident since, from the fact that the implicated proposition entails the proposition that triggers the implicature (I will come back to this point in §5.2.1).

Table 5.9 summarizes the specific instances of Pseudo E-CM’s I am going to explain in this section.

<table>
<thead>
<tr>
<th>Context</th>
<th>Entailment</th>
<th>Implicature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conjecture</td>
<td>( a \text{cacei} ) ( \leftarrow)( a \text{cacei} \text{ keneng} ) ( \leftarrow)( a \text{cacei} \text{ p} )</td>
<td>( a \text{cacei} \text{ keng} ) ( \sim)( a \text{cacei} \text{ p} )</td>
</tr>
<tr>
<td>Desiderative</td>
<td>( a \text{xiwang} ) ( \leftarrow)( a \text{xiwang} \text{ neng} ) ( \leftarrow)( a \text{xiwang} \text{ p} )</td>
<td>( a \text{xiwang} \text{ neng} ) ( \sim)( a \text{xiwang} \text{ p} )</td>
</tr>
<tr>
<td>Doxastic-emotive</td>
<td>( a \text{danxin} ) ( \leftarrow)( a \text{danxin} \text{ neng} ) ( \leftarrow)( a \text{danxin} \text{ p} )</td>
<td>( a \text{danxin} \text{ p} ) ( \sim)( a \text{danxin} \text{ neng} \text{ p} )</td>
</tr>
</tbody>
</table>

Table 5.9: Inference Patterns Underlying Pseudo E-CM’s

My account of Pseudo E-CM is built on three groups of proposals besides the standard analyses assumed for modals and attitudes. One line of theories is the comparative semantics for certain attitudes (Stalnaker 1984, Heim 1992, Villalta 2006, Rubinstein 2012). The comparative analysis was originally proposed for desiderative verbs. Villalta (2006, 2008) applied the approach broadly to all predicates that select subjunctive mood. My analyses of the doxastic-emotive and conjecture verbs involve a comparative component as well. The second line of proposals consists of the ideas about the semantics

The first two groups of theories have been reviewed in Chapter 2, so here I will only discuss the theories for explaining strengthening implicatures. Subsection 5.2.1 is devoted to this purpose. After gathering the requisite tools, in subsection 5.2.2 I apply them to account for the inference patterns summarized in Table 5.9. Lastly, 5.2.3 concludes the section.

5.2.1 Background: Strengthening Implicatures

5.2.1.1 Gricean Theory of Conversational Implicature

The term *implicature* is used by Paul Grice (1969) to refer to the part of speaker meaning that is meant but not said. Implicature falls into two major subclasses -- *conventional* and *conversational*. Consider (5.15) (Horn 2004, (1)):

(5.15) a. Even KEN knows it's unethical.

   a’. Ken is the least likely [of a contextually invoked set] to know it’s unethical.

   b. The cat is in the hamper or under the bed.

   b’ I don’t know for a fact that the cat is under the bed.

(5.15a’) is a conventional implicature of (5.15a), and (5.15b’) is a conversational implicature of (5.15b).

The distinction between the two subtypes is that conventional implicatures are not **cancelable** but are **detachable**: It is contradictory to say “Even Ken knows its unethical

---

37 Grice did not develop a full analysis for implicature in Grice (1965). The exemplar used by Grice is therefore; other items traditionally used for illustration include but, even, still etc. A recent formal analysis of conventional implicature is developed by Chris Potts (2004).
but that’s not surprising”, which indicates that the inference (5.15a’) cannot be canceled without causing contradiction. The same truth-conditional content of (5.15a), however, can be expressed in a way not triggering the inference (5.15a’). For instance, we can say KEN knows it’s unethical too instead. Thus, the implicature is detachable (i.e. can be removed). By contrast, the conversational implicatures exemplified by (5.15b’) is cancelable but not detachable. For example, the following discourse cancels (5.15b) and is felicitous: The cat is in the hamper or under the bed...Ok, I will tell you. It’s under the bed. But there is no way to remove the implicature in the same context while preserving the same truth-conditional content of (5.15b). For instance, the following sentence implicates (5.15b’) as well: There are two possible locations where you can find your cat: one is in the hamper; one is under the bed.

There is also a distinction between particularized vs. generalized conversational implicatures (Grice 1975, Simons 2011). Generalized conversational implicatures are implicatures that normally arise when a particular form is used. For example, as (5.15b) above illustrates, or is associated with the implicature that the speaker is ignorant of which disjunct is true, and this type of implicature almost always goes along with or. Particularized conversational implicature, by contrast, relies highly on the context, and some particular background assumptions. Take (5.16; Horn 2004, (1b)): The inference (5.16b) will only arise in the context of evaluating a candidate for a philosophy position.

(5.16) [in a recommendation letter for philosophy position ]

a. Jones dressed well and writes grammatical English.

b. Jones is no good at philosophy.
Recall that I classify the implicatures in Table 5.9 above (e.g. from “x hope can p” to “x hope p”) as generalized conversational implicatures (GCI). The main reason is that the implicatures can be drawn without relying on specific background assumptions between interlocutors in the context. In normal cases, the attitude-modal combinations alone will trigger the relevant implicatures.

Besides recognizing the phenomenon of conversational implicature, Grice (1975) also proposes a framework to account for it. At the center of Gricean theory of conversational implicature is Cooperative Principle (CP), based on which four categories of Maxims of Conversation are specified to explain and derive the conversational implicatures:

**Cooperative Principle:** Make your conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged.

**Conversational Maxims:**

*Quality:* Try to make your contribution one that is true
1. Do not say what you believe to be false.
2. Do not say that for which you lack adequate evidence.

*Quantity*
1. Make your contribution as informative as is required (for the current purposes of the exchange).
2. Do not make your contribution more informative than is required.

*Relation:* Be relevant
*Manner:* Be perspicuous
1. Avoid obscurity of expression
2. Avoid ambiguity
3. Be brief (avoid unnecessary prolixity)
4. Be orderly

Now let us look at how Gricean theory accounts for scalar implicature, a particular kind of implicature that has received special attention in the literatures. First consider a standard example (5.17): here the sentence (5.17a) implicates (5.17c):
(5.17) a. Some of my friends are linguists.
   b. More than some (most, all…) of my friends are linguists.
   c. It is not the case that more than some (most, all…) of my friends are linguists.

**Gricean reasoning:**

(i) The question what proportion of the speaker’s friends are linguists is *relevant* to the conversation. [Relevance]

(ii) It is presumed that the speaker is fully informative with respect to the proportion of friends who are linguists. [Quantity-1]

(iii) (5.17b) entails (5.17a); thus is more informative than (5.17a).

(iv) The speaker could have made a more informative statement by saying (5.17b), suppose it is true.

(v) The speaker is not in a position to say (5.17b), because it is not true [Quality]

(vi) (5.17c) is implicated.

The now standard analysis of (5.17a) $\leadsto$ (5.17c) is the solution proposed by Horn (1984), which is built on a rigorous revision of the same basic idea. I will introduce Horn’s theory in the following subsection.

**5.2.1.2 Horn Scale**

The Gricean account presented above does not make reference to any particular lexical item. However, it is not always feasible to derive Quantity-based implicatures without referring to a specific expression. This is because (5.17c) is a generalized conversational implicature of (5.17a), which is available even without particular context. A full explanation of (5.17a) $\leadsto$ (5.17c) should account for the context independent characteristic of the implicature.
Horn’s solution to the scalar implicature invokes an ordering of linguistic items that form a scale of informational strength. The relative informativity of the expressions is measured in terms of entailment relations. Formally, if \( Q \) is a Horn scale of the form \(<\alpha_1, \alpha_2, \alpha_3, \ldots, \alpha_{n-1}, \alpha_n>\), any sentence \( S \) containing \( \alpha_i \) will entail a sentence \( S' \) which is identical to \( S \) except for containing \( \alpha_{i+1} \) in place of \( \alpha_i \) (assuming that \( \alpha_i \) and \( \alpha_{i+1} \) are not under other operators). Some examples of Horn scales are presented in (5.18).

(5.18) a. \(<\ldots, n, n-1, \ldots, three, two, one>\)

b. \(<all, most, many, some, few>\)

c. \(<certain, possible>\)

d. \(<must, should, may>\)

Sentences containing scalar items are associated with generalized implicatures of the following forms: (i) Utterance of a sentence containing a “weaker” term in the scale implicates the falsity of the alternatives containing a “stronger” element in the scale. For example, asserting \( \text{Some of my friends are linguists} \) implicates \( \text{Not all/most of my friends are linguists} \). (ii) If the asserted sentence contains the negation of the “stronger” element in the scale, it implicates the non-negative sentence with a “weaker” term in the scale. For example, asserting \( \text{Not all of my friends are linguists} \) will implicate \( \text{Some of my friends are linguists} \). In other words, scale reversal happens under negation.

Scalar implicature is not the only type of generalized conversation implicature. Many implicatures evidently cannot be explained by Horn’s theory. Take (5.19) for example. As discussed in the previous chapter, (5.19b) is an implicature of (5.19a), and \( \text{can} \) in (5.19a) is a Pseudo E-CM.

(5.19) a. Mary hopes John can see the cherry blossom this year. \( \sim \)
b. Mary hopes John will see the cherry blossom this year.

Assuming that the dual of the ability/circumstantial modal *can* is *will*, and the two modals form the scale <will, can>. Horn’s theory predicts that in root context, the complement clause of (5.19a)(repeated as (5.20a)) implicates (5.20b).

(5.20) a. John can see the cherry blossom this year.

   b. It is not the case that John will see the cherry blossom this year.

   c. Mary hopes it is not the case that John will see the cherry blossom this year.

   d. It is not the case that Mary hopes John will see the cherry blossom this year.

As *can* is in the embedded clause in (5.19a), if it triggers a scalar implicature, the inference is generated either locally or globally. Suppose the implicature is local, (5.19a) should implicate (5.20c). Otherwise, suppose the implicature associated with *can* is generated globally, what inferred by (5.19a) should be (5.20d). However, neither of (5.20c-d) coincides with (5.19b)-- what (5.19a) actually implicates. Therefore, I conclude that the inference (5.19a) ↝ (5.19b) cannot be explained by Quantity-based pragmatic reasoning.

5.2.1.3 Principle of Informativeness

Atlas & Levinson (1981) distinguishes implicatures that make “what is communicated” more definite than the original assertion and implicatures that make “what is communicated” more precise than “what is said”. The authors argue that the former class is derivable by the Gricean inference from Quantity, while the latter class requires a

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38 Portner (2009; § 4.4)
treatment employing a different set of pragmatic machineries, namely the **Maxim of Relativity**, **Conventions of Noncontroversiality** and **Principle of Informativeness**.

First let us figure out what they mean by “more definite” and “more precise” by looking at some concrete examples:

(5.21) a. Morton has three children. [what is said]
   
   b. Morton has no more than three children. [what is implicated]
   
   c. Morton has exactly three children. [what is communicated]

The literal meaning of (5.21a) leaves it open whether Morton has more than three children: he could have four or five or more. However, the implicature (5.21b) from Quantity rules out these possibilities. As a result, the possible states of affairs associated with (5.21a) are “shrunk” to a smaller range, namely (5.21c). In contrast, in cases of strengthening implicature, as exemplified by (5.22), the range of possible states of affairs associated with “what is said” is “reshaped” to a narrower range.

(5.22) a. Kurt went to the store and bought some wine. [what is said]
   
   b. Kurt went to the store in order to buy some wine. [what is implicated]
   
   c. Kurt went to the store in order to buy some wine, and bought some wine. [what is communicated]

The authors did not devote much energy to the distinction between “more definite” and “more precise”. My understanding of their discussion is as follows: (5.21c) is more “definite” than (5.21a), in the sense that the additional information contributed by the implicature modifies the quantity of the information in the same domain, here, the number of children. Contrastively, (5.22c) is more “precise” than (5.22a) because the implicature (5.22b) contributes information about a distinct domain. Unlike (5.21b),
(5.22b) does not modify the quantity of events Kurt participated in, but rather specifies the relation between the two events expressed by (5.22a).

Next let us look at how Atlas & Levinson account for the implicatures that render more precise assertions. The proposal is built on a class of new pragmatic notions (Atlas & Levinson 1981: p. 40):

Maxims of Relativity:

1. Do not say what you believe to be highly noncontroversial, that is, to be entailed by the presumptions of the common ground.

2. Take what you hear to be lowly noncontroversial, that is, consistent with the presumptions of the common ground.

Conventions of Noncontroversiality:

1. Convention of Intension (Common Knowledge): The obtaining of stereotypical relations among individuals is noncontroversial.

2. Convention of Extension (Exportation):

   If A is “about” t, then
   a. If $^\tau t \approx$ is a singular term, $^\tau \exists x (x = t)$ is noncontroversial
   b. If $^\tau t \approx$ denotes a set, $^\tau \exists x (x \in t)$ is noncontroversial
   c. If $^\tau t \approx$ denotes a state of affairs or a proposition, $^\tau t$ is actual $\approx$ and $^\tau t$ is true $\approx$ is noncontroversial.

Principle of Informativeness:

Suppose a speaker S addresses a sentence A to a hearer H in a context K. If H has n COMPETING interpretations $A^{u_1}$, $A^{u_2}$, …, $A^{u_n}$ of A in the context K with information contents INF ($A^{u_1}$), INF ($A^{u_2}$), …, INF ($A^{u_n}$), and $G_A$ is the set of
propositions that are noncontroversial in $K$, then the “best” interpretation $A^{u*}$ of $A$
for $H$ is the most informative proposition among the competing interpretations that
is consistent with the common ground.

Let $A^{u*}$ be $A^{u^j}$ for the least $j$, $1 \leq j \leq n$, such that $\text{INF} (A^{u^j} + G_A) = \max \text{INF} (A^{u^i} + 
G_A)$, $1 \leq i \leq n$.

The sentence $A$ will tend to convey the pragmatic content $\text{PRON}(A)$ to the hearer
$H$: $\text{PRON}(A) = \text{INF} (A^{u*} + G_A^{u*})$ where $G_A^{u*}$ is the set of propositions that are
noncontroversial in $K$ and that are “about” what $A^{u*}$ is “about”.

The core idea of the Principle of Informativeness is expressed by the underlined part of
the definition, and the two paragraphs following the statement gives a formal description
of the same content.

Now we can apply the toolkit just introduced to the example (5.22).

$A =$ Kurt went to the store and bought some wine.

Some competing interpretations include:

$A^{u_1}$: Kurt went to the store; Kurt bought some wine at the store.

$A^{u_2}$: Kurt went to the store; Kurt bought some wine later at another place.

$A^{u_3}$: Kurt went to the store to buy hand soap; Kurt bought some wine at the store.

$A^{u_4}$: Kurt went to the store in order to buy some wine; Kurt bought some wine there.

…

In a stereotypical scenario where a person goes to a store and purchases something,
there is a teleological relation between the two events, and the store is the place where the
buying event happens. According to the second maxim of Relativity and the Convention
of Intension, among \{ $A^{u_1}, A^{u_2}, A^{u_3}, A^{u_4}$ \}, $A^{u_1}$: and $A^{u_4}$ are noncontroversial in $K$, while
\(A^{u_2}\) and \(A^{u_3}\) are excluded as being inconsistent with common knowledge. In addition, \(\inf (A^{u_1}) < \inf (A^{u_4})\), and thus \(A^{u_4}\) is the best interpretation among the competing alternatives.

In the next subsection, I will apply the tools introduced in this subsection including the Principle of Informativeness to explain the inference patterns underlying Pseudo E-CM’s39.

5.2.2 Explaining the Data

The subsection explains the inference patterns underlying Pseudo E-MC’s as summarized in Table 5.9 in §5.2.0 (repeated below):

<table>
<thead>
<tr>
<th>Context</th>
<th>Entailment</th>
<th>Implicature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conjecture</td>
<td>(a\ cacei) (‘guess’) (p \models)\n(a\ cacei\ keneng) (‘might’) (p)</td>
<td>(a\ cacei\ keneng\ (p\ \sim\ a\ cacei\ (p))</td>
</tr>
<tr>
<td>Desiderative</td>
<td>(a\ xiwang) (‘hope’) (p \models)\n(a\ xiwang\ neng) (‘can’) (p)</td>
<td>(a\ xiwang\ neng\ (p\ \sim\ a\ xiwang\ (p))</td>
</tr>
<tr>
<td>Doxastic-emotive</td>
<td>(a\ danxin) (‘worry’) (neng) (‘can’) (p \models)\n(a\ danxin\ (p))</td>
<td>(a\ danxin\ (p\ \sim\ a\ danxin\ neng\ (p))</td>
</tr>
</tbody>
</table>

Table 5.9 (repeated): Inference Patterns Underlying Pseudo E-CM’s

In what follows, I first show how the entailments in the table above are derived from the semantics of the relevant attitudes. Then I show how the implicatures listed are calculated from the Principle of Informativeness.

5.2.2.1 Semantics of the Relevant Attitude Verbs

To start out, let us recap the semantics of relevant attitudes introduced in Chapter 2:

<table>
<thead>
<tr>
<th>Class</th>
<th>Lexical Entry</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doxastic</td>
<td>([\text{believe}]^{w,S}(p)(a)(w) = 1\ \text{iff} \ \forall w' \in S' : [p]^{w',S'} = 1,)\n(S' = D_{\alpha,a,w})</td>
<td>Yalcin (2007)</td>
</tr>
</tbody>
</table>

39 Strengthening implicature received less attention compared to Quantity-based implicatures among researchers. To the limit of my knowledge, the proposal of Atlas & Levinson seems to be the most elaborated account so far. Horn (1984) accounts for the same core data with the R-principle (Make your contribution necessary; say no more than you must \([\text{given Q}]\)), and his underlying idea of the theory is very similar to Atlas & Levinson’s. I will not get into the details of the R-principle here.
Desiderative

\[[\text{want}]^{f,w}(p)(a)(w)\text{ is defined iff}\]

\[\cap f(w) \cap p \neq \emptyset \text{ and } \cap f(w) \cap \neg p \neq \emptyset; \text{ if defined,}\]

\[[\text{want}]^{f,w}(p)(a)(w) = 1 \text{ iff } \cap f(w) \cap p \prec \cap f(w) \cap \neg p\]

• (Quantificational implementation)

\[[\text{want}]^{f,w}(p)(a)(w) = 1 \text{ iff } \forall w' \in \max_{D_E S_{a,w}}(f(w)), \mathcal{I}^{w'} = 1\]

Rubinstein (2012)

Doxastic-Emotive

\[[\text{hope}]^{c,w,S,g}(p)(a)(w)\text{ is defined iff}\]

• Uncertainty condition

\[p\text{-verifiers in } S' \neq \emptyset \text{ and } p\text{-falsifiers in } S' \neq \emptyset; \text{ if defined,}\]

\[[\text{hope}]^{c,w,S,g}(p)(a)(w) = 1 \text{ iff}\]

• Doxastic assertion

\[\exists w' \in S': [p]^{c,w',S',g} = 1 \land\]

• Preference assertion

\[p\text{-verifiers } \prec_{D_E S_{a,w}} p\text{-falsifiers}\]

where \(S' = D_{a,w}, p\text{-verifiers in } S' = \lambda S'', S'' \subset S' \land \forall S''' \subset S'' : [\forall w' \in S''': [p]^{w'',S'''} = 1] = \text{pow}(S' \cap p); p\text{-falsifiers}

\[\neg p\text{-verifiers in } S' = \text{pow}(S' \cap \neg p)\]

Anand & Hacquard (2013)

Table 5.10: Lexical Entries of Doxastic, Desiderative and Doxastic-Emotive Verbs

Recall that \(p\text{-verifiers, (} \text{might } p\text{-verifiers, and (} \text{must } p\text{-verifiers are the same (see}\)

§ 2.3.2.2 for details).

\textit{Renwei} ‘think’ behaves differently from \textit{xiangxin} ‘believe’ in terms of modal concord.

\textit{Renwei} is in Real Concord with weak necessity epistemic \textit{yinggai}, while \textit{xiangxin} is not

in concord with any of the modal expressions studied in this dissertation. To account for

this difference, I analyze \textit{renwei} as (5.23), inspired by Rubinstein’s (2012) analysis of

\textit{ought} (§ 2.2.3.1). The underlying idea is that \textit{renwei} is the weak necessity counterpart of

\textit{xiangxin} ‘believe’. “\textit{A think } p” means \textit{a} believes \textit{p} conditionally. In other words, the

belief of \(p\) is supported by the information currently available to the attitude holder, and

is subjective to change.

(5.23) \[[\text{renwei}]^{f,w,S,g}(p)(a)(w) = 1 \text{ iff } \forall w' \in S': [p]^{w',S'} = 1,\]

where \(S' = D_{a,w} \cap i; i \text{ is the information } a \text{ has in } w \text{ that is pertinent to}\)
the Question Under Discussion in the context.

Xiwang ‘hope’ does not allow an epistemic possibility modal in its complement, so I classify it as a pure desiderative rather than doxastic-emotive. I consider the core semantics of xiwang to be the same as the weak necessity analysis of want.

(5.24) \([xiwang]^{f, w, g}(p)(a)(w) = \text{is defined iff}\)

\(\bigcap f(w) \cap p \neq \emptyset \text{ and } \bigcap f(w) \cap \neg p \neq \emptyset. \text{ If defined,}\)

\([xiwang]^{f, w, g}(p)(a)(w) = 1 \text{ iff } \forall w' \in \max_{DSEA,w}(f(w)): [p]^{w'} = 1\)

I propose that the principle difference between worry and hope lies in the preference assertion. For hope, the complement \(p\) is more preferable than \(\neg p\). To the opposite, when the matrix verb is worry, the negation of the complement \(\neg p\) is more desirable than \(p\).

For example, given the sentence Darren worries that it will rain tomorrow, we may infer that Darren prefers not raining to raining. Based on the difference between worry and hope, I propose that danxin ‘worry’ has hybrid semantics like English hope, except that the order of \(p\) and \(\neg p\) in the preference assertion is flipped. Note that following Villalta (2008), I assume the doxastic worlds are a subset of the modal base (one can want something that he does not believe).

(5.25) \([danxin]^{f, w, S, g}(p)(a)(w) \text{ is defined iff}\)

\(p\)-verifiers in \(S' \neq \emptyset \land p\)-falsifiers in \(S' \neq \emptyset. \text{ Uncertainty condition}\)

If defined, \([danxin]^{f, w, S, g}(p)(a)(w) = 1 \text{ iff}\)

\([\exists w' \in S': [p]^{f, w, S', g} = 1 ] \land \text{ Doxastic Assertion}\)

\(\neg p\)-verifiers in \(\bigcap f(w) <_{DSEA,w} p\)-verifiers in \(\bigcap f(w), \text{ Preference Assertion}\)
where \( S' = \text{Dox}_{a,w} \subseteq \cap f(w) \); \( p \)-verifiers in an information state \( S = \lambda S'. S' \subseteq S \land \forall S'' \subseteq S': [\forall w' \in S'': [p]^{w'',S''} = 1] = \text{pow}(S' \cap p) \);

\( p \)-falsifiers in \( S = \neg p \)-verifiers in \( S = \text{pow}(S \cap \neg p) \).

Conjecture verbs have rarely been studied in formal semantics literature. As they license both epistemic possibility and epistemic necessity in their complements, a naïve hypothesis is to give \textit{caice} ‘guess’ a semantics similar to \textit{believe} except for the accessibility relation:

\[
(5.26) \, [\textit{caice}]^w_S (p)(a)(w) = 1 \iff \forall w' \in S': [p]^{w',S'} = 1, \text{ where } S' = \text{Gus}_{a,w}
\]

\( (\text{Gus}_{a,w} \text{ stands for the worlds compatible with what } a \text{ guesses in } w) \)

However, remember that \textit{caice} is in a Pseudo Concord relation with the epistemic possibility modal \textit{keneng}, while \textit{xiangxin} ‘believe’ is not. A treatment like (5.26) will leave no room to account for this difference. Taking this difference into consideration, I hypothesize that the conjecture verbs have a comparative semantics like desiderative verbs. The leading intuition is simple: Suppose \( p \) is a non-modalized proposition; “\( a \) guesses \( p \)” presupposes that the attitude holder is uncertain about the truth of \( p \), and asserts that the evidence makes the attitude holder to rank \( p \) as more likely than \( \neg p \). I define the more likely than relation \(<_{\text{LIKELY}_{a,w}}\) in the same fashion Villalta defines \(<_{\text{DES}_{a,w}}\).

\[
(5.28) \text{ a. For any } w, w', w'' \in W, \, w' <_{a,w} w'' \text{ iff } w' \text{ is more likely to } a \text{ in } w \text{ than } w'' \\
\text{ b. For any } p \subseteq W, q \subseteq W, \, p <_{\text{LIKELY}_{a,w}} q \text{ iff } \forall w'' \in q \exists w' \in p \text{ such that } w' <_{a,w} w'', \text{ and it is not the case that } \forall w' \in p \exists w'' \in q \text{ such that } w'' <_{a,w} w'
\]
Based on the relation $<_\text{LIKELY}_{a,w}$, I tentatively analyze *caice* ‘guess’ as (5.29). Following Rubinstein (2012), the comparative semantics is transposed into quantificational format in (5.30). The $\max_{\text{LIKELY}_{a,w}}$ function takes the modal base and returns the best-ranked worlds ordered by the relation $<_\text{LIKELY}_{a,w}$.

(5.29) $\llbracket \text{caice} \rrbracket^w,S,a,g (p)(a)(w) =$ is defined iff

$p$-verifiers in $\text{Dox}_{a,w} \neq \emptyset \land p$-falsifiers in $\text{Dox}_{a,w} \neq \emptyset$; If defined,

$\llbracket \text{caice} \rrbracket^w,S,a,g (p)(a)(w) = 1$ iff

$p$-verifiers $<_\text{LIKELY}_{a,w}$ $p$-falsifiers,

(5.30) **Quantificational Format**

$\forall w' \in S': [p]^{w',S',a,g} = 1$,

where $S' = \max_{\text{LIKELY}_{a,w}}(f(w))$; $p$-verifiers in an information state $S = \lambda S'. S' \in S \land \forall S'' \subset S' : [\forall w' \in S' : [p]^{w''} = 1] = \text{pow} (S \cap p)$;

$p$-falsifiers in $S = \neg p$-verifiers in $S = \text{pow} (S \cap \neg p)$.

According to the definition of the $<_\text{LIKELY}_{a,w}$ relation, when “a *caice p*” is true, for every $\neg p$-world there is a better $p$-world in the modal base; so if we look at the worlds that are ranked highest only, there will be no $\neg p$-world in the set. In other words, all the maximally likely worlds are $p$ worlds. Thus (5.29) can be transposed as (5.30). The other way around holds as well. When the condition “$\forall w' \in S': [p]^{w',S',a,g} = 1$” holds, since the highest ranked worlds are all $p$-worlds, for any $\neg p$-world, there will be a better $p$-world; thusly $p$ is more likely than $\neg p$ in every modal base world. Therefore, (5.30) can be converted to (5.29).
Although the preference assertion can be formalized either in the ordering semantics style (like Rubinstein’s analysis of want) or in the dynamic semantics style (like Anand & Hacquard’s proposal for hope), the two formats of preference assertions may have different consequences. Think about this: (ModEpil p)-verifiers and p-verifiers are both the power set of $(S \cap p)$ (refer to §2.3.2.2 for proof), while (ModEpil p)-falsifiers and p-falsifiers are both the power set of $(S \cap \neg p)$. As a result, both (5.31a) and (5.31b) will be reduced to (5.31c)

(5.31) a. $\neg p$-verifiers $<_{\text{LIKELY},a,w} p$-falsifiers

b. (ModEpil p)-verifiers $<_{\text{LIKELY},a,w}$ (ModEpil p)-falsifiers

c. $\emptyset(S \cap p) <_{\text{LIKELY},a,w} \emptyset(S \cap \neg p)$

Consequently, “a caice p”, “a caice keneng p” and “a caice yinggai p” will be incorrectly predicted to be semantically equivalent. In contrast, the preference assertion expressed in the quantificational format (5.30) renders different truth conditions for “a caice keneng p” and “a caice yinggai p” (assuming that the definedness conditions are satisfied):

(5.32) a. $\llbracket a \text{ caice keneng } p \rrbracket^{f,w,S,g}_{S'} = 1$, iff

\[
\forall w' \in S': \exists w'' \in S': \llbracket p \rrbracket^{f,w,S',g}_{S'} = 1, \text{ iff } \\
\exists w'' \in S': \llbracket p \rrbracket^{f,w,S',g}_{S'} = 1
\]

b. $\llbracket a \text{ caice yinggai } p \rrbracket^{f,w,S,g}_{S'} = 1$, iff

\[
\forall w' \in S': \exists w'' \in S': \llbracket p \rrbracket^{f,w,S',g}_{S'} = 1, \text{ iff } \\
\forall w'' \in S': \llbracket p \rrbracket^{f,w,S',g}_{S'} = 1, \\
\text{ where } S' = \max_{\text{LIKELY},a,w}(f(w))
\]
When the complement contains a possibility epistemic, according to (5.30), (5.32a) is true, iff some maximally likely worlds in the modal base are \( p \) worlds. When the complement is a weak necessity epistemic, (5.32b) is true iff all the maximally likely worlds in the modal base should be \( p \) worlds. This truth condition matches our judgments that the necessity epistemic yinggai is in Real Concord with caice. For this reason, I analyze the semantics of caice as (5.33):

\[
(5.33) \llbracket caice \rrbracket ^{f,w,S,g} (p)(a)(w) \text{ is defined iff }
\]

\[
p\text{-verifiers in } Dox_{a,w} \neq \emptyset \land \neg p\text{-falsifiers in } Dox_{a,w} \neq \emptyset. \text{ If defined,}
\]

\[
\llbracket caice \rrbracket ^{f,w,S,g} (p)(a)(w) = 1 \text{ iff } \forall w' \in S': \llbracket p \rrbracket ^{w',S',g} = 1,
\]

where \( S' = \text{max}_{\text{LIKELY},w}(f(w)); p\text{-verifiers in an information state } S = \lambda S'. S' \subseteq S \land \forall S'' \subseteq S': [\forall w' \in S'': \llbracket p \rrbracket ^{w'',S''} = 1] = \text{pow} (S \cap p) \); \( p\text{-falsifiers in } S = \neg p\text{-verifiers in } S = \text{pow} (S \cap \neg p). \)

Now let us evaluate the comparative analysis of caice ‘guess’ proposed above against a concrete scenario:

\[
(5.34) \text{Alex’s laptop was broken, and she decided to buy a new one. Alex did some research and narrowed down her choice to three products of similar price. Product A is excellent in all respects, and is very popular among Alex’s friends. Product B and C have some problems, but are overall decent. Product B is on promotion, and 3-year guarantee is offered for free. Only Product C has Alex’s favorite color--green.}
Becky, as Alex’s best friend, knows the following facts about her. Alex prefers things that are unique. She is a big fan of the color green. Alex decided to buy a new computer mainly because she thinks the charge for repairing the old one is too much. Becky has also noticed Alex spent quite a bit time comparing the black and white models of Product B.
\]

<table>
<thead>
<tr>
<th>Judgment</th>
<th>Prediction</th>
</tr>
</thead>
<tbody>
<tr>
<td>False</td>
<td>False</td>
</tr>
<tr>
<td>True</td>
<td>True</td>
</tr>
</tbody>
</table>

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c. Becky guesses Alex will buy Product C. [False] [False]

The context can be modeled as follows: the ordering source \( O = \langle \langle p \text{ “The product has longest free guarantee”} \rangle, \langle q = \text{ “The product is not overly popular”} \rangle, r = \text{ “The product has desirable color”}\rangle \ldots \rangle \). Since having longest free guarantee is the primary concern, \( p \)-worlds are ranked higher than \( \neg p \) worlds. Since \( p \) is true in buying-B worlds, but false in not-buying-B worlds, Alex buying product B is most likely to Becky. Uniqueness and color are secondary priorities. Product A does not satisfy either of them, so none of the ordering source propositions is true in Buying-A worlds, thus buying-A worlds are ranked lowest, and Alex buying-A is least like for Becky.

![Figure 5.1: Illustration of the Buying-Laptop Scenario](image)

In this context, my judgments on the three statements of (5.34) are: (5.34a) and (5.34c) are both False, while (5.34b) is true. The semantics presented in (5.33) makes correct predictions for these sentences, because the maximally worlds are those in which Alex buys product B.

Lastly consider the information state determined by \( caice \). According to the theory of Anand & Hacquard (2013), \( caice \) allows epistemic modals regardless of modal force, so it must have an information state that can be passed along to the embedded epistemics.
Yet, the theory also claims that attitudes with comparative semantics do not combine with their complements via their information states. So we have to either give up the comparative analysis for *caice*, or add an amendment to Anand & Hacquard’s theory to allow some attitudes with comparative semantics to have information states, and thusly license epistemic modals in their complements. I have argued that a Hintikkan style semantics leaves no room to explain the different behaviors of *xiangxin* ‘believe’ and *caice* in terms of modal concord. Therefore, I opt for the other solution. I propose that conjecture verbs are sensitive to two conversational backgrounds, the modal base and the informal the attitude holder applies to decide the likelihood of the contextual alternatives. The two conversational backgrounds jointly define a non-trivial set of worlds -- the worlds that are maximally likely according to the ordering source. It is this set, formally represented as $\max_{\text{LIKELY}a,w}(\cap f(w))$, that serves as the information state associated with *caice*.

5.2.2.2 Entailments

Recall that the goal of current section (§5.2) is to account for the Pseudo E-CM’s identified in the previous chapter. I focus on three specific combinations: (1) possibility epistemic *keneng* under conjecture verb *caice* ‘guess’; (2) ability/circumstantial *neng* under desiderative verb *xiwang* ‘hope’; and (3) ability/circumstantial *neng* under doxastic-emotive verb *danxin* ‘worry’. The three pairs share the following logical properties: One of “$x \text{ Attitude } M \ p$” and “$x \text{ Attitude } p$” entails the other, and the entailed one implicates the stronger proposition. In this subsection, I will show how the entailments associated with these Pseudo E-CM’s are derived, then in §5.2.2.3, I will present the derivations of the implicatures that give rise to the Pseudo Concord readings.
Firstly, consider *keneng* ‘might’ under *caice* ‘guess’. According to (5.33), when the definedness condition is satisfied, “a *caice* *p*” is equivalent to $\Box_{\text{max}_d} (\cap f(w)) p$.

When the complement of *caice* contains a possibility epistemic *keneng*, the embedded modal retrieves its quantificational domain from the matrix verb. The result of the combination is the “dual” of *caice*, and “a *caice* *keneng* *p*” can be represented as $\Diamond_{\text{max}_d} (\cap f(w)) p$. In modal logic, when the domain is not empty, $\Box_{\text{max}_d} (\cap f(w)) p$ entails $\Diamond_{\text{max}_d} (\cap f(w)) p$. The entailment “$x$ *caice* *p*” $\vDash$ “$x$ *caice* *keneng* *p*” is therefore explained. See the derivation below:

(5.35) a. $[[a \text{ *caice* *keneng* } p]]^{f,w,S,p}$ is defined, iff

$(\textit{keneng}-p)$-verifiers in $D_{\text{max}_d} x \neq \emptyset \land (\textit{keneng}-p)$-falsifiers in $D_{\text{max}_d} x \neq \emptyset$.

If defined, $[[a \text{ *caice* *keneng* } p]]^{f,w,S,p} = 1$ iff

$\forall w' \in \text{max}_d x w (\cap f(w)) : [[\textit{keneng } p]]^{f,w,S',p} = 1$, iff

$\forall w' \in \text{max}_d x w (\cap f(w)) : \exists w'' \in S' \exists [p]^{w',S'} = 1$, iff

$\exists w'' \in S' \exists [p]^{w',S'} = 1$,

where $S' = \text{max}_d x w (D_{\text{max}_d} x w)$; and $(\textit{keneng } p)$-verifiers in any information state $S = \lambda S'.S' \in S \land S'' \subset S'$:

$[[\forall w' \in S' : [[\textit{keneng } p]]^{w',S''} = 1]] = \text{pow} (S \cap p)$;

(\textit{keneng } p)$-falsifiers $= \neg (\textit{keneng } p)$-verifiers $= \text{pow} (S \cap \neg p)$

b. $[[a \text{ *caice* } p]]^{f,w,S,p}$ is defined iff

$[p$-verifiers in $D_{\text{max}_d} x \neq \emptyset] \land [p$-falsifiers in $D_{\text{max}_d} x \neq \emptyset]$; if defined,

$[[a \text{ *caice* } p]]^{f,w,S,p} = 1$ iff $\forall w' \in S' \exists [p]^{w'',S'} = 1$,
where $S' = \max_{\text{likely}, w}(\text{Dox}, w)$; and $p$-verifiers in any information state $S$

$$= \lambda S'. S' \subseteq S \land \forall S'' \subseteq S': [\forall w' \in S'': \llbracket p \rrbracket^{w', S''} = 1] = \text{pow}(S \cap p);$$

$p$-falsifiers in $S = \neg p$-verifiers in $S = \text{pow}(S \cap \neg p)$

Next, consider the entailment from “$x \text{xiwang}$ (‘hope’) $p$” to “$x \text{xiwang neng}$ (‘can’) $p$”.

This inference is more straightforward. As presented in (5.36) below, given (5.36a-c), it follows that for every world in the domain, if $p$ is true, “can $p$” is true as well. Thusly (5.36d) is derived.

(5.36) a. $\llbracket a \text{xiwang neng } p \rrbracket^{f, w, g}$ is defined iff

$$\cap f(w) \cap (\text{neng } p) \neq \emptyset \text{ and } \cap f(w) \cap \neg (\text{neng } p) \neq \emptyset. \text{ If defined,}$$

$$\llbracket a \text{xiwang neng } p \rrbracket^{f, w, g} = 1 \text{ iff } \forall w' \in \max_{\text{Desa}, w}(\cap f(w)): \llbracket \text{neng } p \rrbracket^{w'} = 1$$

b. $\llbracket x \text{xiwang } p \rrbracket^{f, w, g}$ is defined iff

$$\cap f(w) \cap p \neq \emptyset \text{ and } \cap f(w) \cap \neg p \neq \emptyset. \text{ If defined,}$$

$$\llbracket a \text{xiwang } p \rrbracket^{f, w, g} = 1 \text{ iff } \forall w' \in \max_{\text{Desa}, w}(\cap f(w)): \llbracket p \rrbracket^{w'} = 1$$

c. $p \models \text{neng } p$

d. $a \text{xiwang } p \models a \text{xiwang neng } p$

Lastly, turn to the entailment from “$a \text{danxin}$ ‘worry’ $\text{neng}$ ‘can’ $p$” to “$a \text{danxin } p$”.

$\text{Danxin}$ contains both a doxastic component and a preference assertion. First consider the preference assertion. According to the definition of verifiers, line (ii) of (5.37a) is equivalent to line (iii), which can be transposed to line (iv). Similarly, line (ii) of (5.37b) can be transformed to line (iv). We already proved that $p \models \text{neng } p$. It follows from $p \models \text{neng } p$ that “$\neg (\text{neng } p)$” $\models \neg p$. Thus, for every world in the domain
\( \max_{\text{DES}_a,w}(\cap f(w)) \), the maximally desirable worlds in the modal base, if

“\( \neg(neng\ p) \)” is true in that world, “\( \neg p \)” is true in the same world as well. Therefore, (5.37a-iv) entails (5.37b-iv), and from there we may conclude that the preference assertion of “a danxin neng p” entails that of “x danxin p”.

(5.37) a. \([x\ \text{danxin}\ p]^{f,w,S,g} \) is defined iff

\( p \)-verifiers in \( S' \neq \emptyset \) \& \( p \)-falsifiers in \( S' \neq \emptyset \). If defined,

\([a\ \text{danxin}\ p]^{f,w,S,g} = 1 \) iff

(i) \([\exists w' \in S': [p]^{f,w',\emptyset,S,g} = 1} \) \& Doxastic Assertion

(ii) \([\neg p \text{-verifiers in } \cap f(w) <_{\text{DES}_a,w} p \text{-verifiers in } \cap f(w)] \) Preference Assertion

where \( S' = \text{Dox}_{a,w} \subset \cap f(w) \); \( p \)-verifiers in an information state \( S = \lambda S'. S' \subset S \\& \forall S'' \subset S': [\forall w' \in S'': [p]^{w'',S''} = 1} = \text{pow} (S' \cap p); \)

\( p \)-falsifiers in \( S = \neg p \)-verifiers in \( S = \text{pow} (S \cap \neg p) \)

(iii) \( \emptyset (\cap f(w) \cap \neg (neng\ p)) <_{\text{DES}_a,w} \emptyset (\cap f(w) \cap (neng\ p)) \)

(iv) \( \forall w' \in \max_{\text{DES}_a,w}(\cap f(w))): [\neg neng\ p]^{w'} = 1 \)

b. \([a\ \text{danxin}\ neng\ p]^{f,w,S,g} \) is defined iff

\( (neng\ p) \)-verifiers in \( S' \neq \emptyset \) \& \( (neng\ p) \)-falsifiers in \( S' \neq \emptyset \). If defined,

\([a\ \text{danxin}\ neng\ p]^{f,w,S,g} = 1 \) iff

(i) \([\exists w' \in S': [neng\ p]^{f,w',\emptyset,S,g} = 1} \) \& Doxastic Assertion

(ii) \([\neg (neng\ p) \text{-verifiers in } \cap f(w) <_{\text{DES}_a,w} (neng\ p) \text{-verifiers in } \cap f(w)] \)

Preference Assertion

where \( S' = \text{Dox}_{a,w} \subset \cap f(w) \); \( p \)-verifiers in an information state \( S = \lambda S'. S' \subset S \\& \forall S'' \subset S': [\forall w' \in S'': [p]^{w'',S''} = 1} = \text{pow} (S' \cap p);\)
Next consider the doxastic component. Because \( p \models neng \ p \), (5.37a-i) asymmetrically entails (5.37b-i). Note that this fact conflicts with our judgment that “\( a \ danxin \ neng \ p \)” entails “\( a \ danxin \ p \)”. So we have to revise our generalization about the logic properties of \( neng \) under \( danxin \). The preference assertion made by “\( a \ danxin \ neng \ p \)” entails the preference assertion of “\( a \ danxin \ p \)”; but the doxastic assertion made by “\( a \ danxin \ neng \ p \)” is entailed the doxastic assertion of “\( a \ danxin \ p \)”. These two properties predict that the truth of “\( a \ danxin \ neng \ p \)” does not guarantee the truth of “\( a \ danxin \ p \)”. The proposition “\( a \ danxin \ p \)” could be false because its doxastic component is false, even though “\( a \ danxin \ neng \ p \)” is absolutely true. In other words, scenarios that meet the following conditions exist:

<table>
<thead>
<tr>
<th>( a \ danxin \ p )</th>
<th>( a \ danxin \ neng \ p )</th>
<th>( a \ believes \ p ) is possible</th>
<th>( a \ believes \ can-p ) is possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>( F )</td>
<td>( T )</td>
<td>( F )</td>
<td>( T )</td>
</tr>
</tbody>
</table>

According to (5.37a-i), the doxastic assertion made by “\( a \ danxin \ neng \ p \)” is equivalent to the meaning of “\( a \ believes \ can-p \) is possible”\( ; \) and (5.37b-i) indicates that the doxastic assertion associated with “\( a \ danxin \ p \)” is equivalent to “\( a \ believes \ p \) is possible”. If in a scenario “\( a \ believes \ p \) is possible” is false, then “\( a \ danxin \ p \)” has to be false too. But in the same context “\( a \ believes \ can-p \) is possible” still can be true, and so can “\( a \ danxin \ neng \ p \)”. Here is a concrete example:

(5.38) Scenario: Alex’s father owns a gun. Alex is now ten years old. Lately his father believes that Alex is able to operate the gun and kill their pets, so is
a little worried. However, Alex loves animals. Thus the father also believes that his son will never shoot at their pets.

a. Alex’s father worries that Alex can kill the pets with his gun.

b. Alex’s father worries that Alex will kill the pets with his gun.

In the scenario described above, the assertion (b) is false, while (a) is true. The example illustrates that “a danxin neng p” ≠ “a danxin p”, because the doxastic component of “a danxin neng p” does not entail that of “a danxin p”. According to this fact, we have to revise the generalization of inference patterns underlying Pseudo E-CM’s (originally presented in Table 9) as follows:

<table>
<thead>
<tr>
<th>Context</th>
<th>Entailment</th>
<th>Implicature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conjecture</td>
<td>a cacei (‘guess’) p ⊨ a cacei keneng (‘might’) p</td>
<td>a cacei keneng p ⊲ a cacei p</td>
</tr>
<tr>
<td>Desiderative</td>
<td>a xiwang (‘hope’) p ⊨ a xiwang neng (‘can’) p</td>
<td>a xiwang neng p ⊲ a xiwang p</td>
</tr>
<tr>
<td>Doxastic-emotive</td>
<td>Doxastic Assertion:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a danxin (‘worry’) p ⊨ a danxin neng (‘can’) p</td>
<td></td>
</tr>
<tr>
<td>Preference</td>
<td>a danxin neng p ⊨ a danxin p</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a danxin neng p ⊲ a danxin p</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.11: Revised Inference Patterns Underlying Pseudo E-CM’s

5.2.2.3 Strengthening Implicatures

This subsection aims to explain the implicatures presented in Table 5.11. I will show how them are derived from the Principle of Informativeness.

Firstly, look at “a cacei (‘guess’) keneng (‘might’) p” ⊲ “a cacei p”.

(5.39) - Jingfang zhao-dao xiongshou le ma?

police find culprit ASP. SFP

‘Did the police find the culprit?’

- Hai mei. Dan (A = ) Lao Li cacei Xiao Wang keneng shi xiongshou.
yet not but Lao Li guess Xiao Wang might be culprit

‘Not yet. But Lao Li guesses that Xiao Wang might be the culprit.’

Some competing interpretations of A include:

$A^{u_1}$: Lao Li guesses that there is a possibility that Xiao Wang is the culprit.

$A^{u_2}$: Lao Li thinks that there is a possibility that Xiao Wang is the culprit.

$A^{u_3}$: Lao Li knows that Xiao Wang is the culprit.

$A^{u_4}$: Lao Li guesses that it is a necessity that Xiao Wang is the culprit.

$A^{u_5}$: Lao Li guesses that there is a possibility that Xiao Wang is the culprit, and guesses Xiao Wang rather than other suspects is the culprit.

$A^{u_6}$: Lao Li guesses that there is a possibility that Xiao Wang is the culprit, and guesses another suspect, Alex, is the culprit.

…

The theory proposed by Atlas & Levinson needs more elaborations in many respects. One of them is how the set of competing interpretations are drawn. I generate the alternative interpretation set for the utterance A in (5.39) as follows: I first include the literal interpretation $A^{u_1}$ into the alternative set. $A^{u_2}$ and $A^{u_3}$ are two interpretations generated by substituting the matrix verb of $A^{u_1}$ with other related attitude verbs. The possibility modal keneng forms a Horn scale with necessity modals. $A^{u_4}$ is generated by replacing the possibility modal with its scale-mate in this lexical scale. $A^{u_5}$ is the “right” interpretation, which consists of the literal meaning and the implied information in the context. $A^{u_6}$ is generated by substituting the subject of the second conjunct of $A^{u_5}$.

In a stereotypical scenario where the police are trying to narrow down the suspects, the police do not know who is the culprit yet, but the evidence will help them make guesses. The guess is not knowledge, thus $A^{u_3}$ is not a competitive interpretation. Also, in stereotypical cases, if a person claims a suspect $x$ is likely to be the culprit, s/he does not
mean to communicate by that claim that the other suspect is the culprit; therefore, \( A^{u_6} \) is against our common assumption as well. In addition, according to the Maxim of Quantity, if the speaker believes the stronger statement is true, s/he should say that. Thus, \( A^{u_4} \) does not follow from our common assumptions either. Formally, according to the second maxim of Relativity and the Convention of Intension, among \( \{ A^{u_1}, A^{u_2}, A^{u_3}, A^{u_4}, A^{u_5}, A^{u_6} \} \), \( A^{u_1}, A^{u_2}, \) and \( A^{u_5} \) are noncontroversial in \( K \), while the other candidates are excluded for being inconsistent with common knowledge. Since “a guesses \( p \)” asserts the doxastic possibility of \( p \), \( A^{u_2} \) is entailed by \( A^{u_1} \); thus \( \text{INF}(A^{u_2}) < \text{INF}(A^{u_1}) \). Also, it is obvious that \( \text{INF}(A^{u_3}) < \text{INF}(A^{u_5}) \), as the \( A^{u_1} \) is a conjunct of \( A^{u_5} \). Therefore, \( A^{u_5} \) is the best interpretation among the competing alternatives.

Next consider “a xiwang (‘hope’) neng (‘can’) \( p \)” \( \Rightarrow \) “a xiwang \( p \”).

\[(5.40) \quad \text{Lao Li yaoqing Xiao Wang le ma? Wo tingshuo tamen da yi jia} \]

‘Did Lao Li invite Xiao Wang? I heard that they had a fight.)

\[- Qing le. Shishi-shang, (A =) Lao Li xiwang Xiao Wang neng can jia wuhui. \]

‘He did. In fact, Lao Li hopes Xiao Wang can come to the party.’

Below are some competing interpretations of \( A \). \( A^{u_1} \) is the literal meaning. \( A^{u_2} \) is the literal meaning supplemented by the implied meaning. \( A^{u_3} \) is generated by substituting modal with its scale mate in the Horn scale it triggers. \( A^{u_4} \) to \( A^{u_6} \) are generated via replacing the attitude verb of the literal interpretation.

- \( A^{u_1} \): Lao Li hopes that Xiao Wang is able to come to the party.
- \( A^{u_2} \): Lao Li hopes that Xiao Wang is able to come to the party, and will come.
$A^u_3$: Lao Li hopes that Xiao Wang will come to the party.

$A^u_4$: Lao Li knows that Xiao Wang is able to come to the party.

$A^u_5$: Lao Li guesses that Xiao Wang is able to come to the party.

$A^u_6$: Lao Li thinks that Xiao Wang is able to come to the party.

... In a stereotypical scenario where a person’s desire about a future event is at issue, the agent is ignorant about whether the circumstances will allow the desired event to be realized (thus $A^u_4$ and $A^u_6$ should be excluded). The doxastic component of $A^u_5$ does not contradict the common knowledge, but the preference component (that it is more likely that Xiao Wang is able to come to the party) does -- people do not always desire for things there likely. Thus, $A^u_5$ should be excluded as well. $A^u_3$ is compatible with the common assumptions, because typically when speaking of desires, people compare the desirability of actual events, rather than the desirability of possibilities. In this case, what the attitude holder actually compare are the desirability of “Xiao Wang shows up in the party” and the desirability of “Xiao Wang does not show up in the party”. Formally, according to the second maxim of Relativity and the Convention of Intension, $A^u_1, A^u_2, A^u_3$ and $A^u_5$ are noncontroversial in $K$, while $A^u_4$ and $A^u_6$ are eliminated. Among the remaining alternatives, $A^u_1$ and $A^u_3$ are both entailed by $A^u_2$, so $\text{INF} (A^u_1) < \text{INF} (A^u_2)$, and $\text{INF} (A^u_3) < \text{INF} (A^u_2)$. Given this ordering of informativeness, $A^u_2$ is the best interpretation among the competing alternatives.

Lastly, let us move on to “a danxin (‘worry’) p” \sim “a danxin neng (‘can’) p”. Note that the doxastic assertion made by the utterance A in (5.41) (“a danxin p”) entails the
doxastic assertion of “a danxin neng p”. So the implicature is only between the preference assertions made by the two propositions.

(5.41) - Lao Li de biaoxian hen guguai.

Lao Li de behavior very weird
‘Lao Li’s behavior is very weird’
- Zhe bu qiguai. (A =) Lao Li danxin Xiao Wang faxian ta-de mimi.

this not surprising Lao Li worry Xiao Wang discover his secret
‘Not surprising. Lao Li worries Xiao Wang will discover his secret.’

Some competing interpretations of A are listed below.

$A^u_1$: Lao Li worries that his secret will be discovered by Xiao Wang.

$A^u_2$: Lao Li believes that his secret will be discovered by Xiao Wang.

$A^u_3$: Lao Li worries that his secret can be discovered by Xiao Wang.

$A^u_4$: Lao Li worries Xiao Wang will discover his secret, and also worries that he is able to discover it by herself.

$A^u_5$: Lao Li worries Xiao Wang will discover his secret, but does not worry that he is able to discover it by herself.

$A^u_6$: Lao Li worries Xiao Wang will discover his secret, because he believes Xiao Wang will use it against him.

$A^u_7$: Lao Li worries Xiao Wang will discover his secret, but keeps the secret for him.

... 

$A^u_1$ is the literal meaning of A, and $A^u_2$ is generated by substituting the matrix verb of $A^u_1$.

$A^u_3$ differs from $A^u_1$ in that an item in the same Horn scale as will is used in place of it.
$A^u_4$ and $A^u_6$ are generated by adding a relevant claim to $A^u_1$. Finally, replacing the continuations of $A^u_4$ and $A^u_6$ with a proposition contradicts the original one yields the interpretation $A^u_5$ and $A^u_7$.

In a stereotypical scenario where one worries his secret will be discovered by someone, he believes the possibility that his secret is discovered by that person. However, he is not sure whether that person will in fact discover the secret. Thus, $A^u_2$ contradicts our common knowledge. The literal meaning of $A$ says that Lao Li prefers his secret not being discovered by Xiao Wang. Among worlds that are compatible with this desire, there are (i) worlds in which Xiao Wang is not capable of discovering the secret at first place, and (ii) worlds where Xiao Wang has the ability to but failed to discover the secret. Usually we will assume the type-(i) worlds are more preferable for Lao Li, as this kind of situation guarantees that Lao Li’s secret will not be discovered by Xiao Wang. Therefore, $A^u_4$ is noncontroversial in $\mathcal{K}$ but $A^u_5$ is, so $A^u_5$ should be excluded from the competing alternatives. Also, if one does not want others to discover his secret, he probably thinks the secret will be used against him, rather than kept secret by the person discovered it; thus $A^u_7$ is not a compatible with the stereotypical assumptions. So the remaining candidates are $A^u_1$, $A^u_3$, $A^u_4$ and $A^u_6$. It is not hard to see $\inf (A^u_1) < \inf (A^u_4)$, $(A^u_2) < \inf (A^u_4)$, and $\inf (A^u_3) < \inf (A^u_6)$. The problem is which one between $\inf (A^u_4)$ and $\inf (A^u_6)$ is greater? I don’t think they are directly comparable, so both $A^u_4$ and $A^u_6$ should both be the second-best interpretations of $A$, and the best interpretation of $A$ should be the conjunction of the two (i.e. $A^u_4 \& A^u_6$).

So far in (5.39-5.41) I showed how an interpretation more informative than the literal meaning of an utterance is derived. However, this pragmatic approach developed by
Atlas & Levinson is not very robust. I have explicitly pointed out one problem of this account, namely the lack of instruction in generating competing interpretations of the target utterance. Another problem revealed in the process of derivation is that the solution does not seem to provide much insight about the semantics of the configurations under discussion. The basic logic of the approach is: $p$ implicates $q$, because $p$ is the stereotypical way for $q$ to be true. But the deep reason why $p$ is the stereotypical way to make $q$ true remains unexplained. Is the deep reason a linguistic one? Is it due to the convention of the language? Or do we need to invoke specific world knowledge and general cognitive principles to explain that? These issues need to be addressed for a more desirable theory of strengthening implicatures. That said, in spite of the fact that informativeness approach needs further improvements, it seems to be the best theoretical tool developed so far in formal semantics/pragmatics literature for the purpose at issue. I do not try to improve the theory here, because the main task of this dissertation is to identify the different routes via which the concord effect is arrived. So what is more interesting to me at this point is to verify the fact that a strengthening implicature is partly responsible for the concord reading of some attitude-modal combinations, rather than to figure out the exact pragmatic process the implicature is derived.

5.2.3 Summary

In this section, I presented the derivation of the concord reading for three Pseudo Concord attitude-modal combinations identified in Chapter 4. Table 5.12 presents the three pairs and the logical properties that are responsible of the Pseudo Concord relations between two operators of each pair.
<table>
<thead>
<tr>
<th>Combination</th>
<th>Logical Properties</th>
<th>Theoretical Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>caice ‘guess’-keneng ‘might’</td>
<td>( \text{caice } \models \text{caice keneng } ) ( \text{caice keneng } \rightarrow \text{caice } )</td>
<td>Explaining Entailments: - Lexical semantics of the attitude verbs - Domain shifting of embedded epistemic modals (A &amp; H 2013)</td>
</tr>
<tr>
<td>xiwang ‘hope’ - neng ‘can’</td>
<td>( \text{xiwang } \models \text{xiwang neng } ) ( \text{xiwang neng } \rightarrow \text{xiwang } )</td>
<td>Explaining Implicatures: - Principle of Informativeness (A &amp; L 1981)</td>
</tr>
</tbody>
</table>
| danxin ‘worry’ - neng ‘can’ | Doxastic Assertion (not responsible for concord)  
\( \text{danxin } \models \text{danxin neng } \)  
Preference Assertion:  
\( \text{danxin neng } \models \text{danxin } \)  
\( \text{danxin } \rightarrow \text{danxin neng } \) | |

Table 5.12: Pseudo Concord Combinations & the Underlying Inference Patterns

The entailment relations are derivable on the basis of the lexical semantics as summarized in Table 5.13. When an embedded epistemic modal is involved, the modal is interpreted in Yalcin style: that is, the domain of the modal is shifted by the embedding verb. The implicatures are accounted for by employing the pragmatic Principle of Informativeness (Atlas & Levinson 1981).

<table>
<thead>
<tr>
<th>Class</th>
<th>Lexical Entry</th>
</tr>
</thead>
</table>
| Desiderative | \( [\text{xiwang}]^{f,w,g}(p)(a)(w) \) is defined iff  
\( \cap f(w) \cap p \neq \emptyset \) and \( \cap f(w) \cap \neg p \neq \emptyset \). If defined,  
\( [\text{xiwang}]^{f,w,g}(p)(a)(w) = 1 \) iff  
\( \forall w' \in \text{max}_{\text{Des}_{a,w}}(f(w)): [p]^{w'} = 1 \) | Rubinstein (2012) |

Conjecture | \( [\text{caice}]^{f,w,S,g}(p)(a)(w) \) is defined iff  
p-verifiers in \( \text{Dox}_{a,w} \neq \emptyset \) and \( p \)-falsifiers in \( \text{Dox}_{a,w} \neq \emptyset \). If defined,  
\( [\text{caice}]^{f,w,S,g}(p)(a)(w) = 1 \) iff  
\( \forall w' \in S': [p]^{f,w,S',g} = 1 \)  
where \( S' = \text{max}_{\text{Likely}_{a,w}}(f(w)); p \)-verifiers in an information state \( S = \lambda S'. \forall S' \subset S \land \forall S'' \subset S': [\forall w' \in S'': [p]^{w'',S''} = 1] = \text{pow} (S \cap p) \); \( p \)-falsifiers in \( S = \neg p \)-verifiers in \( S = \text{pow} (S \cap \neg p) \) | N/A |

Doxastic-Emotive | \( [\text{danxin}]^{c,w,S,g}(p)(a)(w) \) is defined iff  
- Uncertainty condition  
p-verifiers in \( S' \neq \emptyset \) and \( p \)-falsifiers in \( S' \neq \emptyset \); if defined,  
\( [\text{danxin}]^{c,w,S,g}(p)(a)(w) = 1 \) iff  
- Doxastic assertion  
\( \exists w' \in S': [p]^{c,w,S',g} = 1 \)  
\( \land \) | Anand & Hacquard (2013) |
• Preference assertion

\[-p\text{-verifiers in } \cap f(w) \triangleleft_{\text{DES}_a,w} p\text{-verifiers in } \cap f(w)\]

where \(S' = \Delta x_{a,w} \subset \cap f(w)\); \(p\)-verifiers in an information state \(S = \lambda S'. S' \subset S \land \forall S'' \subset S': [\forall w' \in S'': [p]^{w''} S'' = 1]\)

\[= \text{pow}(S \cap p); p\text{-falsifiers in } S = \neg p\text{-verifiers in } S = \text{pow}(S \cap \neg p)\]

Table 5.13: Lexical Semantics of Xiwang, Caice and Danxin

The major innovations in the analyses proposed in this section include: (i) The semantics of the negative emotive danxin ‘worry’. (ii) The comparative analysis for the conjecture verb caice ‘guess’.

5.3 Real Concord Constructions

In the previous section I demonstrated the derivation of three Pseudo E-CM’s. In this section, I will provide explanations for instances of Real Concord attitude-modal combinations. The specific combinations I am going to analyze are listed below:

(5.42) Epistemic E-CM’s

a. huaiyi (‘suspect’)-keneng (‘might’)

b. renwei (‘think’)-yinggai (‘should’)

c. baozheng (‘assure’)-yiding (‘definitely’)

(5.43) Priority E-CM’s

a. pizhun (‘permit’)-keyi (‘may’)

b. jianyi (‘suggest’)- yinggai (‘should’)

c. yaoqiu (‘demand’)-bixu (‘must’)

d. piping (‘criticize’)-bu yinggai (‘should not’)

I will extend the idea of domain shifting from Yalcin (2007) to account for the combinations above. The approach involves two key points. One is domain binding: the embedded modal retrieves its quantificational domain from the attitude via some kind of
anaphoric relations. The other is that the embedded modal has the same quantificational force as the matrix verb. Domain binding and force matching together make the quantification contributed by the attitude verb vacuous, which gives rise to the illusion that the two operators behave as if one. Because most of the verbs in (5.42-5.43) receive analyses more sophisticated than Hintikkan style semantics, the details of domain shifting turn out more complex than the mechanism proposed in Yalcin’s (2007) original work. In the remainder of this section, §5.3.1 discusses the instances in (5.42), §5.3.2 presents the derivation of concord interpretation for the pairs in (5.43).

5.3.1 Epistemic E-CM’s

5.3.1.1 Epistemic Possibility

The epistemic possibility modal *keneng* is in Real Concord with *huaiyi* ‘suspect’ and *danxin* ‘worry’. I take *huaiyi-keneng* to illustrate how the possibility epistemic ends up to be an E-CM. Since the semantics of *huaiyi* ‘suspect’ has not been discussed yet, let us first spend some time on the semantic properties of this verb

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An interesting fact about *huaiyi* that I am not going to discuss in the main text is: When *huaiyi* is modified by the degree adverb *hen* ‘very’, the whole predicate *hen huaiyi* exhibits a semantic behavior similar to English *doubt*. Consider the following contrast:

   Lao Li originally think culprit not be Xiao Wang but now he suspect culprit be Xiao Wang.
   ‘Lao Li originally thought the culprit is not Xiao Wang. But now he suspects the culprit is Xiao Wang.’

   Lao Li originally think culprit not be Xiao Wang but now he very suspect culprit be Xiao Wang.
   ‘Lao Li originally thought the culprit is not Xiao Wang. But now he doubts that the culprit is Xiao Wang.’

The counterpart of English *doubt* is not lexicalized in Mandarin. So how should we explain the morphology-semantics connection between *huaiyi* and *hen-huaiyi*? Specifically, can we derive the doubt-like semantics of *hen-huaiyi* compositionally from the suspect-like semantics of *huaiyi* and the typical function of *hen* as a degree modifier?

There seems to be evidence suggesting that the behavior of *hen-huaiyi* is not straightforwardly compositional. Consider the examples below:

a. *?Lao Li wanqun huaiyi Xiao Wang shi xiongshou.*
   Lao Li completely suspect Xiao Wang be culprit
   ‘Lao Li suspect completely that Xiao Wang is the culprit.’
Firstly, *huaiyi* entails uncertainty. This point is illustrated by the infelicity of (5.44a-b). The discourses in (5.44) show that both “*a queding* (*‘certain’*) $p \land a$ *huaiyi* $p$” and “*a queding* $\neg p \land a$ *huaiyi* $p$” are contradictory, indicating that “*a huaiyi* $p$” is incompatible with either “*a queding* $p$” or “*a queding* $\neg p$”.

(5.44) #a. *Lao Li queding Xiao Wang shi xiongshou, dan ta huaiyi Xiao Wang shi xiongshou.*

Lao Li certain Xiao Wang be culprit but he suspect Xiao Wang be xiongshou.

Lao Li is certain that Xiao Wang is the culprit, but he suspects that Xiao Wang is the culprit.

#b. *Lao Li queding Xiao Wang bu shi xiongshou. dan ta huaiyi Xiao Wang shi xiongshou.*

Lao Li certain Xiao Wang not be culprit but he suspect Xiao Wang shi xiongshou.

Lao Li is certain that Xiao Wang is not the culprit, but he suspects that Xiao Wang is the culprit.

As the sentences above show, *huaiyi* accepts adjectives that diagnose minimum degrees (*youdian* ‘slightly’), seems to be OK with degree maximizing modifiers (*wanqun* ‘completely’). When co-occurring with *wanqun* ‘completely’ and *youdian* ‘slightly’, *huaiyi* is interpreted as ‘suspect’. High degree modifiers other than *hen*, such as *shifen* ‘very’ and *jiqi* ‘extremely’, however, are not naturally acceptable. Based on the examples above, the last two in particular, it seems that *hen-huaiyi* is a peculiar, idiosyncratic usage. Even though usages such as (c-d) may be coerced, the coerced reading of Modifier-*huaiyi* seems to be “strongly doubt” rather than “doubt”.

b. *Lao Li youdian huaiyi Xiao Wang shi xiongshou.*

Lao Li slightly suspect Xiao Wang be culprit

‘Lao Li suspect slightly that Xiao Wang is the culprit.’

c. ?? *Lao Li shifen huaiyi Xiao Wang shi xiongshou.*

Lao Li very suspect Xiao Wang be culprit

d. ?? *Lao Li jiqi huaiyi Xiao Wang shi xiongshou.*

Lao Li extremely suspect Xiao Wang be culprit

As the sentences above show, *huaiyi* accepts adjectives that diagnose minimum degrees (*youdian* ‘slightly’), seems to be OK with degree maximizing modifiers (*wanqun* ‘completely’). When co-occurring with *wanqun* ‘completely’ and *youdian* ‘slightly’, *huaiyi* is interpreted as ‘suspect’. High degree modifiers other than *hen*, such as *shifen* ‘very’ and *jiqi* ‘extremely’, however, are not naturally acceptable. Based on the examples above, the last two in particular, it seems that *hen-huaiyi* is a peculiar, idiosyncratic usage. Even though usages such as (c-d) may be coerced, the coerced reading of Modifier-*huaiyi* seems to be “strongly doubt” rather than “doubt”.

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Secondly, *huaiyi* simply asserts that the complement is true in some world(s) compatible with the information state of the attitude holder. Unlike English *doubt, huaiyi* does not compare the probability of its complement and other contextually-available alternatives. Consider the scenario described below:

(5.45) **Scenario:** The police are investigating a case of murder. After a week, they narrowed down the suspects to Xiao Wang and Xiao Ma according to the evidence gathered.

a. *Jingfang huaiyi Xiao Wang shi xiongshou.*

   police   suspect   Xiao Wang be   culprit

   ‘The police suspect Xiao Wang is the culprit.’

b. *Jingfang huaiyi Xiao Ma shi xiongshou.*

   police   suspect   Xiao Ma be   culprit

   ‘The police suspect that Xiao Ma is the culprit.’

There are two suspects in the context, and the police have not figured out who is the culprit, so the judgment is both (5.45a) and (5.45b) are true. If “*a huaiyi p*” entails *p* is more likely than its alternatives, then given that (5.45a) is true, *p* = “*Xiao Wang shi xiongshou*” (‘Xiao Wang is the culprit’) should be more likely than *q* = “*Xiao Ma shi xiongshou*” (‘Xiao Ma is the culprit’). In consequence, it is false to assert “*Jingfang huaiyi q*” (‘The police suspect that Xiao Ma is the culprit’). In other words, (5.45b) should be false. This prediction contradicts the judgment that in this scenario (5.45b) is true as well. This data point suggests that a comparative semantics is not appropriate for *huaiyi* ‘suspect’.

Based on the arguments above, I sketch out the lexical semantics of *huaiyi* ‘suspect’ as (5.46).
(5.46) \[ [\text{huaiyi}]^f, w, S, \theta \] (p)(a)(w) is defined iff

\[ p\text{-verifiers in } S' \neq \emptyset \land p\text{-falsifiers in } S' \neq \emptyset, \text{ if defined,} \]

\[ [\text{huaiyi}]^f, w, S, \theta \] (p)(a)(w) = 1 iff

(i) \( \exists w' \in S' : [p]^{f, w', S', \theta} = 1 \)

where \( S' = D_{\text{ox}_a, w}; p\text{-verifiers in an information state} \)

\[ S = \lambda S'. S' \subset S \land \forall S'' \subset S': [\forall w' \in S'' : [p]^{w'', S''} = 1] = \text{pow}(S' \cap \neg p); \]

\( p\text{-falsifiers in } S = \neg p\text{-verifiers in } S = \text{pow}(S \cap \neg p) \)

(5.46) not only accounts for the properties discussed in (5.44-5.45), but also explains why

necessity epistemic is not quite compatible with \text{huaiyi}: When the complement is of the form \( \phi = \Box_{\text{epi}} p \), the doxastic assertion of “a \text{huaiyi} \phi” is true if and only if \( \exists w' \in S' : \forall w'' \in S' : [p]^{f, w'', S', \theta} = 1 \). As the two quantifiers range over the same domain \( S' \), the condition is equivalent to \( \forall w'' \in S' : [p]^{f, w'', S', \theta} = 1 \). This obviously contradicts the uncertainty condition. Therefore, a necessity epistemic is not allowed under \text{huaiyi},

unless it receives a Escape Hatch reading, where its domain is not anaphoric to the matrix verb.

Now let us consider what will happen if the complement of \text{huaiyi} is modified by a possibility epistemic. As presented in (5.47), the truth conditions of “a \text{huaiyi} \text{keneng} p” and “a \text{huaiyi} p” are equivalent to each other.

(5.47) \[ [a \text{huaiyi} \text{keneng} p]^f, w, S, \theta \] is defined iff

\( (\text{keneng } p)\text{-verifiers in } S' \neq \emptyset \land (\text{keneng } p)\text{-falsifiers in } S' \neq \emptyset. \) If defined,

\[ [a \text{huaiyi} \text{keneng} p]^f, w, S, \theta = 1, \text{ iff} \]

(i) \( \exists w' \in S' : [\text{keneng } p]^{f, w', S', \theta} = 1, \text{ iff} \)
(ii) \( \exists w' \in S' : \exists w'' \in S' : [p]^{w''S'} = 1 \), iff

(iii) \( \exists w'' \in S' : [p]^{w''S'} = 1 \),

where \( S' = \text{Dox}_{a,w} \), (keneng \( p \))-verifiers in an information state

\[ S = \lambda S' \cdot S' \subset S \land \forall S'' \subset S' : [\forall w' \in S'' : [p]^{w''S''} = 1] = \text{pow}(S \cap p); \]

(keneng \( p \))-falsifiers in \( S = \neg(\text{keneng} \ p) \)-verifiers in \( S = \text{pow}(S \cap \neg p) \).

As the verifiers of \( p \) and keneng \( p \) are both the power set of \( (S' \cap p) \), the definedness condition of (5.47) is the same as that in (5.46). As keneng is bound by the matrix verb, (5.47-i) is equivalent to (5.47-ii). Because the two possibility operators range over the same domain \( \text{Dox}_{a,w} \), (5.47-ii) is reduced to (5.47-iii), which is the same as line (i) of (5.46). Since both the definedness condition and the possibility assertion of (5.47) are equivalent to that of (5.46), “a huaiyi keneng \( p \)” \( \equiv \) “a huaiyi \( p \)”, and thusly the Real Concord status of keneng is explained.

5.3.1.2 Epistemic Necessity

In this subsection, I extend the mechanism presented in §5.3.1.1 to the necessity epistemic E-CM’s. But before that, we need to pin down the semantics of the weak necessity epistemic yinggai, and the strong necessity epistemic yiding.

For the semantics of the epistemic yinggai, we can modify the lexical semantics proposed by Rubinstein (2012) for the priority weak necessity modals (see also §2.2.3.1). Recall that Rubinstein’s final analysis for ought is as (5.48):

\[
(5.48) [\text{ought to}]^C = \lambda q_{s,t} \lambda w. \forall w' : w' \in \text{Fav}^C(w) \cap b.q(w'), \text{where } b \text{ is a secondary priority in } C \text{ and } b \text{ is a pertinent answer to } QUD^C.
\]

(Rubinstein 2012, p.82, (60))
The $\text{Fav}^C$ function returns the worlds favored by the ordering sources in the conversational context. $\text{QUD}^C$ stands for question under discussion, which is a partition of $\text{Fav}^C(w)$. The epistemic $\textit{ought}$ differs from the priority $\textit{ought}$ in modal flavor, but shares the same strength, which is argued to be derived from the shrinking of quantificational domain. I will assume the lexical entry for the epistemic $\textit{yinggai}$ is the same as $\textit{ought}$, except for the nature of $b$.

$\textit{Yiding}$ is an adverb, and its semantics is not exactly the same as the English $\textit{must}$. While $\textit{must}$ is in Real Concord with $\textit{believe}$, $\textit{yiding}$ is not in concord with $\textit{xiangxin}$ ‘believe’. Instead, $\textit{yiding}$ is in concord under $\textit{jianxin}$ ‘firmly believe’. One approach to account for this fact is to assume that $\textit{yiding}$ is in a sense stronger than $\textit{must}$: Because $\textit{yiding}$ is stronger than a plain necessity modal $\textit{must}$, “$\textit{a xiangxin yiding p}$” expresses a stronger doxastic claim than “$\textit{a xiangxin p}$”, while “$\textit{a believe must p}$” is equivalent to “$\textit{a believe p}$” in semantics. Suppose this account is on the right track, what is the nature of the strong-ness?

A possible account is that the strengthening effect is derived in a way analogous to how the weakness of $\textit{ought}$ is derived. To be specific, $\textit{yiding}$ is a necessity modal, but it somehow widens the domain (cf. domain restriction analysis of weak necessity modals). Then does the domain widening work? A good place to start with is the partitioning of ordering sources proposed by von Fintel & Iatridou (2008). This theory says each modal is sensitive to a bi-partitioned sequence of ordering sources. One partition is the primary sequence, and the other is the secondary sequence. The strong necessity modal is with respect to the primary sequence only, while the weak necessity modal is sensitive to both sequences of orderings.
(5.49) The context provides for each modal, a modal base $f$ and a bi-partitioned sequence of ordering sources $<<g_1,\ldots,g_i>, <g_{i+1},\ldots,g_k>>$.

- Strong necessity modals say that the prejacent is true in all worlds in $\max_{g_i(w)}(\ldots \max_{g_1(w)}(\bigcap f(w))))$.

- Weak necessity modals say that the prejacent is true in all worlds in $\max_{g_k(w)}(\ldots(\max_{g_{i+1}(w)}(\max_{g_i(w)}(\ldots \max_{g_1(w)}(\bigcap f(w)))))))$.

(von Fintel & Iatrida 2008, p138, footnote 35)

With the setup above, the more propositions a modal makes reference to, the more restricted its domain is, and the weaker the modal feels. Following this logic, to make a modal feel stronger, its domain should be less restricted, which means the modal is relativized to less propositions than the weaker one. So we can further partition the primary sequence of ordering sources: $<< <g_1,\ldots,g_j> < g_{j+1},\ldots,g_i>>, <g_{i+1},\ldots,g_k>>$. Then make a plain necessity modal must interpreted relative to the whole primary sequence, and assume a strong necessity modal yiding is with respect to a subset of the primary sequence. Here arises the key question: How is the primary sequence divided up?

To account for the weakness of ought, Rubinstein (2012) proposes that the cutoff between primary and secondary premises lies in the status of a premise in the presuppositions of the conversation participants. If a proposition $q$ is collectively committed to, then $q$ belongs to the primary ordering source. Otherwise, it is secondary. So what is the cutoff of the collective commitments? The contrast between jianxin (‘firmly believe’)-yiding and xiangxin (‘believe’)-yiding provides some clue. A person’s beliefs can be ordered according to the degree of commitment the attitude holder holds toward a proposition. Therefore, the threshold for strong commitment in the context may
serve to partition the propositions that are collectively committed. *Yiding* is sensitive to this partition, and is relativized to the primary orderings that the speaker or attitude holder is strongly committed to. Take (5.50) for example, *must* in (5.50a) is relativized to the collective commitments in the conversation; *should* in (5.50b) is interpreted with respect to the collective commitments and a secondary ordering *b*; *definitely* in (5.50c) is interpreted relative to a subset of the ordering sources that are collectively committed to, namely the propositions toward which the speaker holds a high degree of commitment.

(5.50) a. The culprit must be John.
    b. The culprit should be John.
    c. The culprit is definitely John.

In sum, I treat *yiding* as a necessity modal that is sensitive to a subset of primary ordering. So the domain of *yiding* is the union of the favored worlds and the part of *b* worlds that are in the modal base. Formally:

\[(5.51) \, [yiding]^{w,f,a} = \lambda q \lambda w. \forall w' \in Fav^c (w) \cup (b \cap MB) : q(w'), \]

where *b* is a partition of primary orderings, and the attitude holder *a* holds a high degree of commitment to *b*; \(MB = \bigcap f (w)\)

Now that we have provided lexical entries for the epistemic necessity modals *yinggai* and *yiding*, next turn to the attitude-modal pairs that are in Real Concord with them. In the remainder of this subsection, I will show that for the embedded epistemic necessity, some complications are involved in domain shifting. This is because the specific

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41 I use English examples because in Chinese there is no counterpart of *must*, thus the three-way distinction cannot be made.
necessity modal expressions may make particular assumptions about the premises in the context.

First consider *yinggai* as an E-CM. *Yinggai* is in Real Concord with *renwei* ‘think’ and *caice* ‘guess’. The two verbs both have weak necessity semantics. I take *renwei* for illustration. The semantics of *renwei* ((5.23) in §5.2.2.1) is repeated below:

\[(5.52) \left[ renwei \right]^{f,w,S,g}(p)(a) = 1 \text{ iff } \forall w' \in S': [p]^{w',S'} = 1,\]

where \(S' = Dox_{a,w} \cap i; i\) is the information \(a\) has in \(w\) that is pertinent to the QUD in the context.

Since \(g\) is private to the attitude holder, it has the same nature as the secondary premise \(b\) the weak necessity epistemic *yinggai* is sensitive to.

\[(5.53) \left[ yinggai \right]^{c} = \lambda q_{<s,t>}. \lambda w. \forall w' : w' \in Fav^{c}(w) \cap b.q(w'),\]

where \(b\) is a secondary premise in \(C\) and \(b\) is a pertinent answer to \(QUD^{c}\).

As presented in (5.54), the verb is sensitive to some information \(i\) that is private to the attitude holder; and \(i\) can serve as the secondary ordering, with respect to which *yinggai* is interpreted. Therefore, the domain of *renwei* is passed to *yinggai* without change. As a consequence, and the verb ends up contribute a vacuous quantification, and thus *renwei-* *yinggai* are in concord.

\[(5.54) \left[ a \ right. \left[ renwei \right] \left. yinggai \right]^{f,w,S,g} p = 1 \text{ iff } \forall w' \in S': [yinggai \left. p \right]^{w',S'} = 1, \text{ iff } \forall w' \in S': \forall w'' \in Fav^{c}(w) \cap b : [p]^{w'',S'} = 1, \text{ iff } \forall w' \in S': \forall w'' \in S' : [p]^{w'',S'} = 1, \text{ iff } \]

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∀w'' ∈ S' : [p]^{w'',s'} = 1

where S' = Doxa,w ∩ i; i is the information a has in w that is pertinent to
the QUD in the context. Fav^C(w) = Doxa,w, and b = i

In contrast, as (5.55) illustrates, when yiding appears in the place of yinggai, domain
widening occurs. As a result, a stronger statement is rendered.

(5.55) [a renwei yiding p]^f,w,s,g = 1 iff
∀w' ∈ S': [yiding p]^{w',s'} = 1, iff
∀w' ∈ S': ∀w'' ∈ Fav^C(w) ∪ (b ∩ MB) : [p]^{w'',s'} = 1, iff
∀w'' ∈ S' ∪ (b ∩ MB): [p]^{w'',s'} = 1,

where S' = Doxa,w ∩ i; i is the information a has in w, which is pertinent to the
QUD in the context. b is a partition of primary premises, a holds a high degree
of commitment to b, and MB = ∩f(w), Fav^C(w) = Doxa,w.

The mechanism of strength matching and domain adjusting described above also
explains why neither yinggai nor yiding is not in concord with xiangxin ‘believe’.
Xiangxin does not provide a secondary ordering, and is not sensitive to a subset of
propositions that the attitude holder believes more. As a result, yinggai will retrieves the
domain from xiangxin and shrinks it, while yiding will retrieve domain and enlarge it.

Next turn to yiding under baozheng ‘assure’. The lexical semantics of baozheng
‘assure’ has not received any formal analysis in the literature to the best of my knowledge.
A most relevant discussion is the analysis for the argumentation verb claim as in (5.56).
Note that it is expressed in event-relative framework proposed by Hacquard (2006, 2011).

(5.56) [claim e p] = claim'(e) & ∀w compatible with Goal(e)
\[
[\forall w' \in \bigcap \text{CON}(e_{CG-w'}) \ [p(w') = 1]]
\]

Anand & Hacquard (2011; (32))

There are two metalanguage predicates in the formula above. \( \text{Goal}(e) \) returns the conversational goal of the claiming event \( e \), while \( \text{CON}(e) \) picks out the contents of the event/state, i.e. a set of propositions associated with the event. The event \( e_{CG-w'} \) refers to a state of common ground, namely, the proposed common ground updated by the claiming event. The whole formula says, “claim \( p \)” denotes a claiming event, and for all worlds compatible with the discourse goal of the event, \( p \) is in the proposed common ground (in other words, all worlds that are compatible with the common ground are \( p \)-worlds). Note that (5.56) contains two layers of modality: the outer layer is teleological (the goal of the discourse move is concerned), while the inner layer is representational (the domain is determined by the state of the proposed common ground).

How can we extend the analysis of \( \text{claim} \) to \( \text{baozheng} \) ‘assure’? Firstly, we need to figure out in what aspects the two attitudes differ. Assuring is also a kind of discourse move with a particular goal. But the goal of assuring is not simply make the complement proposition \( p \) part of CG. In fact, \( p \) is probably already in the CG; at least, the conversation participants are aware of \( p \). The goal of assuring is to make the addressee not only accept it for the purpose of conversation, but actually believes it. So when the conversational goal of assuring succeeds, in the updated context, \( p \) becomes part of Common Beliefs (CB, the propositions that are believed by all participants of the conversation), which is a subset of CG. This idea leads to the analysis of \( \text{baozheng} \) ‘assure’ as below:

\[(5.57) \llbracket a \text{ baozheng } e \ p \rrbracket^f_{w,S,d} \text{ is defined iff}\]
If defined, $[[a \ baozheng \ e \ p]]_{f,w,S,a} = 1$ iff

(i) $\forall w' \in \cap \text{Goal}(e): [\forall w'' \in S': [p]_{f,w'',S',a} = 1]$,

where $S' = \cap CB - \text{w}^{'}, (= \cap \text{CON}(e_{\text{CB-w'}})); p$-verifiers in an information state $S = \lambda S'. S' \subset S \land \forall S'' \subset S': [\forall w' \in S'' : [p]_{w'',S'',a} = 1] = \text{pow}(S \cap p)$;

$p$-falsifiers in $S = \neg p$-verifiers in $S = \text{pow}(S \cap \neg p)$.

The event argument is necessary to refer to the discourse move, and to retrieve the conversational goal of the event. For verbs of discourse moves, I will accept the event-relativity assumption. Other attitudes we have encountered can be easily transposed to this framework as well.

When *yiding* is in the complement of *baozheng*, the modal checks whether the matrix verb provides a distinction of premises with different degrees of commitment by the attitude holder. *Baozheng* presupposes a distinction of CG, propositions that are collectively accepted, and CB, propositions that are collectively believed to be true by all participants of the conversation. Suppose $a$ believes $p$, and pragmatically accept $q$ but does not believe $q$. Then the degree of commitment of $a$ towards $p$, mark it as $d'(a, p)$, is a higher than the degree of commitment of $a$ towards $q$, $d'(a, q)$. Thus, CG serves as the primary premises for *yiding*, and CB the subset with high degree of commitment. In consequence, $S'$ is passed down to *yiding* and remains intact (i.e. (5.58-ii) is transformed to (5.58-iii)). The result is a trivial layer of quantification, thus (5.58-iii) is reduced to (5.58-iv), which is equivalent to (5.57-i). The concord relation between *baozheng-yiding* is thusly explained.

(5.58) $[[a \ baozheng \ yiding \ p]]_{f,w,S,a}$ is defined iff
If defined, $\llbracket \text{a baozheng yiding } p \rrbracket^{f,\mathcal{w}.\mathcal{S}.\mathcal{g}} = 1$ iff

(i) $\forall \mathcal{w}' \in \bigcap \text{Goal(e)}: \forall \mathcal{w}'' \in \mathcal{S}': [\llbracket \text{yiding } p \rrbracket^{f,\mathcal{w}''.\mathcal{S}'.\mathcal{g}} = 1]$, iff

(ii) $\forall \mathcal{w}' \in \bigcap \text{Goal(e)}: \forall \mathcal{w}'' \in \mathcal{S}': \forall \mathcal{w}''' \in \text{Fav}^C(\mathcal{w}') \cup (b \cap MB): [\llbracket \mathcal{w}'''.\mathcal{S}' = 1]$, iff

(iii) $\forall \mathcal{w}' \in \bigcap \text{Goal(e)}: \forall \mathcal{w}'' \in \mathcal{S}': \forall \mathcal{w}''' \in \mathcal{S}': [\llbracket \mathcal{w}'''.\mathcal{S}' = 1]$, iff

(iv) $\forall \mathcal{w}' \in \bigcap \text{Goal(e)}: \forall \mathcal{w}'' \in \mathcal{S}': [\llbracket \mathcal{w}'''.\mathcal{S}' = 1]$, iff

where $\mathcal{S}' = \bigcap \text{CB-w}'$; ($\text{yiding } p$)-verifiers in an information state

$\mathcal{S} = \lambda S'. S' \subset \mathcal{S} \land \forall S'' \subset \mathcal{S}': [\forall \mathcal{w}' \in S'': [\llbracket \mathcal{w}'''.\mathcal{S}' = 1] = \text{pow}(\mathcal{S} \cap p)$;

($\text{yiding } p$)-falsifiers in $\mathcal{S} = -\text{yiding } p$-verifiers in $\mathcal{S} = \text{pow}(S \cap -p)$.

$b$ is a partition of primary premises, $a$ holds a high degree of commitment to $b$,

and $\text{MB} = \bigcap f(\mathcal{w}); \text{Fav}^C(\mathcal{w}') = \bigcap \text{CG-w}',$ and $\text{Fav}^C(\mathcal{w}') \cup (b \cap MB) = \bigcap \text{CB-w}'$.

Lastly, turn to the fact that weak necessity epistemic and possibility epistemic are not acceptable in the complement of $\text{baozheng}$ unless they receive Escape Hatch reading.

This fact can be explained by the conflict between the semantics of “a $\text{baozheng yinggai/keneng } p$” and scalar implicatures triggered by asserting them. To be specific, because the epistemic modals form a Horn scale $<$keneng, yinggai, yiding$>$, “a $\text{baozheng yinggai/keneng } p$” implicates that $\text{I=}_\text{a baozheng } -\text{yiding } p$$"$. However, the pragmatic characteristics of the assuring as a discourse move requires that in the context in which the discourse goal of assuring is accomplished, Mod$_E p$ should be true and certain in CB -- in other words, all worlds in $S'$ are $p$-worlds. As (5.59) demonstrates, there is a confliction between the implicature I and the goal of assuring. The derivation is almost the same as (5.58) above, except that a negation is involved. At an intuitive level, this
corresponds to the fact that if one is not certain about what he asserts, his speech act by asserting that proposition will not be an assuring act.

\[(5.59) \llbracket a \ baozheng \neg(yiding p) \rrbracket^{f,w,S,g} \text{ is defined iff} \]

\[(yiding p)\text{-verifiers in } CB \neq \emptyset \land (yiding p)\text{-falsifiers in } CB \neq \emptyset \text{ iff} \]

\[\emptyset(CB \cap p) \neq \emptyset \land \emptyset(CB \cap \neg p) \neq \emptyset; \]

If defined, \(\llbracket a \ baozheng \neg(yiding p) \rrbracket^{f,w,S,g} = 1 \text{ iff} \]

\[\forall w' \in \cap \text{Goal}(e): \forall w'' \in S': \llbracket \neg(yiding p) \rrbracket^{f,w'',S',g} = 1, \text{ iff} \]

\[\forall w' \in \cap \text{Goal}(e): \forall w'' \in S': \neg\forall w''' \in S': \llbracket p \rrbracket^{w''',S'} = 1, \text{ iff} \]

\[\forall w' \in \cap \text{Goal}(e): \forall w'' \in S': \neg\forall w''' \in S': \llbracket p \rrbracket^{w''',S'} = 1, \text{ iff} \]

\[\forall w' \in \cap \text{Goal}(e): \neg\forall w''' \in S': \llbracket p \rrbracket^{w''',S'} = 1, \text{ iff} \]

where \(S' = \cap CB-w'\); \((yiding p)\text{-verifiers in an information state} \]

\[S = \lambda S'. S' \subset S \land \forall S'' \subset S':[\forall w' \in S'': \llbracket p \rrbracket^{w'',S'} = 1] = \text{pow}(S \cap p); \]

\((yiding p)\text{-falsifiers in } S = \neg(yiding p)\text{-verifiers in } S = \text{pow}(S \cap \neg p). \]

\(b\) is a partition of primary premises, \(a\) holds a high degree of commitment to \(b\),

and \(MB = \cap f(w), Fav^C(w') = \cap CG-w', \text{ and } Fav^C(w') \cup (b \cap MB) = \cap CB-w'. \]

### 5.3.1.3 Summary

In this subsection (§5.3.1), I strive to account for the epistemic modals in Real Concord relation with the matrix verb. I focused on three specific attitude-modal combinations, namely *huaiyi* (‘suspect’)-*keneng* (‘might’), *renwei* (‘think’)-*yinggai* (‘should’) and *baozheng* (‘suspect’)-*yiding* (‘definitely’). To account for these E-CM’s, I proposed lexical semantics for the attitude verbs, and also discussed the peculiar properties of *yiding*. Table 5.14 summarized these innovative analyses:
<table>
<thead>
<tr>
<th>Class</th>
<th>Lexical Entry</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doxastic</td>
<td>[[\text{huaiyi}]^{f,w,g}(p)(a)(w)] is defined iff</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>(p)-verifiers in (S' \neq \emptyset \land p)-falsifiers in (S' \neq \emptyset). If defined, [\text{huaiyi}]^{f,w,S',g}(p)(a)(w) = 1 iff (\exists w' \in S': [p]^{f,w,S',g} = 1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>where (S' = \text{Dox}_{a,w}; p)-verifiers in an information state (S = \lambda S'; S' \subset S \land \forall S'' \subset S':[\forall w' \in S'': [p]^{w'',S''} = 1] = \text{pow}(S' \cap p)); (p)-falsifiers in (S = \text{pow}(S \cap \neg p))</td>
<td></td>
</tr>
<tr>
<td>Doxastic</td>
<td>[[\text{renwei}]^{f,w,S,g}(p)(a)(w) = 1 iff (\forall w' \in S': [p]^{f,w,S',g} = 1,) where (S' = \text{Dox}_{a,w} \cap i; i) is the information (a) has in (w) that is pertinent to the (\text{QUD}) in the context.</td>
<td>N/A</td>
</tr>
<tr>
<td>Argumentation</td>
<td>[[\text{baozheng}]^{f,w,S,g}(e)(p)(a)] is defined iff (p)-verifiers in (CB \neq \emptyset \land p)-falsifiers in (CB \neq \emptyset). If defined, [[a \text{ baozheng } e \ p]^{f,w,S,g} = 1 \iff \forall w' \in \cap \text{Goal}(e): [\forall w'' \in S': [p]^{f,w'',S',g} = 1])</td>
<td>Anand &amp; Hacquard (2011)</td>
</tr>
<tr>
<td></td>
<td>where (S' = \cap CB \cdot w' = (\cap \text{CON}(e_{CB-w'})); p)-verifiers in an information state (S = \lambda S'; S' \subset S \land \forall S'' \subset S':[\forall w' \in S'': [p]^{w'',S''} = 1] = \text{pow}(S \cap p)); (p)-falsifiers in (S = \text{pow}(S \cap \neg p))</td>
<td></td>
</tr>
<tr>
<td>Strong necessity modal</td>
<td>[[yiding]^{w,f,g} = \lambda q \lambda w. \forall w' \in \text{Fav}^C(w) \cup (b \cap MB) : q(w')), where (b) is a partition of primary orderings, and the attitude holder (a) holds a high degree of commitment to (b); (MB = \cap f(w))</td>
<td>Rubinstein (2012)</td>
</tr>
</tbody>
</table>

Table 5.14: Lexical Semantics of Huaiyi, Renwei and Baozheng

Domain shifting plays an important role in the explanations for the epistemic E-CM’s. The possibility modal retrieves its domain from the matrix verb in the manner proposed in Yalcin (2007), but necessity modal yinggai and yiding interact with the embedding attitudes in a more sophisticated way. The embedded modal will first check whether the attitude has the same “strength” it has. Yinggai looks for a secondary ordering. If the attitude verb has a weak necessity semantics (that is, it involves ranking of worlds based on information/priorities that are private to the attitude holder), then the information state \(S'\) determined by the attitude verb is passed down to the modal without adjustment.

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Otherwise, *yinggai* will inherit *S*’ and shrinks it. *Yiding* is in a sense stronger than a plain strong necessity such as English *must*. It looks for a subset of the premises that receive higher degree of commitment by the attitude holder. If the attitude verb can provide such a set, *yiding* will retrieve the domain determined by the verb without adjusting it. Otherwise, domain widening will happen. Matching in quantificational force, especially the micro-variation of strengths, is crucial for whether concord reading arises. Real Concord happens only when the attitude verb and the epistemic modal have the same strength.

### 5.3.2 Concord Priority Modals

In this subsection I will extend the approach sketched out in §5.3.1 to the priority E-CM’s. The remainder of this subsection is organized by the sub-types of the attitude verbs.

#### 5.3.2.1 The Permissive Verbs

*Keyi* ‘may’ is a concord modal when embedded in the complement of *pizhun* ‘permit; authorize’. Note that other possibility modals such as *neng* also have priority usages, but the combination of *pizhun-neng* is only marginally acceptable, because *neng* mainly receives the ability/circumstantial interpretation. This fact suggests that collocationality does play a role in modal concord (for details on the collostructional analysis, refer to §5.1). Also note that *pizhun* does not have the sense “is compatible with the priorities”; it only has the “to give permission” reading.

I analyze the permissive verb in the style inspired by the semantics of *claim* discussed in §5.3.1.2. *Pizhun* is treated as a report of discourse move, which reports an event of giving permission. Thus, a sentence with the scheme (5.60a) can be paraphrased as (5.60b).
(5.60) a. *a pizhun p (p = x P)*

b. *In the reported context, there is a discourse move by a giving permission p.*

To produce a semantics that arrives at the paraphrase above, we must know what it means for a sentence to be a “permission”. Portner (2010) provides a formal definition of permission as (5.61):

\[(5.61) S \text{ is a permission sentence in context } c \text{ if an utterance of it in } c \text{ results, as a matter of its conventional meaning, in a context } c' \text{ in which some best-ranked worlds are in } [S].\]

\[\exists w \left[ w \in \bigcap CG \land w \in [S] \land \neg \exists w' \left[ w \in \bigcap CG \land w' <_t w \right] \right]\]

Based on (5.61), I propose to analyze a permissive verb as follows: Firstly, it presupposes that its complement is not already permitted. In the dynamic semantics terms, before the permitting event, *x doing P* is prohibited, so *x’s To-Do List* (§2.3.1) ranks the \(\neg p\)-worlds highest \((p = PRO P = P(x), \text{ since } PRO \text{ is co-indexed with } x)\). This condition is formally expressed as (5.62):

\[(5.62) \llbracket a \text{ pizhun } x \_ [PRO} \_ P] \rrbracket^{C,w}_{w} \text{ is defined iff }\]

\[\neg \exists w' \in max_{g-1}(\bigcap CG_{e-1}) : [p]^{w'} = 1\]

\[\text{where } p = PRO P = x P, \ g-1 = T_{e-1}(x).\]

CG\(_{e-1}\) stands for the Common Ground before the permitting event, and \(T_{e-1}(x)\) refers to *x’s To-Do List* before the permitting event.

Secondly, a permissive verb asserts that the complement is allowed in the updated context. This is captured by making the set ranked highest by the updated To-Do List of *x* contain \(p\)-worlds. This idea is formally expressed in (5.63):

\[(5.63) \text{When defined, } \llbracket a \text{ pizhun } x \_ [PRO} \_ P] \rrbracket^{C,w}_{w} = 1 \text{ iff }\]

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\[ \exists w' \in \max_{g+1}(\cap CG_{e+1}): [p]^{w'}, \text{ where } p = PRO P = x P; \ g_{e+1} = T_{c+1}(x). \]

CG_{e+1} strands for the Common Ground after the permitting event, and T_{c+1}(x) refers to x’s To-Do List after permitting. Note that (5.63) has only one layer of quantification over possible worlds. Different from the argumentation verbs such as claim, giving permission not just attempts to affect the context, but actually updates context immediately. Thus, there is no need to introduce a layer of teleological modality in which the conversational goal of the discourse move is accomplished.

Next consider the cases where the complement of pizhun is modalized. There are two puzzling facts about the verb’s interaction with embedded modals. One is that a necessity (priority) modal is unacceptable under permissive verbs. A sentence with the schema “a pizhun bixu/yinggai p” is infelicitous. The sentence does not receive the potentially possible interpretation *It is permitted by a that p is required*. The other fact is that the meaning of keyi is highly restricted under pizhun. A sentence with the form “a pizhun keyi x P” cannot be interpreted as, say, *a permits that it is compatible with the goal of x that p*, *a permits that it is compatible with the state law that x does P*, etc. In fact, the only felicitous interpretation of keyi is the one in which the modal is in concord with the embedding verb.

I will discuss the second puzzle first. Suppose keyi has its normal meaning under pizhun, “a pizhun x keyi p” will assert line (ii) of (5.64), which says: There is a world w’ in the worlds ranked highest by the updated To-Do List of x such that p is true in some of the worlds favored by the relevant priorities in w’.

(5.64) When defined, \( [[a \ pizhun \ e \ x_i \ [PRO_i \ keyi \ P]]^{C,w=1} \) iff

(i) \( \exists w' \in \max_{g+1}(\cap CG_{e+1}): [\text{keyi p}]^{w'}=1, \) iff
(ii) \( \exists w' \in max_{g+1}(\cap CG_{e+1}) : \exists w'' \in max_{g'}(w') : \llbracket p \rrbracket^{w''} = 1, \)

where \( p = P(PRO) = P(x); \quad g_{+1} = T_{e+1}(x) \)

This semantics is obviously too unrestricted. It allows the \( max_{g'}(w') \) to have all possible flavors. To narrow down the interpretation of \( keyi \) to the concord reading only, I propose that \( max_{g'}(w') \) is anaphoric to \( max_{g+1}(\cap CG_{e+1}) \). As (5.65) illustrates, if the domain of the modal is bound by the matrix verb, then the quantification contributed by the matrix verb will be trivial:

(5.65) When defined, \( \llbracket [a pizhun \: x_i \: PRO_i \: keyi \: P] \rrbracket^{C,w} = 1 \) iff

(i) \( \exists w' \in max_{g+1}(\cap CG_{e+1}) : \llbracket keyi \: p \rrbracket^{w'} = 1, \) iff

(ii) \( \exists w' \in max_{g+1}(\cap CG_{e+1}) : \exists w'' \in max_{g+1}(\cap CG_{e+1}) : \llbracket p \rrbracket^{w''} = 1, \) iff

(iii) \( \exists w'' \in max_{g+1}(\cap CG_{e+1}) : \llbracket p \rrbracket^{w''} = 1, \)

where \( p = PRO \: P = P(x); \quad g_{+1} = T_{e+1}(x) \).

The result above is desirable, but to make this analysis more convincing, we also need to be specific about the conditions under which this anaphoric behavior happens to the priority modals. My hypothesis is as follows:

(5.66) Hypothesis about the Binding of Embedded Priority Modal:

(a) A priority modal is usually bound when it is in the complement of a discourse move verb that aims to update the To-Do Lists of the conversational background.

(b) A bound priority modal retrieves its modal base and ordering source in an anaphoric manner from the embedding attitude verb.
(5.66-a) states the condition under which the binding of embedded priority modals happens, and (5.66-b) describes how the binding works exactly.

The last piece needed for the analysis of pizhun taking a modalized complement is the definedness condition when the complement contains a modal. Pizhun presupposes that Mod p is not already permitted, the set of worlds highest ranked by the addressee’s To-Do List before the permission is given should be a falsifier of Mod p. Take keyi for illustration:

\[
(a pizhun e x_i [PRO_i keyi P])^{f,w,g}\text{ is defined iff}
\]

(i) \(\text{max}_{\tau_{e-1}(x)} (\cap CG_{e-1})\) is a \((keyi p)\)-falsifier; iff

(ii) \(\forall S' \subset \text{max}_{\tau_{e-1}(x)} (\cap CG_{e-1}): \llbracket \text{keyi p} \rrbracket ^{S'} = 0\), iff

(iii) \(\forall S' \subset \text{max}_{\tau_{e-1}(x)} (\cap CG_{e-1}): \forall \in w' \in S': \llbracket p \rrbracket ^{w',S'} = 0\), iff

(iv) \(\forall \in w' \in \text{max}_{\tau_{e-1}(x)} (\cap CG_{e-1}): \llbracket \neg p \rrbracket ^{w',S'} = 1\)

where \(p = PRO P = x P\).

A consistent set of worlds \(S\) is a falsifier of \(\phi\), if and only if \(\phi\) is false relative to \(S\) and all the subsets of \(S\). According to this definition, (5.67-i) is transformed to (5.67-ii). In the world-relative terms, \(\phi = keyi p\) is true with respect to \(S\), if and only if some worlds in \(S\) are \(p\)-worlds. Accordingly, (5.67-ii) can be transposed to (5.67-iii), which is equivalent to (5.67-iv).

Now put together (5.67), (5.65) and the hypothesis (5.66), the analysis in (5.68) is yielded:

\[
(a pizhun e x_i [PRO_i keyi P])^{f,w,g}\text{ is defined iff}
\]

\[
\text{max}_{\tau_{e-1}(x)} (\cap CG_{e-1})\text{ is a (keyi p)-falsifier; iff}
\]
(i) \( \forall S' \subseteq max_{\tau_{e-1}(x)}(\cap CG_{e-1}) : \llbracket keyi \ p \rrbracket^{S'} = 0, \text{ iff} \)

(ii) \( \forall w' \in max_{\tau_{e-1}(x)}(\cap CG_{e-1}) : \llbracket \neg p \rrbracket^{w'} = 1. \text{ If defined,} \)
\[
\llbracket a \text{ pizhune } x_1 [PRO}_{i} \text{ keyi } P \rrbracket^{f,w,g} = 1 \text{ iff}
\]
\[
\exists w' \in max_{\tau_{e+1}(x)}(\cap CG_{e+1}) : \llbracket keyi \ p \rrbracket^{f,w',g} , \text{ iff}
\]

(iii) \( \exists w'' \in max_{\tau_{e+1}(x)}(\cap CG_{e+1}) : \exists w' \in max_{\tau_{e+1}(x)}(\cap CG_{e+1}) : \llbracket p \rrbracket^{f,w'',g} = 1, \text{ iff} \)

(iv) \( \exists w'' \in max_{\tau_{e+1}(x)}(\cap CG_{e+1}) : \llbracket p \rrbracket^{f,w'',g} = 1 \)

where \( p = PRO \) \( P = P(x); (keyi-p)-\text{verifiers in } S = \lambda S'. S' \subseteq S \wedge \forall S'' \subseteq S'.[\forall w' \in S'' : \llbracket p \rrbracket^{w'',g} = 1] = \text{pow}(S' \cap p) \)

Line (5.68-i) and (5.68-ii) are from (5.67), omitting some intermediate steps. In computing the truth conditions, following the hypothesis (5.66), the modal base and ordering source with respect to which keyi is interpreted are anaphoric to \( CG_{e+1} \) and \( T_{e+1(x)} \) respectively; thusly, (5.68-iii) is derived. Since in (5.68-iii) the two possibility quantifiers have identical domain, the outer quantifier becomes vacuous, and (5.68-iii) is reduced to (5.68-iv). The definedness condition and truth conditions derived in (5.68) are the same as those in (5.62-5.63), the concord status of keyi under pizhun is therefore explained.

Next let us move to the infelicity of pizhun-\( x \)-priority combinations. My proposal is as follows: pizhun-bixu/yinggai is infelicitous because the semantics of “a pizhun \( x \) bixu/yinggai P” contradicts its implicature. Pizhun (‘permit’) and yaoqiu (‘require’) form a Horn Scale <pizhun, yaoqiu>. As a result, when (5.69a) is asserted, the mechanism of scalar inference will give rise to the implicature (5.69b):

(5.69) a. a pizhun \( x \) P

b. \( \neg(a \text{ yaoqiu } x \ P) \)
The meaning of (5.69a) is computed in (5.70):

(5.70) \([a \text{ pizhun } e \ x_i [\text{PRO}_l \ bixu \ P]]\)^{f,w,g} \text{is defined iff }
\max_{T_{e-1}(x)}(\bigcap CG_{e-1}) \text{ is a } (\text{bixu } p) \text{-falsifier; iff }
\begin{align*}
(i) \ & \forall S' \subset \max_{T_{e-1}(x)}(\bigcap CG_{e-1}): [bixu \ p]^{s'} = 0, \text{ iff} \\
(ii) \ & \forall S' \subset \max_{T_{e-1}(x)}(\bigcap CG_{e-1}): \forall w' \in S': [p]^{w',s'} = 0, \text{ iff}\end{align*}
(iii) \ & \forall w' \in \max_{T_{e-1}(x)}(\bigcap CG_{e-1}): [-p]^{w',s'} = 1. \text{ If defined, }
\begin{align*}
[a \text{ pizhun } e \ x_i [\text{PRO}_l \ bixu \ P]]^{f,w,g} &= 1 \text{ iff } \\
\exists w' \in \max_{T'}(\bigcap CG_{e+1}): [bixu \ p]^{f,w',g} = 1, \text{ iff } \\
(iv) \ & \exists w' \in \max_{T'}(\bigcap CG_{e+1}): \forall w'' \in \max_{T'}(\bigcap CG_{e+1}): [p]^{f,w'',g} = 1, \text{ iff } \\
(v) \ & \forall w'' \in \max_{T'}(\bigcap CG_{e+1}): [p]^{f,w'',g} = 1
\end{align*}
where \(p = \text{PRO } P = x \ P\)

As the derivation above shows, based on the definition of \(\phi\)-falsifier, the definedness condition is expressed as (5.70-i), which is transposed to the world-relative notion in (5.70-ii), and then reduced to (5.70-iii). Also, following from the hypothesis (5.66), \(bixu\) is relativized to the CG and \(x\)'s To-Do List after the permitting move, thusly (5.70-iv) is yielded. As the domain of the possibility quantifier is identical to the succeeding necessity quantifier, the possibility quantification becomes trivial. Consequently, (5.70-iv) is transformed to the last line (5.70-v).

Next turn to the implicature (5.69b). The derivation of its truth conditions is presented in (5.71). \(Yaoqiu\) 'require' is tentatively treated as the dual of the permission verb (see the §5.3.2.2 for more discussions on the analysis of require verbs).

(5.71) \([-\neg(a \text{ yaoqiu } e \ x_i [\text{PRO}_l \ bixu \ P])]\)^{f,w,g} \text{ is defined iff }

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\[
\text{max}_{T_{e-1}}(\cap CG_{e-1}) \text{ is a not (bixu p)-verifier; iff}
\]

(i) \(\neg \forall S' \subset \text{max}_{T_{e-1}}(\cap CG_{e-1}): [\text{bixu p}]^{S'} = 1, \text{ iff} \)

(ii) \(\neg \forall S' \subset \text{max}_{T_{e-1}}(\cap CG_{e-1}): \forall w' \in S': [p]^{w',S'} = 1, \text{ iff} \)

(iii) \(\neg \forall w' \in \text{max}_{T_{e-1}}(\cap CG_{e-1}): [p]^{w',S'} = 1. \text{ If defined,} \)

\[
\lceil \neg (a \text{ yaoqiu e } x_i [\text{PRO}_l \text{ bixu P}]) \rceil^{f,w,g} = 1 \text{ iff}
\]

\[
\neg \forall w' \in \text{max}_{T_{e+1}(x)}(\cap CG_{e+1}): [\text{bixu p}]^{f,w',g} = 1, \text{ iff} \)

(iv) \(\neg \forall w' \in \text{max}_{T_{e+1}(x)}(\cap CG_{e+1}): \forall w'' \in \text{max}_{T_{e+1}(x)}(\cap CG_{e+1}): [p]^{f,w'',g} = 1, \)

(v) \(\text{iff } \neg \forall w'' \in \text{max}_{T_{e+1}(x)}(\cap CG_{e+1}): [p]^{f,w'',g} = 1 \)

where \(p = \text{PRO} P = P(x); \text{ (bixu-p)-falsifiers } = \neg (\text{bixu p})\)-verifiers in \(S = \)

\[
\lambda S'. S' \subset S \land \forall S'' \subset S': [\forall w' \in S'': \lceil \neg p \rceil^{w'',S''} = 1] = \text{pow}(S' \cap p \neg)
\]

In contrast to the permissive verb, the directive verb presupposes that the complement is not already required. When the complement \(\phi = \text{bixu p}, \) this condition is formally expressed by (5.71-i), which is then transposed to (5.71-ii) in world-relative terms, and further reduced to (5.71-iii). The condition in line (5.71-iv) is derived following hypothesis (5.66). Yaoqiu is a verb of discourse move, which attempts to affect the To-Do List of the addressee, thus bixu is bound by the matrix verb. Then due to domain sharing, the outer layer of universal quantification in (5.71-iv) turns vacuous. As a result, (5.70-v) is yielded.

The truth conditions in (5.71) basically say when defined, the implicature \( \neg (a \text{ yaoqiu x P}) \) is true if and only if not all the highest ranked worlds in the updated context are \(p\) worlds. This obviously contradicts (5.70-iii), the truth conditions of \(a \text{ pizhun x P}\). In short, (5.70-5.71) together reveal that if a necessity modal appears in the complement of
pizhun, the semantics of the sentence will contradict the scalar implicature triggered by
the matrix verb. It is this contradiction between semantics and pragmatics that blocks
necessity priority modals to appear under the permissive verb.

5.3.2.2 The Requirement Verbs

I use the term requirement verb to cover jianyi ‘suggest; advice’ and yaoqiu ‘demand;
require’, as both of them report illocutionary acts that belong to a subtype of requirement.
The characteristics of grounds against which the illocutionary acts are performed
determine the subtypes of requirements (Portner 2010). For example, a sentence is a
request if it helps the speaker achieve her goals/desires, and the speaker is not entitled
with any authority. A sentence is a suggestion/advice, if the sentence helps the addressee
to achieve her desires/goals. According to these theoretical assumptions, it is possible to
provide the same core semantics for jianyi and yaoqiu, and distinguish the two with
different presuppositions about the contexts.

Parallel to the analysis of the permission verb, a sentence headed by a requirement
verb with the scheme (5.72a) can be paraphrased as (5.72b).

(5.72) a. a require that p

b. In the reported context, there is a discourse move by a issuing requirement p.

Again, to produce semantics that yields the paraphrase (5.71b), we need to specify what
the term “requirement” exactly means. According to Portner (2010), requirement can be
formally analyzed as (5.73):

(5.73) S is a requirement sentence in context c if an utterance of it in c results, as a
matter of its conventional meaning, in a context c’ in which all best-ranked worlds are in[[S]].

\[ \forall w[ (w \in \cap CG \land \neg \exists w' [w \in \cap CG \land w' <_t w']) \rightarrow w \in [[S]] ] \]
Based on the definition in (5.73), I analyze the semantics of requirement verbs as (5.74).

(5.74) $[[a \text{ REQUIRE } e \ x_i \ [\text{PRO}_i \ P]]^f,wo,g]$ is defined iff

$$\neg \forall w' \in \max_{T_{e-1}(x)}(\cap CG_{e-1}): [p]^{f,wo,g} = 1.$$ If defined,

$$[[a \text{ require } e \ x_i \ [\text{PRO}_i \ P]] = 1 \iff \forall w' \in \max_{T_{e+1}(x)}(\cap CG_{e+1}): [p]^{f,wo,g} = 1,$$

where $p = \text{PRO} \ P = x \ P$.

Like the semantics of the permissive verb, there is only one layer of modality in (5.74), since when a requirement is issued, the To-Do Lists will be actually updated as a consequence. Requirement verbs presuppose that the complement is not already required for $x$; that is, not every world in the $\cap CG_{e-1}$ worlds ranked highest by $T_{e-1}(x)$ is a world in which $x$ makes $P$ true in it. When the complement is modalized, the sentence “$a \text{ REQUIRE } x \text{ Mod } P$” presupposes that $\max_{T_{e-1}(x)}(\cap CG_{e-1})$ is not a $(\text{Mod } p)$-verifier:

(5.75) $[[a \text{ REQUIRE } e \ x_i \ [\text{PRO}_i \ \text{Mod } P]]^f,wo,g]$ is defined iff

$\max_{T_{e-1}(x)}(\cap CG_{e-1})$ is a not $(\text{bixu } p)$-verifier; iff

(i) $\neg \forall S' \subseteq \max_{T_{e-1}(x)}(\cap CG_{e-1}): [\text{bixu } p]^{S'} = 1,$ iff

(ii) $\neg \forall S' \subseteq \max_{T_{e-1}(x)}(\cap CG_{e-1}): \forall w' \in S': [p]^{w',S'} = 1,$ iff

(iii) $\neg \forall w' \in \max_{T_{e-1}(x)}(\cap CG_{e-1}): [p]^{w',S'} = 1.$ If defined,

$$[[a \text{ REQUIRE } e \ x_i \ [\text{PRO}_i \ \text{Mod } P]] = 1 \iff \forall w' \in \max_{T_{e+1}(x)}(\cap CG_{e+1}): [\text{Mod } p]^{f,wo,g} = 1,$$

where $p = \text{PRO} \ P = x \ P$.

*Yaoqiu* ‘demand’ and *jianyi* ‘suggest’ are in concord with the strong necessity *bixu* and the weak necessity *yinggai* respectively. This is predicted because *jianyi* has weak
necessity semantics but \textit{yaoqi} does not. Also, priority modals under requirement verbs are evidently bound by the matrix verbs unless explicit backgrounds are provided to force a free interpretation. For example, \textit{yinggai} is accepted in the complement of (5.76), but it is relativized to the census results, rather than the requirements of the Congress.

(5.76) \textit{Yihui yaoqi zongtong yinggai genju minyi diaocha jieguo cizhi.}

congress demand president should according to census result resign

‘The Congress demanded the President to resign according to results of census.’

Given the semantics of \textit{yaoqi} in (5.75), the concord relation between \textit{yaoqi} and \textit{bixu} can be explained away with the help of the mechanism of domain binding. Consider the derivation below:

(5.77) $\llbracket a \textit{yaoqi} e \ x_i [\text{PRO}_i \ \textit{bixu} \ P] \rrbracket^{f,w,g}$ is defined iff

$max_{T_{e-1}(x)}(\nabla CG_{e-1})$ is a not ($\textit{bixu}$ $P$)-verifier; iff

(i) $\forall S' \subseteq max_{T_{e-1}(x)}(\nabla CG_{e-1}): \llbracket \textit{bixu} \ P \rrbracket^{S'} = 1$, iff

(ii) $\forall w' \in max_{T_{e-1}(x)}(\nabla CG_{e-1}): \llbracket P \rrbracket^{w',S'} = 1$. If defined,

$\llbracket a \textit{yaoqi} e \ x_i [\text{PRO}_i \ \textit{bixu} \ P] \rrbracket^{f,w,g} = 1$, iff

$\forall w' \in max_{T_{e+1}(x)}(\nabla CG_{e+1}): \llbracket \textit{bixu} \ P \rrbracket^{f,w',g} = 1$, iff

(iii) $\forall w' \in max_{T_{e+1}(x)}(\nabla CG_{e+1}) \forall w'' \in max_{T_{e+1}(x)}(\nabla CG_{e+1}): \llbracket P \rrbracket^{f,w'',g} = 1$, iff

(iv) $\forall w'' \in max_{T_{e+1}(x)}(\nabla CG_{e+1}): \llbracket P \rrbracket^{f,w'',g} = 1$, iff

where $p = \text{PRO} \ P = x \ P$.

As presented in (5.77), a sentence with the scheme “$a \textit{yaoqi} x \textit{bixu} P$” presupposes that the set of worlds ranked highest by the To-Do List of $x$ before the requirement is issued is
not a “bixu p”-verifier. This condition is expressed as (5.77-i), which can be transposed to the world-relative format (5.77-ii). Because yaoqiu reports a discourse move that aims to update the To-Do Lists of the conversation, bixu is bound by the matrix verb. Specifically, it is interpreted relative to the CG and x’s To-Do List after the requiring move, as expressed in (5.77-iii). The condition in (5.77-iii) is equivalent to (5.77-iv), for the two universal quantifiers share the same domain, so the outer layer of quantification becomes trivial.

A possibility modal is unacceptable under yaoqiu, because a sentence of the form (5.78a) will trigger a scalar implicature with the scheme (5.78b). The implicature, however, is incompatible with the pragmatic assumptions about the requiring acts. For a speech act to be a requiring act, after the discourse move is taken, the set of worlds ranked highest by the addressee’s To-Do List should be a verifier of the complement φ=keyi p. It is formally expressed by (5.78c), which is formally expressed as (5.78c), and can be transformed in world-relative format as (5.78d). However, (5.78d) and (5.79-v), the truth conditions of (5.78b), contradict each other. This conflict between semantics and pragmatics lead to the incompatibility of possibly priority under yaoqiu.

(5.78) a. a yaoqiu x keyi P
b. a yaoqiu x ¬(bixu P)
c. ∀S’ ⊆ max_{T_{e+1}(x)}(∩CG_{e+1}): [keyi p]^{S'} = 1
d. ∀w'' ∈ max_{T_{e+1}(x)}(∩CG_{e+1}): [p]^{w'',θ} = 1

(5.79) [a yaoqiu e x_i ¬([PRO_i bixu P])]^{w,θ} is defined iff
max_{T_{e-1}(x)}(∩CG_{e-1}) is not a ¬(bixu p)-verifier; iff

(i) ¬∀S’ ⊆ max_{T_{e-1}(x)}(∩CG_{e-1}): [¬(bixu p)]^{S'} = 1, iff
(ii) \( \neg \forall S' \subseteq max_{\tau_{e-1}(x)}(\cap CG_{e-1}): \neg \forall w' \in S': [\neg (bixu \ p)]^{S'} = 1 \), iff

(iii) \( \exists \in w' \in max_{\tau_{e-1}(x)}(\cap CG_{e-1}): [p]^{w',S'} = 1 \). If defined,

\[
[a \ yaoqiu \ e \ x_i \ \neg([\text{PRO}_i \ bixu \ P]) ]^{f,w,g} = 1, \text{ iff}
\]

\( \forall w' \in max_{\tau_{e+1}(x)}(\cap CG_{e+1}): [\neg (bixu \ p)]^{f,w',g} = 1, \text{ iff} \)

(iv) \( \forall w' \in max_{\tau_{e+1}(x)}(\cap CG_{e+1}): \forall w'' \in max_{\tau_{e+1}(x)}(\cap CG_{e+1}): [p]^{f,w'',g} = 1, \text{ iff} \)

(v) \( \forall w'' \in max_{\tau_{e+1}(x)}(\cap CG_{e+1}): [p]^{f,w'',g} = 1, \)

where \( p = \text{PRO} \ P = x \ P. \)

So far we have seen how the concord reading of \( yaoqiu-bixu \) is derived, and why the \( yaoqiu-keyi \) combination is ruled out. Next, let us turn to the interaction of the suggestive verb \( jianyi \) ‘suggest’ and priority modals in its complement. Recall that the patterns are as follows: the strong necessity modal \( bixu \) strengthens the assertion; the weak necessity \( yinggai \) is in Real Concord with \( jianyi \); and the possibility modal \( keyi \) is in Pseudo Concord relation with the verb.

\( jianyi \) ‘suggest’ has a weak necessity semantics. This is so because a suggestion is always made based on beliefs and preferences private to the attitude holder. For example, in a scenario of visiting a doctor, the symptoms and medical records of the patient are the modal base, and the patient’s concerns and preferences that are public to both parties are the primary priorities. In addition to these, the doctor’s person beliefs and preferences certainly affect the suggestions he will give to the patient. Therefore, in addition to the pragmatic analysis as (5.74), a suggestive verb can also be analyzed as (5.80):

(5.80) \( [jianyi]^{f,w,g}(p)(a)(w) = 1 \text{ iff } \forall w' \in max_{o_1,PRE_a,w} (\cap f (w)): [p]^{w'} \)

where \( o_1 = \text{primary priorities}, \text{PRE}_a,w = a’s \text{ preferences in } w \text{ that are pertinent to} \)

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the QUD.

The function \(\text{max}_{g,\text{PRE}_{a,w}}\) returns the worlds that are ranked highest by the primary ordering \(o_1\) and a secondary priorities represented as \(\text{PRE}_{a,w}\).

Since a suggestive speech act aims to affect the To-Do List of the addressee, a priority modal in the complement of \(\text{jianyi}\) is bound by the matrix verb according to the hypothesis (5.66). As (5.81) presents, because the matrix verb provides a secondary ordering, the domain of the verb is passed along to the embedded modal without adjustment. This makes the quantification contributed by the verb vacuous, and leads to the Real Concord reading of the \(\text{jianyi}-\text{yinggai}\) pair.

\[(5.81) \quad [a \ jianyi \ yinggai \ p]^{f,w,g} = 1 \iff \forall w' \in \text{max}_{o_1,\text{PRE}_{a,w}} (\cap f(w)) : [\text{yinggai} \ p]^{f,w',g}, \iff \forall w' \in \text{max}_{o_1,\text{PRE}_{a,w}} (\cap f(w)) : \forall w'' \in \text{max}_{o_1,\text{PRE}_{a,w}} (\cap f(w)) : [p]^{f,w'',g}, \iff \forall w'' \in \text{max}_{o_1,\text{PRE}_{a,w}} (\cap f(w)) : [p]^{f,w'',g}\]

where \(o_1\) is primary ordering, \(\text{PRE}_{a,w}\) is \(a\)'s preferences in \(w\) that are pertinent to the QUD.

In contrast, if \(\text{bixu}\) appears in the place of \(\text{yinggai}\), as \(\text{bixu}\) is not sensitive to a secondary ordering, it only inherits the modal base \(f(w)\) and primary priories \(o_1\) from the matrix verb. As a result, \(\text{bixu}\) retrieves the domain of the verb but enlarges it. Again, the contribution of the verb is trivial, as the domain of the verb is a subset of the domain of the modal. Using \(\text{bixu}\) makes the statement stronger, because it widens the domain of quantification.

\[(5.82) \quad [a \ jianyi \ bixu \ p]^{f,w,g} = 1 \iff \forall w' \in \text{max}_{o_1,\text{PRE}_{a,w}} (\cap f(w)) : [\text{bixu} \ p]^{f,w',g}, \iff \forall w' \in \text{max}_{o_1,\text{PRE}_{a,w}} (\cap f(w)) : [\text{bixu} \ p]^{f,w',g}\]
∀w′ ∈ max_{o1,PREa,w} (∩f(w)): ∀w'' ∈ max_{o1} (∩f(w)): [p]_{f,w'',g}, iff
∀w'' ∈ max_{o1} (∩f(w)): [p]_{f,w'',g}

where o_1 is primary ordering, PRE_{a,w} is a’s preferences in w that are pertinent to the QUD.

The fact that keyi p may implicate yinggai p is closely related to the fact that keyi is a Pseudo E-CM under jianyi. Consider the scenario below:

(5.83) Lao Li does not feel very well recently. He visited his doctor, and after careful examination, the doctor diagnosed that Lao Li is not sick, but clearly needs to workout more often.

a. (The doctor:) Lao Li, ni keyi duo yundong-yundong.
   Lao Li, you may more workout workout
   ‘Lao Li, you may try workout more often.’

b. Ni yinggai duo yundong-yundong.
   you should more workout workout
   ‘You should try workout more often.’

In the context above, the root sentence (5.83a) with schema keyi p implicates (5.83b).

(5.83) is a strengthening implicature, and is naturally derivable when the speaker is in the position to provide suggestions and advices.

(5.84) a. Yisheng jianyi Lao Li keyi duo yundong-yundong.
   doctor suggest Lao Li may more workout workout
   ‘The doctor suggested that Lao Li may try workout more often.’

b. Yisheng jianyi Lao Li yinggai duo yundong-yundong.
   doctor suggest Lao Li should more workout workout
The doctor suggested that Lao Li should try workout more often.’

When (5.83a) is embedded under jianyi as in (5.84a), the strengthening implicature is generated even without particularized context. It is because the embedding verb itself will trigger a stereotypical context (like (5.83)) in which a suggestion is issued. As a result, (5.84a) will implicate (5.84b):

(5.85) (i) “a jianyi p” ⊨ “a jianyi keyi p”
     (ii) “a jianyi keyi p” ← “a jianyi yinggai p”
     (iii) “a jianyi p” ≡ “a jianyi yinggai p”
     (iv) “a jianyi keyi p” ↝ “a jianyi p”

As (5.85) illustrates, (5.85-iii) functions to bridge (5.85-ii) and (5.85-iv). And since both (i) and (iv) hold, the Pseudo Concord relation between keyi and jianyi is explained accordingly.

5.3.2.3 The Factive-Emotive Verb

The attitude underlying the factive-emotive verb piping ‘criticize’ can be described as (5.86b):

(5.86) a. a piping x, PRO, P
     b. p = PRO P =P (x). ¬p is expected according to the priorities that are collectively committed to.

The paraphrase (5.86b) leads us to the analysis as presented below:

(5.87) [a piping x, PRO, P]_{f,w,g} if defined, =1 iff
     ∀w' ∈ max_g (∩f (w)): [¬p]_{f,w',g} =1,

where g = the priorities collectively committed to in w, p = PRO P = x P.
Piping also belongs to the verbs of discourse move. However, a criticizing act does not target to update the To-Do List of the addressee; therefore, the hypothesis (5.66) predicts that the modal bu yinggai is not bound by the matrix verb. Indeed, domain binding cannot explain the concord status of bu yinggai under piping. As (5.88) illustrates, the truth conditions derived for “a piping x bu yinggai P” via domain binding in fact contradict the truth conditions expressed in (5.87).

(5.88) \[ [a \text{ piping } x, \text{ PRO}_l (\text{bu yinggai}) P]^{f,w,g} \text{ if defined, } = 1 \text{ iff } \]
\[ \forall w' \in \max_g (\cap f(w)) : \neg (\text{bu yinggai } p)^{f,w',g} = 1, \text{ iff } \]
\[ \forall w' \in \max_g (\cap f(w)) : \neg \text{yinggai} (\neg p)^{f,w',g} = 1, \text{ iff } \]
\[ \forall w' \in \max_g (\cap f(w)) : \neg \forall w'' \in \max_g (\cap f(w)) : \neg p^{f,w'',g} = 1, \text{ iff } \]
\[ \neg \forall w'' \in \max_g (\cap f(w)) : \neg p^{f,w'',g} = 1, \]

where \( g \) = the priorities collectively committed to in \( w, p = \text{PRO } P = x P \).

I propose that it is better to analyze the semantics of piping in neo-Davisonian style sketched out in Kratzer (2013). The syntactic evidence for this treatment is that piping can take a DP object, which is the patient argument of the verb. Compare (5.89a-c):

(5.89) a. Laoban piping le Xiao Wang.

boss criticize ASP Xiao Wang

‘The boss criticized Xiao Wang.’

*b. Laoban jianyi /yaoqiu le Xiao Wang.

boss suggest/demand ASP Xiao Wang

‘The boss suggested/demanded Xiao Wang.’

c. Laoban kaichu le Xiao Wang.
boss fire ASP Xiao Wang

‘The boss fired Xiao Wang.’

The examples above show that *piping* patterns with the plain event-denoting verb *kaichu* ‘fire’ rather than the discourse move verbs *jianyi* ‘suggest’ and *yaoqi* ‘require’.

In addition to a patient argument, *piping* also has a proposition argument, which is headed by an impossibility modal feature. The modal feature may be expressed overtly. The overtly expressed modal head is of course in concord with the embedding verb.

\[(5.90)\]
\[
a. \left\lfloor \text{piping} \right\rfloor = \lambda x \lambda p \lambda e \ (\text{criticize}(e) \land \text{Patient}(x, e) \land p(e))
\]
\[
b. \left\lfloor a \text{ piping } x \left[ [\text{bu yinggai} ] \ \text{PRO } P \right] \right\rfloor = 1 \text{ iff } \exists e \ (\text{criticize}(e) \land \text{Agent}(x, e) \land \text{Patient}(x, e) \land \\
\[\neg \exists w (w \in max_g (\cap f(w)): p(e))],
\]

where \( g \) = the priorities collectively committed to in \( w \), \( p = \text{PRO } P = x \ P \).

The analysis above also explains that when the complement clause contains an ability or generic modal, the sentence is felicitous, and both layers of modality are recognizable. In fact, the two modals can co-occur grammatically:

\[(5.91)\] *Laoban piping* Xiao Wang *bu yinggai* name neng tuoyan.

boss criticize Xiao Wang not should so can procrastinate

“The boss criticized Xiao Wang, saying he should not procrastinate like that.”

In contrast to (5.91), a priority modal other than *bu yinggai* is not allowed in the complement clause of *piping*. My hypothesis is that a priority modal will compete for the syntactic position where the default modal resides in, so a sentence like (5.92) will not be generated:
(5.92) *Laoban piping Xiao Wang bu yinggai bixu nuli gongzuo. 

boss criticize Xiao Wang not should must hard work

5.3.2.4 Summary

In this subsection, I provided formal analyses for E-CM’s that have priority flavors. For each attitude-modal combination, I illustrated how the concord effect is derived. I attempted to extend the domain binding idea that I adopted to account for the concord epistemic modals in §5.3.1 to the priority E-CM’s. Epistemic modals are always anaphoric, but priorities modal are not. Therefore, to pursue the domain binding approach, it is necessary to elaborate the conditions under which a priority modal retrieves its modal from the embedding operator. My hypothesis is that in order to bind the embedded priority modal, the verb has to report a discourse move that attempts to affect the To-Do Lists of the conversation. The domain binding mechanism supplemented by this hypothesis successfully explains the behaviors of the permissive and requirement verbs. However, the piping (‘criticize’)-bu yinggai (‘should not’) combination cannot be accounted for by this approach, because the discourse move encoded by piping does not attempt to update the To-Do Lists of the conversation. Therefore, I propose that its syntactic behaviors and interaction patterns with embedded modals are better captured if the verb has a Davisonian semantics, and the clausal complement is headed by a modal feature that expresses a priority impossibility.

The ununiformed analyses presented in the table above triggers the follow theoretical question: can we extend the Davisonian style semantics to other verbs as well? My position is that a uniform treatment is not necessary, if not impossible. First, neo-Davisonian analysis is not always handy in explaining the behavior of an attitude verb.
For example, suppose \textit{believe} takes a clausal complement which is headed by a modal feature that comes with universal force. How does the grammar work when the complement contains \textit{might}? Is \textit{might} located in the same position as the modal feature? If not, is the covert head still there and contributing its force? We have to figure out many technical details to make the syntactic derivation and semantic composition work as expected. Second, there are probably other attitude verbs that favor a neo-Davisonian analysis. For example, I can easily think of Mandarin verbs like \textit{manyuan} ‘complain’, \textit{baoyuan} ‘complain’, \textit{zeguai} ‘blame’, etc. that exhibit similar patterns as \textit{piping}. I will further investigate the syntax-semantics properties of \textit{piping} and its relatives in the future work.

Table 5.15 summarizes my analyses of the attitude verbs discussed in this subsection:

<table>
<thead>
<tr>
<th>Class</th>
<th>Lexical Entry</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jussive</td>
<td>$[\text{a} \text{ pizhun } e \ x_i \ [\text{PRO}<em>i \ P]] f</em>{\text{w}g} \text{ is defined iff}$ $\max_{\text{e} \text{-} 1(\text{x})}(\cap \text{CG}<em>{\text{e} \text{-} 1})$ is a $\phi$-falsifier; $\exists w' \in \max</em>{\text{e} + 1(\text{x})} (\cap \text{CG}<em>{\text{e} + 1})$: $[p] f</em>{\text{w}g} = 1$</td>
<td>Portner (2010)</td>
</tr>
<tr>
<td></td>
<td>where $p = \text{PRO} P = P(x)$; $\phi = p$ or (Mod $p$)</td>
<td></td>
</tr>
<tr>
<td>Jussive</td>
<td>$[\text{a} \text{ yaoqiu } e \ x_i \ [\text{PRO}<em>i \ P]] f</em>{\text{w}g} \text{ is defined iff}$ $\max_{\text{e} \text{-} 1(\text{x})}(\cap \text{CG}<em>{\text{e} \text{-} 1})$ is a not $\phi$-verifier; $\forall w' \in \max</em>{\text{e} + 1(\text{x})} (\cap \text{CG}<em>{\text{e} + 1})$: $[p] f</em>{\text{w}g} = 1$</td>
<td>Portner (2010)</td>
</tr>
<tr>
<td></td>
<td>where $p = \text{PRO} P = P(x)$; $\phi = p$ or (Mod $p$)</td>
<td></td>
</tr>
<tr>
<td>Jussive</td>
<td>$[[\text{jianyi}] f_{\text{w}g}(p)(a)(w) = 1 \text{ iff}$ $\forall w' \in \max_{\text{e} \text{-} 1(\text{x})}(\cap \text{CG}<em>{\text{e} \text{-} 1})$: $[p] f</em>{\text{w}g} = 1$</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>where $a_1 = \text{primary priorities}$; PRE$_{a,w} = a$’s preferences in $w$ that are pertinent to the QUD.</td>
<td></td>
</tr>
<tr>
<td>Factive-emotive</td>
<td>$[[\text{a} \text{ piping } x \ [\text{byunggal}] \text{ PRO } P]] = 1 \text{ iff}$ $\exists e \ (\text{criticize}(e) \land \text{Agent}(x, e) \land \text{Patient}(x, e) \land$ $\neg \exists w(w \in \max_g (\cap f(w))$ : $p(e)))$</td>
<td>Kratzer (2013)</td>
</tr>
</tbody>
</table>

Table 5.15: Lexical Semantics of Pizhun, Yaoqiu, Jianyi and Piping
5.4 Conclusion

This chapter pursues to account for various subtypes of E-CM’s identified in the previous chapter. It began with evaluating the previous approach, and then sketched out explanations for Pseudo Concord and Real Concord constructions respectively. What is characteristic about the Pseudo Concord is the strengthening implicature. It can be either from “a Attitude M p” to “a Attitude p” or the opposite. I demonstrated the derivation of these implicatures utilizing the Principle of Informativeness developed by Atlas and Levinson (1981). In some cases, the implicature is derived through a chain of inferences. For example, the implicature from “a jianyi keyi p” to “a jianyi p” is bridged by the inference “a jianyi keyi p” \(\sim\) “a jianyi yingga p” and “a jianyi yingga p” \(\equiv\) “a jianyi p”.

The leading idea underlying the account of real E-CM’s is domain binding. Passing down the domain of quantification to the embedded modal will lead to a vacuous quantification by the attitude verb. Analogously, it is as if the domain of the matrix verb is snapped by the embedded modal. If the quantificational force of the attitude verb happens to be identical to the force of the modal, the two operators will seem to be fused into one.

Epistemic modals are always anaphoric to the embedding verb, but priority modals are only bound under jussive verbs, verbs that report discourse moves with the goal of updating To-Do Lists. Epistemic modals retrieve from the matrix verb the information state it determines, while priority modals retrieve the premises relative to which they are interpreted. Modals that encode certain pragmatic assumptions about the context may shrink or enlarge the inherited domain. The weak necessity modal yingga will restrict the domain if the attitude verb does not have weak necessity semantics. The strong necessity
epistemic yiding will strengthen the statement by widening the domain, unless the
attitude verb provides a salient subset of primary premises that the attitude holder accepts
with higher degree of commitment.

Not all instances of Real Concord can be accounted for by domain binding. The piping
(‘criticize’)-bu yinggai (‘should not’) combination is an exception. Following Kratzer
(2013), I provide a Davisonian semantics for piping, and attribute the modality expressed
by the verb to a modal feature heading the clausal complement. The modal expression bu
yinggai is in concord with piping, because the expression is the overt manifestation of the
modal feature that is silent in other cases.

In conclusion, E-CM’s are from various sources. According to whether “a Attitude M
p” ≡ “a Attitude p”, the E-CM’s fall into two major sub-types: If the equivalence holds
for a attitude-modal pair, it belongs to the Real Concord group (“Real” means the effect
is purely semantic). Otherwise, it belongs to the Pseudo Concord class (“Pseudo” means
the concord effect is not a pure semantic phenomenon). Both groups contain further sub-
variations, which makes a simple uniform analysis within each major type hard to
achieve. I take the principle mechanism of Real Concord to be semantic equivalence, and
that of Pseudo Concord as illusion of equivalence caused by strengthening implicature.
Each sub-variety of concord combinations has its special properties, and requires
particular machineries to derive the concord effect; nonetheless, they all follow the
principle mechanism of their major type.

In the end, I will briefly comment on the fundamental question of why human
languages need modal concord. Or put it differently, what is the function of modal
concord, if the use of an additional modal does not contribute anything to the meaning of
the sentence? For Real Concord, it seems that the modality expressed by the sentence gets highlighted through repetition. For example, keyi under pizhun ‘permit’ highlights the information that the modal’s prejacent becomes licit. Similarly, using keneng in the complement of huaiyi ‘suspect’, highlights the information that the possibility of the prejacent is raised. As for the Pseudo Concord, the behavior of people using a “weaker” statement to communicate a “stronger” meaning can be explained by the Principle of Politeness (Brown & Levinson 1987). For example, in the scenario of providing suggestions, the speech act is face-threatening to the hearer, because it assumes the inferiority of the hearer in knowledge or status. So to save the face of the hearer, the speaker can use I suggest you may p to implicate that I suggest you (should) p.
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