Natural Language & Linguistic Theory manuscript No.
(will be inserted by the editor)

Guiding assertions and questions in discourse: Mandarin *dique* and *zhende*

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the date of receipt and acceptance should be inserted later

Abstract This paper explores how discourse markers contribute to the update of discourse through a detailed study of Mandarin *dique* 'indeed' and *zhende* 'really'. On the basis of empirical data and a naturalness rating experiment, we show that *dique* and *zhende* make similar yet different contributions to discourse updates. *Dique* presupposes that its prejacent issue is old, while *zhende* presupposes that its prejacent issue is old and that some discourse participant has failed to resolve this issue. Furthermore, *dique* and *zhende* can embed both assertions and questions. This supports Farkas & Bruce's (2010) Table stack model, which provides a uniform treatment for assertions and questions.

Keywords Speech Acts · Discourse structure · Common Ground · Table stack · Presupposition · Mandarin

1 Introduction

In daily language use, most of our utterances are not isolated from their preceding and following utterances. Utterances are always connected with each other to form a longer unit of language, i.e., discourse. In order to make the discourse coherent and easy to understand, we use a class of lexical expressions to connect individual utterances and 'glue' them together. These expressions are often referred to as discourse markers.[1] This study is

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[1] A variety of terms are used to refer to this class of expressions, including 'discourse marker' (Schiffrin 1987), 'pragmatic marker' (Fraser, 1996; Brinton, 1996), 'discourse particle' (Schourup 1985), 'connective' (Blakemore 1987), etc. The term 'discourse marker' and 'discourse particle' are both frequently used. We did not adopt the term 'discourse particle' for the words discussed in this study (i.e., *dique* and *zhende*), since they are polysyllabic and contain significant phonetic content, and thus do not fit the label 'particle'.

concerned with two Mandarin discourse markers, *dique* 'indeed' and *zhende* 'really', which are illustrated below:[2]

(1) *Dique*, Li chuguo le.
indeed Li go-abroad PERF
'Indeed, Li went abroad.'

(2) *Zhende*, Li chuguo le.
really Li go-abroad PERF
'Really, Li went abroad.'

Dique and *zhende* are treated as adverbs in traditional Chinese grammar. They do not contribute to the propositional content of the utterance. (1), (2) and (3) have the same propositional content and the same truth conditions. (3) is true if and only if Li went abroad, and so are (1) and (2).

(3) Li chuguo le.
Li go-abroad PERF
'Li went abroad.'

What *dique* and *zhende* do is to convey information about how the utterance containing them is related to the prior discourse, and hence these two adverbs belong to the group of discourse markers. As a first approximation, *dique* in (1) suggests that this utterance is an agreement with an old issue. In (4), B uses *dique* to show his agreement with A's resolution of the issue, i.e., whether or not Li went abroad.

(4) A: Li chuguo le.
Li go-abroad PERF
'Li went abroad.'
B: *Dique*, ta chuguo le.
Indeed he go-abroad PERF
'Indeed, he went abroad.'

Zhende works differently. (2) suggests that the speaker is trying to convince the addressee of the proposition p 'Li went abroad', that is, the addressee does not quite believe p in the previous discourse. For example, in (5), by using *zhende*, the speaker C shows that he disagrees with B's utterance and agrees with A's utterance.

(5) A: Li chuguo le.
Li go-abroad PERF
'Li went abroad.'
B: Bu keneng!
no possible
'Impossible!'
C: *Zhende*, ta chuguo le.
really he go-abroad PERF
'Really, he went abroad.'

Deleting the discourse markers in (4) and (5) does not change the propositional content of the utterances in which they occur. However, without *dique* and *zhende*, the utterances become

[2] The Mandarin data reported in this paper are based on the introspection of the first author, who is a native speaker of Mandarin Chinese, unless otherwise noted.

isolated from the prior discourse, and it sounds like B in (4) and C in (5) are speaking to themselves rather than responding to the previous utterances.

The goal of this paper is twofold. First, we reveal the semantic contribution of *dique* and *zhende*. These discourse markers make consistent contributions in assertions and questions. We propose that *dique* marks its prejacent issue as an old issue in both assertions and questions, whereas *zhende* marks its prejacent issue as old and unresolved in both speech acts. The different functions of *dique* and *zhende* explains why (1) and (2) are felicitous in different contexts. The second goal of this paper is to support the Stalnakerian (1978) discourse structure in which the progression of a discourse is regarded as a series of updates on the Common Ground. To formalize the semantics of *dique* and *zhende*, in particular, we support Farkas & Bruce's (2010) idea that there is an overlap in the function of assertions and questions. Farkas & Bruce (2010) focus on the similarity between assertions and questions and treat both speech acts in a uniform fashion. More specifically, both an assertion and a question raise an issue on the Table and update the projected set. Since *dique* and *zhende* have the same function in assertions and questions, i.e., indicating an old issue and an unresolved issue, the current study offers additional support for Farkas & Bruce's (2010) unified model of the discourse structure.

The paper is structured as follows: Section 2 presents introspection-based generalizations of the distributions of *dique* and *zhende* across different speech acts. In both assertions and questions, *dique* guides the discourse by indicating that its prejacent is an old issue, whereas *zhende* indicates that its prejacent issue is old and unresolved. These generalizations are empirically supported by a naturalness rating experiment. Section 3 proposes that *dique* and *zhende* are presupposition triggers and provides semantic definitions for them within the stack model of Farkas & Bruce (2010), where both assertions and questions are characterized as adding issues onto the Table stack and updating the projected set. Adopting Farkas & Bruce's (2010) framework allows us to offer a unified analysis of the discourse markers. *Dique* presupposes that its prejacent issue is on the top of the Table stack in both assertions and questions, and *zhende* additionally presupposes that some discourse participant has failed to resolve the issue in both speech acts. We also elaborate on how the study of *dique*/*zhende* serves as support for Farkas & Bruce's model. Section 4 shows that *zhende* is preferred to *dique* when the presuppositions of *zhende* are satisfied, which is correctly predicted by the principle of MAXIMIZE PRESUPPOSITION (Heim, 1991). This result corroborates our presuppositional analysis. Section 5 concludes this study.

2 *Dique* and *zhende* in assertions and questions

Mandarin discourse markers *dique* and *zhende* are felicitous in different contexts. For example, in (6), B can use *dique* to show his agreement with A, but it is infelicitous for B to use *zhende*.

(6) A: Zuowan xiayu le.
last-night rain PERF
'It rained last night.'
(B heard the sound of rain last night, so he knows that it rained.)
B: *Dique*/#*Zhende*, xiayu le.
indeed/really rain PERF
'Indeed, it rained.'/'#Really, it rained.'

The same contrast is observed in other languages. Just like Mandarin *dique* and *zhende*, English *indeed* and *really* convey information about how the utterance containing them is related to the prior discourse. For example, *indeed* in (7) suggests that B's utterance is an agreement with the previous utterance, and *really* in (8) suggests that C disagrees with B's utterance and C is trying to convince B of the truth of the proposition 'Li went abroad'.[3]

(7) A: Li went abroad.
B: Indeed, he went abroad.

(8) A: Li went abroad.
B: Impossible!
C: Really, he went abroad.

The same contrast observed between Mandarin *dique* and *zhende* is found between English *indeed* and *really*. English *indeed* is felicitous in an example like (9), but *really* is not, indicating that there exists some semantic difference between *indeed* and *really*.

(9) A: It rained last night.
(B heard the sound of rain last night, so he knows that it rained.)
B: Indeed, it rained./#Really, it rained.

Zeevat (2003: 102) proposes that *indeed* marks its prejacent as old information. For example, *indeed* in (7) marks that its prejacent 'Li went abroad' is old information. This correctly predicts that *indeed* is felicitous in (9), where 'It rained last night' has been asserted by A and is thus old information.

How about English *really*? According to Romero & Han (2004: 627), *really* has a meaning identical to the semantic operator VERUM. The VERUM operator is an abstract operator manifested as the VERUM focus, which is a contrastive focus on the verb or the complementizer. For example, in (10-a), the focal stress on the verb *did* signals the presence of the VERUM operator. Romero & Han (2004) claim that both *really*(p) and VERUM(p) are used to assert that the speaker is certain that p should be added to the Common Ground (Stalnaker, 1978). For example, both sentences in (10) indicate that the speaker has a high level of certainty that 'It rained last night' should be a common belief shared by everyone.

(10) a. It DID rain.
b. It really rained.

Romero & Han's analysis, without modification, makes the wrong prediction for English data like (9). In (9), A is committed to p 'It rained last night', and A's assertion can be understood as inviting B to accept p as a common belief. If *really* indicated the speaker's certainty that p should be a common belief, then it would be appropriate for B to use *really* to show his acceptance of p as a common belief. It is not clear why the use of *really* turns out to be infelicitous.[4] Similarly, if we extend Romero & Han's (2004) analysis to Mandarin *zhende* and propose that *zhende* indicates the speaker's certainty, we would not be able to explain why the use of *zhende* is infelicitous in (6).

[3] The English data in (7), (8) and (9) are based on the introspection of two English native speakers the authors consulted.

[4] Romero & Han (2004) only present examples containing VP-initial *really*, but they did not distinguish between sentence-initial and VP-initial *really* in their discussion of *really*. Hence we assume that *really* at both positions is claimed to have the same semantics as the VERUM operator in their analysis. Therefore, Romero & Han's (2004) analysis cannot explain why the use of *really* is infelicitous in (9) unless they propose a different semantics for sentence-initial *really* from that of the VERUM operator.

Another discourse marker that is similar to Mandarin *zhende* is the German unstressed particle *doch*. The particle *doch* is claimed to be a correction marker that triggers a correction presupposition (Zeevat, 2003; Grosz, 2014, among others).[5] According to Grosz (2014), an assertion containing the particle *doch*, represented as *doch*(p), presupposes that the proposition p is uncontroversial and that p corrects a salient proposition q. For example, in (11), the use of *doch* presupposes that: 1) the proposition p 'Jan washed up' is firmly established in the Common Ground; 2) there is a contextually salient focus alternative of p, namely the proposition q 'Jan needs to cook', and the current context entails $\neg(p \wedge q)$. The presupposition triggered by *doch* is satisfied in (11) and thus the use of *doch* is felicitous. By using *doch*, the speaker is correcting the proposition q 'Jan needs to cook'.

(11) Jan muss nicht kochen. Er hat *doch* abgewaschen.
J needs not cook he has doch washed.up
'Jan doesn't need to cook. He doch washed up.'
conveys: 'Jan doesn't need to cook, because he washed up.' (Grosz 2014: 164)

The proposition q is a focus alternative of p, and hence q can also be the negation of p, i.e., ¬p. As in (12), *doch* presupposes that p 'these flowers are beautiful' is established and that there is a contextually salient focus alternative of p, namely ¬p 'these flowers are not beautiful', and the current utterance context (trivially) entails $\neg(p \wedge \neg p)$. By using *doch*, B is correcting A's assertion.

(12) A: Schau mal! Diese Blumen sind so hässlich.
look MAL these flowers are so ugly.
'Have a look! These flowers are so ugly.'
B: Was hast du denn? Diese Blumen sind *doch* schön!
what have you DENN these flowers are doch beautiful
'What is your problem? These flowers are doch beautiful!' (Grosz 2014: 165)

The adverb *zhende* is similar to *doch* in that *zhende* is often used in corrections. As shown in (5), repeated here as (13), by using *zhende*, C is correcting B's statement.

(13) A: Li chuguo le.
'Li went abroad.'
B: Bu keneng!
'Impossible!'
C: *Zhende*, ta chuguo le.
'Really, he went abroad.'

The difference between *zhende* and *doch* is that *zhende*(p) can only be used to correct an opposite proposition ¬p (as in (13)), whereas *doch*(p) is used to correct any focus alternative of p (including ¬p and other propositions). Hence, *zhende* cannot be used in a context like (14). As we will see in Section 2.2, this is because *zhende*(p) indicates that some discourse participant does not believe p.

(14) #Jian bu xuyao zuofan. Ta *zhende* zuo guo qingjie le.
Jan no need cook he really do EXP wash PERF
'Jan doesn't need to cook. He really washed up.'

[5] See more analyses of discourse items in Germanic and Romance languages in Karagjosova (2004, 2006), Coniglio (2008), Coniglio & Zegrean (2010), McCready & Zimmermann (2011) and Kaufmann & Kaufmann (2012).

As can be seen, Mandarin *zhende* and German *doch* exhibit different semantic properties. The previous analysis of German *doch* is enlightening but will not be adopted directly in the study of Mandarin *zhende*.

In this section, we showed that *dique* and *zhende* make different contributions to the update of discourse, which explains the contrast in (6). We generalize the distributions of *dique* in assertions and questions in Section 2.1, and then investigate the distributions of *zhende* in assertions and questions in Section 2.2. The data show that *dique* marks its prejacent issue as old, while *zhende* marks its prejacent issue as old and unresolved. These conclusions are supported by a naturalness rating experiment reported in Section 2.3.

2.1 *Dique* in assertions and questions

The intuition on utterances containing *dique* is summarized in (15).

(15) Utterances containing *dique* expresses a reiteration of old information.

Motivated by (15), we propose that an utterance containing *dique*, represented as *dique*(I) where 'I' represents an issue under discussion,[6] marks the discourse and indicates that I is an old issue:

(16) Let I be an issue. *Dique*(I) indicates:
   a. I is an old issue.
   b. All of the discourse participants believe that I is an old issue, and recognize that they share this belief.

The formal implementation of this proposal is given in Section 3.2. Let us illustrate first the two components of the contribution made by *dique*, (16-a) and (16-b), in Sections 2.1.1 and 2.1.2 respectively.

2.1.1 Old issue

In an assertion containing *dique*, represented as *dique*(p), the first component (16-a) says that p is old information, i.e., p has already been suggested by some individual. This can be illustrated by the following example. Suppose that on the morning of June 1st, Li looks outside and says to his wife *Dique, waimian xiayu le* 'Indeed, it rained outside'. Here, Li's utterance indicates that the proposition p 'It rains on June 1st' must have been suggested by some individual in the previous context. That individual can be the speaker (i.e., Li) or the addressee (i.e., Li's wife), or someone else (such as a weather reporter), as illustrated by (17). By using *dique*, Li is reiterating the old information p and showing his agreement with that individual.

(17) Context: Li and his wife watched the weather report on the evening of May 31st, which predicted that it would rain on June 1st. On the morning of June 1st, Li looks outside and says to his wife:
   Li: *Dique*, waimian xiayu le.
   indeed outside rain PERF
   'Indeed, it rains outside.'

[6] See Section 3.1 for the formal definition of an issue.

If no one had predicted that it would rain on June 1st, as in (18), Li's use of *dique* would be infelicitous.

(18) Context: Li and his wife never watch weather reports, nor do they make any prediction about the weather. On June 1st, waking up in the morning, Li looks outside and says to his wife:
Li: #*Dique*, waimian xiayu le.
'Indeed, it rains outside.'

If p has been suggested by some individual x, then it follows that x is biased towards p. If x is not biased towards p in the prior context, *dique* cannot be used. For instance, the use of *dique* is infelicitous in (19), since p 'Li went abroad' has not been suggested (A is committed to ¬p).

(19) A: Li mei chuguo.
Li not go-abroad
'Li didn't go abroad.'
B: #*Dique*, ta chuguo le.
indeed he go-abroad PERF
'Indeed, he went abroad.'

On the other hand, epistemic modal adverbs, such as *keneng* and *yexu* 'probably', are typical devices for making suggestions (Zeevat, 2003: 99). An assertion containing such adverbs indicates that the speaker is biased towards the propositional content. Thus, B's use of *dique* in (20) is felicitous.

(20) A: Li keneng chuguo le.
Li probably go-abroad PERF
'Li probably went abroad.'
B: *Dique*, ta chuguo le.
'Indeed, he went abroad.'

The effect of the first component of *dique*(p), (16-a), can be observed by the fact that *dique* can occur in answers to biased questions, but not in answers to unbiased questions. Among the various types of questions in Mandarin, *ba* questions (marked by the particle *ba* in sentence-final position) and *shi bu shi* questions (with *shi bu shi* 'be not be' preceding the predicate) are considered requests for confirmation, where the speaker is biased towards the affirmative answer (Li & Thompson, 1981: 309-310; Liu et al., 2004: 788, 792). *Dique* is felicitous in answers to these two questions, as shown in (21) and (22), because the proposition p (i.e., the affirmative answer) has already been suggested by some individual (the questioner).

(21) A: Ta xihuan tian shi ba?
he like sweet food Q
'Does he like sweet food? (I suppose he does)'
B: *Dique*, ta xihuan tian shi.
indeed he like sweet food
'Indeed, he likes sweet food.'

(22) A: Ta shi bu shi xihuan tian shi?
he be not be like sweet food
'Is it the case that he likes sweet food?'

B: *Dique*, ta xihuan tian shi.
'Indeed, he likes sweet food.'

Other types of questions in Mandarin, such as A-not-A questions, can only be used in a neutral context and indicate no bias (Li & Thompson, 1981: 550). *Dique* is banned in answers to A-not-A questions, since the questioner is not biased toward the affirmative answer:

(23) A: Ta xi-bu-xihuan tian shi?
he like-not-like sweet food
'Does he like sweet food or not?'
B: #*Dique*, ta xihuan tian shi.
'Indeed, he likes sweet food.'

Dique can be used not only in assertions but also in questions. In a question containing *dique*, represented as *dique*(*I*), *dique* indicates that *I* is an old question, i.e., it has already been asked. For example, in (24), the question 'Where did you go last Friday?' has been asked by Mr. Li, and thus the use of *dique* is felicitous. By using *dique*, Mrs. Li is reiterating this old question and showing her agreement with Mr. Li that this question should be asked.

(24) Context: Mr. and Mrs. Li just had a meeting with the teacher of their son Xiaoli. The couple are now talking with Xiaoli:
Mr. Li: Shang zhouwu ni qu nali le?
last Friday you go where PERF
'Where did you go last Friday?'
Mrs. Li: *Dique*, ni qu nali le?
indeed you go where PERF
'Indeed, where did you go?'

Without Mr. Li's question, Mrs. Li's use of *dique* would be infelicitous, as in (25). Here, the question is new and should be expressed without *dique*.

(25) Context: Mr. and Mrs. Li just had a meeting with the teacher of their son Xiaoli. The couple are now talking with Xiaoli:
Mrs. Li: #*Dique*, shang zhouwu ni qu nali le?
'Indeed, where did you go last Friday?'
(Here, # means 'infelicitous as discourse initial')

To sum up, the use of *dique* in assertions and questions indicates that its prejacent issue is old.

2.1.2 Shared belief

The second component of the contribution made by *dique* in (16-b) indicates that all of the discourse participants believe that the prejacent of *dique* is old information and that they all recognize that they share this belief. For example, in (17), Li and his wife both believe that p 'It rains on June 1st' has been suggested by the weather reporter, and they both recognize that they share this belief. If the speaker Li is not aware of the suggestion of p, as shown in (26), or if Li does not believe that his wife believes that p has been suggested, as shown in (27), Li's use of *dique* will be infelicitous. In (26) and (27), 'It rains on June 1st' is new information to at least one discourse participant, and the speaker Li will choose a bare

assertion *Xiayu le* 'It rains' to inform his wife about this new information (either new to Li himself or new to his wife).

(26) Context: Li's wife watched the weather report on the evening of May 31st, which predicted that it would rain on the morning of June 1st. Li was reading a book in another room then, so he did not listen to the weather report. On June 1st, waking up in the morning, Li looks outside and says to his wife:

Li: #*Dique*, waimian xiayu le.
'Indeed, it rains outside.'

(27) Context: Li watched the weather report on the evening of May 31st, which predicted that it would rain on the morning of June 1st. Li's wife was reading a book in another room then, so Li knew that his wife did not listen to the weather report. On June 1st, waking up in the morning, Li looks outside and says to his wife:

Li: #*Dique*, waimian xiayu le.
'Indeed, it rains outside.'

The same contribution is observed when *dique* is used in questions as in (24). Mrs. Li's use of *dique* in (24) suggests that Mrs. Li recognizes that this question has been asked.

One thing worth emphasizing is that the first component of the contribution 'p has been suggested by x' entails that x makes his bias towards p verbally or linguistically explicit. In other words, the individual x makes a conversational move indicating that x is biased towards p. The use of *dique* is infelicitous in an assertion when 'x is biased towards p' is a mere common belief shared by discourse participants. Rather, *dique* is used when every discourse participant shares the common belief about x's explicit expression of his bias. Take (28) as an example.[7] According to the world knowledge that it is going to rain if there is thunder and lightning and the contextual knowledge that there is thunder and lighting outside, it is reasonable to assume that people are biased towards the proposition 'It will rain'. So, it is a common belief that B is biased towards p 'It will rain' in (28), but it is not a common belief that B explicitly expresses his bias towards p. In this case, the use of *dique* is infelicitous.

(28) Context: There is thunder and lightning outside. A says to B:

A: #*Dique*, yao xiayu le.
indeed will rain PERF
'Indeed, it will rain.'

To summarize, the use of *dique* indicates that its prejacent issue is old and that every discourse participant shares the belief that this issue is old.

2.1.3 Section summary

We observed that the discourse marker *dique* contributes to the update of discourse by indicating that its prejacent is an old issue. In assertions, *dique* is used when its prejacent has been suggested and all the discourse participants share the belief that it has been suggested. In questions, *dique* is used when its prejacent has been asked and all the discourse participants share the belief that it has been asked.

[7] We assume that p 'It will rain' has not been suggested by anyone in the previous discourse in (28). If some individual has already predicted the rain, as in (17), then the use of *dique* is felicitous here.

2.2 *Zhende* in assertions and questions

The adverb *zhende* 'really' is derived from the morpheme *zhen* 'truth/reality'. Intuitively, *zhende* is used to emphasize truth, as described in (29).

(29) An utterance containing *zhende* expresses an emphasis on truth.
   a. In an assertion, the speaker uses *zhende* to emphasize that the propositional content of the assertion is true.
   b. In a question, the speaker uses *zhende* to emphasize that the question should truly be resolved.

(29-a) can be illustrated with the example in (30). Intuitively, the speaker C in (30) uses *zhende* to emphasize that the proposition p 'it rained last night' is true. C finds it necessary to emphasize the truth of p, because B refused to believe p even though p has been asserted by A. C is emphasizing the truth of p in order to convince B of p.

(30) A: Zuowan xiayu le.
   last-night rain PERF
   'It rained last night.'
   B: Meiyou xiayu.
   not rain
   'It didn't rain.'
   C (to B): *Zhende*, zuowan xiayu le.
   really last-night rain PERF
   'Really, it rained last night.'

(29-b) can be illustrated by (31). By using a question containing *zhende*, the speaker Mrs. Li is emphasizing that the addressee Xiaoli should truly resolve the question 'Where did you go last Friday?' asked by Mr. Li. Mrs. Li finds it necessary to emphasize this, because she believes that the answer Xiaoli provided does not resolve the question.

(31) Context: Mr. and Mrs. Li just had a meeting with their son Xiaoli's teacher. The couple are talking with Xiaoli:
   Mr. Li: Shang zhouwu ni qu nali le?
   last Friday you go where PERF
   'Where did you go last Friday?'
   Xiaoli: Wo zai xuexiao.
   I at school
   'I was at school.'
   Mrs. Li: Women zhidao ni bu zai. *Zhende*, ni qu nali le?
   we know you not at really you go where PERF
   'We know that you were not. Really, where did you go?'

Motivated by the intuition in (29), we propose that an utterance containing *zhende*, represented as *zhende*(I), indicates that I is an old and unresolved issue:

(32) Let I be an issue. *zhende*(I) indicates:
   a. I is an old issue.
   b. All of the discourse participants share the belief that I is old.
   c. Some discourse participant y has failed to resolve I.

As can be seen, the first two components of the contribution made by *zhende* are the same as the two components of *dique*, while the third component of *zhende* is not shared by *dique*. The next sections 2.2.1 and 2.2.2 illustrate the first two components of the contribution and the third one respectively.

2.2.1 Old issue and shared belief

Like *dique*(I), *zhende*(I) indicates that I is an old issue and all discourse participants share the belief that I is old. For example, in (33), the proposition p 'It rained last night' has been suggested by A and every participant recognizes this.

(33) A: Zuowan xiayu le.
last-night rain PERF
'It rained last night.'
(B is not sure. He opens the window and sees that the ground is wet.)
B: *Zhende*, zuowan xiayu le.
really last-night rain PERF
'Really, it rained last night.'

If no one had suggested p or if B did not recognize that A had suggested p, it would be infelicitous to use *zhende*. In (34), 'It rained last night' is new information to B and should be expressed without *zhende*.

(34) Context: B opens the window in the morning and sees that the ground is wet (No information about whether it rained last night has been mentioned before.)
B: #*Zhende*, zuowan xiayu le.
'Really, it rained last night.'

Similarly, in (31), the issue I_1 'Where did you go last Friday?' has been asked by Mr. Li and every participant recognizes this, and hence the use of *zhende* is felicitous. If no one had asked the issue I_1, it would be infelicitous to use *zhende*. As illustrated in (35), I_1 is a new question and should be expressed without *zhende*.

(35) Context: Mr. and Mrs. Li just had a meeting with their son Xiaoli's teacher. After the meeting, Mrs. Li asks Xiaoli:
Mrs. Li: #*Zhende*, shang zhouwu ni qu nali le?
'Really, where did you go last Friday?'

Like *dique*, *zhende* is used when its prejacent issue is old and all discourse participants share this belief.

2.2.2 Unresolved issue

Besides the contributions shared with *dique*(I), *zhende*(I) makes a third component of contribution to the discourse, namely that some discourse participant y has failed to resolve the issue I. In other words, the use of *zhende* in an assertion indicates that some participant y remains publicly uncommitted to p even after recognizing that p has been suggested by x as an answer to the issue. If the participant y accepted the answer p, the issue I would have been resolved.[8] However, the participant y remains uncommitted to p, which means that y has

[8] See Section 3.1 for the formal definition of issue resolvement.

failed to resolve the issue. For example, in (33), A is the suggester x, and B is the participant y. Initially, B was not committed to p 'It rained last night' even though he recognized that A had suggested p. Every discourse participant was aware that B was uncommitted to p, since B walked to the window to check whether p was true. After checking the evidence, B commits himself to p by using an assertion modified by *zhende*. If B was already committed to p before A's suggestion, the use of *zhende* would be unacceptable, as in (6), repeated here as (36). This is because all the discourse participants were committed to p, which contradicts with the semantic contribution of *zhende*(p).

(36) A: Zuowan xiayu le.
'It rained last night.'
(B heard the sound of rain last night, so he knows that it rained.)
B: #*Zhende*, xiayu le.
'Really, it rained.'

If B immediately committed himself to p after A's suggestion, the use of *zhende* would also be unacceptable, as in (37), because all participants were committed to p before the use of *zhende*. *Dique* can be used in both (36) and (37), because the prejacent issue 'It rained last night' is old here, and *dique* does not mark the prejacent issue as unresolved as *zhende* does.

(37) A: Zuowan xiayu le.
'It rained last night.'
(B has no idea if it rained last night, but B always believes in what A says.)
B: #*Zhende*, xiayu le.
'Really, it rained.'

Zhende makes the same semantic contribution in a question. That is, some participant y has provided an answer to the issue I, but that the speaker of *zhende*(I) believes this answer does not resolve I.[9] As in (31), Mrs. Li believes that Xiaoli's answer does not resolve the question asked by Mr. Li. If Mrs. Li believed that Xiaoli's answer resolved the question, as in (38), the use of *zhende* would be unacceptable.

(38) Context: Mr. and Mrs. Li just had a meeting with their son Xiaoli's teacher. The couple are talking with Xiaoli:
Mr. Li: Shang zhouwu ni qu nali le?
'Where did you go last Friday?'
Xiaoli: Wo qu dianyingyuan le.
'I went to a cinema.'

[9] The use of *zhende* indicates that the speaker believes that y's answer does not resolve I. It does not necessarily indicate that the speaker believes that y's answer is false. As in (i), C's answer can be true, i.e., the company is indeed full of beauties. B knows that C's assertion is true, but B believes that this assertion does not resolve A's issue.

(i) Context: A and B (both female) are talking with a new colleague C (male).
A: Ni hen youxiu. Weishenme lai zhe ge xiao gongsi?
'You are excellent. Why did you come to this small company?'
C: Zheli daochu dou shi nimen zheyang de meinu.
'This company is full of beauties like you.'
B: Bie kaiwanxiao. *Zhende*, weishenme lai zheli?
'Don't be kidding. Really, why did you come here?'

Mrs. Li: Mingbai le. #*Zhende*, ni qu nali le?
'I see. Really, where did you go?'

In addition to the contributions of *dique*, then, *zhende* makes the further contribution to the discourse that its prejacent issue has been unresolved.

2.2.3 Comparison with previous studies

Previous studies do not treat *dique* and *zhende* as discourse items, but as modality adverbs that express the speaker's certainty or affirmation (Zhang, 2000: 45; Qi, 2002: 226). It was argued that *dique* and *zhende* in (39-a) and (39-b) both express the speaker's high level of certainty about the truth of p 'Li went abroad'.

(39) a. *Dique*, Li chuguo le.
'Indeed, Li went abroad.'
b. *Zhende*, Li chuguo le.
'Really, Li went abroad.'

This analysis seems to be consistent with native speakers' intuition in assertions, but it makes wrong predictions for other speech acts. Neither *dique* nor *zhende* in (40) conveys the speaker's certainty or affirmation.

(40) *Zhende*/*Dique*, Ni shang zhouwu qu nali le?
really/indeed you last Friday go where PERF
'Really, where did you go last Friday?'/'Indeed, where did you go last Friday?'

In order to precisely characterize the meanings of *dique* and *zhende*, we should focus on the discourse effect caused by *dique*/*zhende* and the interaction between the sentence containing these adverbs and the previous discourse, rather than the meaning of the sentence out of context. Our study reveals that *dique* and *zhende* are not modality adverbs, but discourse markers that contribute to discourse updates. What *dique* and *zhende* do is to connect the current utterance to the previous one. More specifically, *dique* indicates that the current issue is an old issue and *zhende* indicates that it's old and unresolved. The meaning of certainty/affirmation is not the contribution of *dique*/*zhende*, but a pragmatic effect resulting from the combination of the assertion meaning and the semantic contributions made by *dique*/*zhende*. As will be shown in Section 3, we employ Farkas & Bruce's (2010) model of discourse updates in the formal analysis of *dique* and *zhende*, since these two discourse markers contribute to discourse updates.

2.2.4 Section summary

The discourse markers *zhende* and *dique* both indicate that their prejacent issues are old. *Zhende* additionally indiciates that its prejacent issue is unresolved to some discourse participant.[10] When the prejacent issue is old and unresolved, the use of *zhende* is preferred to *dique*, which is exactly what the principle of MAXIMIZE PRESUPPOSITION (Heim 1991) predicts, as will be explained in Section 4. Previous studies have treated *dique* and *zhende* as modality adverbs, which has ignored the discourse effects caused by *dique*/*zhende*

[10] These two discourse markers make the same contributions in another speech act, i.e., commands, as they do in assertions and questions. See Yuan (2015: 208-211) for the discussion of the interaction between *dique*/*zhende* and commands.

and makes wrong predictions regarding their distributions. The current study, in contrast, analyzes *dique* and *zhende* as discourse markers that contribute to discourse updates.

2.3 Naturalness rating experiment

The previous sections concluded that *dique* and *zhende* make semantic contributions to the discourse. Their contributions are not the same but there are also overlaps. In order to validate these conclusions, this section reports a naturalness rating experiment on assertions containing *dique* and *zhende* (See Schütze (1996) and Cowart (1997) for why such an experiment can validate the conclusions).

Based on the observations made in Section 2.1 and Section 2.2, we hypothesize that an assertion containing *dique*, i.e., *dique*(p), is used in the context in which p has been suggested, whereas *zhende*(p) is used in the context where p has been suggested and some participant is uncommitted to p. Based on this hypothesis, we make the predictions in (41), which will be tested in the experiment.

(41) Predictions:
   a. *Dique*(p) is judged to be more natural in a context where p has been suggested than in a context where p has not been suggested.
   b. *Zhende*(p) is judged to be more natural in a context where p has been suggested and some participant is uncommitted to p, than in a context where p has not been suggested.
   c. *Zhende*(p) is judged to be more natural in a context where p has been suggested and some participant is uncommitted to p, than in a context where p has been suggested and all participants are committed to p.

Method In this experiment, the participants judged the naturalness of assertions containing *dique*/*zhende* in different contexts. For *dique*, each stimulus consists of a context and a target sentence, i.e., an assertion containing *dique*. There are two conditions in this part of the experiment, suggested and unsuggested. Each condition has 10 items, and thus 20 target stimuli were created. A suggested context refers to a context where the prejacent of *dique* has been suggested, while an unsuggested context is where the prejacent has not been suggested before. As in (42), the proposition p 'Xiaolan went out to jog' has not been suggested in the unsuggested context, but has been suggested by Mr. Lan in the suggested context. According to the predictions in (41), the target sentence *Dique, Xiaolan qu paobu le* in the suggested context should be judged more natural than in the unsuggested context.

(42) Target Sentence: *Dique, Xiaolan qu paobu le.* 'Indeed, Xiaolan went out to jog.'
   a. Unsuggested Context: Mr. Lan arrives home and finds that his son Xiaolan is not at home. Mrs. Lan tells Mr. Lan:
   b. Suggested Context: Mr. Lan arrives home and finds that his son Xiaolan is not at home. He sees that Xiaolan's sneakers are not on the shoe rack, so he says to Mrs. Lan: 'I suppose Xiaolan went out to jog?'. Mrs. Lan answers:

As for *zhende*, each stimulus also consists of a context and a target sentence, i.e., an assertion containing *zhende*. In this part of the experiment, there are three conditions: *unsuggested*, *suggested and agreed*, and *suggested and challenged*. Each condition has 10 items, and thus 30 target stimuli were created. A suggested and agreed context refers to a

context where the prejacent of *zhende* has been suggested and all the discourse participants are committed to it, while a suggested and challenged context is where the prejacent has been suggested but not all the participants accept it. As in (43), the proposition p 'There was an earthquake last night' has not been suggested in the unsuggested context. In the suggested and agreed context, p has been suggested by A and all discourse participants are committed to p. In the suggested and challenged context, p has been suggested by A's roommate and A is uncommitted to p. According to the predictions in (41), the target sentence *Zhende, zuowan dizhen le* in the suggested and challenged context should be judged more natural than in the other two contexts.

(43) Target Sentence: *Zhende, zuowan dizhen le.* 'Really, there was an earthquake last night.'

a. Unsuggested Context: Waking up in the morning, A's roommate says to A:
b. Suggested and agreed Context: Waking up in the morning, A tells his roommate 'There was an earthquake last night.' A's roommate also felt the earthquake and says:
c. Suggested and challenged Context: Waking up in the morning, A's roommate tells A 'There was an earthquake last night.' A doesn't believe it and says 'Are you sure? I didn't feel anything.' A's roommate says to A:

Thus, 50 stimuli (20 of *dique* and 30 of *zhende*) and 50 fillers were added to the experiment. The 50 stimuli and 50 fillers, all in Chinese characters, were presented to the participants in an anonymous questionnaire in Qualtrics.[11] The questionnaire was organized into ten blocks, each block containing 5 stimuli and 5 fillers. The order of the 10 items within each block was pseudo-randomized by Qualtrics, ensuring that no minimal pair stimuli appeared together. Each participant completed the questionnaire on a laptop, accompanied by an assistant. The participants were required to judge how natural the target sentences were in the contexts by ticking the numbers on a 5-point Likert scale: completely natural, somewhat natural, undecidable, somewhat unnatural, completely unnatural. 20 native Mandarin speakers, 10 male and 10 female, were each paid 80 Hong Kong dollars to participate in the experiment. The ratings were converted to numerical values as follows: completely natural=5, somewhat natural=4, undecidable=3, somewhat unnatural=2, completely unnatural=1. Differences among the average ratings were analyzed by one-way analysis of variance (ANOVA) followed by the Student-Newman-Keuls test in the statistical software package SPSS (IBM 2011). A value of $p < 0.05$ was considered statistically significant.

Results The average naturalness ratings of the 10 assertions containing *dique* are presented in Figure 1. Native speakers judged *dique*(p) in the context where p has been suggested as much more natural than in the context where p has not been suggested (suggested context = 4.31, unsuggested context = 1.65, $\mathrm{SS}_{\mathrm{group}}$ = 35.38, $\mathrm{SS}_{\mathrm{error}}$ = 3.12, $\mathrm{df}_{\mathrm{group}}$ = 1, $\mathrm{df}_{\mathrm{error}}$ = 18, F = 204.17, $p < .001$). The error bars represent 95% confidence intervals.

As presented in Figure 2, the average ratings of the 10 assertions modified by *zhende* in the three contexts are significantly different (suggested and challenged context = 4.79, suggested and agreed context = 2.51, unsuggested context = 1.825, $\mathrm{SS}_{\mathrm{group}}$ = 48.2, $\mathrm{SS}_{\mathrm{error}}$ = 4.2, $\mathrm{df}_{\mathrm{group}}$ = 2, $\mathrm{df}_{\mathrm{error}}$ = 27, F = 154.94, $p < .001$). Student-Newman-Keuls test shows that native speakers judged *zhende*(p) as more natural in the context where p has been

[11] Qualtrics is a web-based system that conducts online surveys. Version 45634 of the Qualtrics Research Suite. Copyright©2013 Qualtrics. http://www.qualtrics.com.

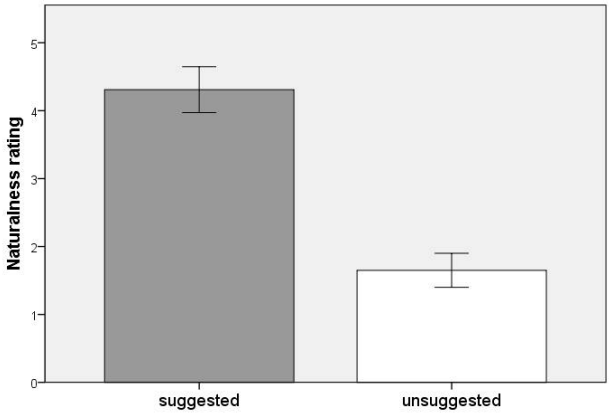

Fig. 1 Average ratings of assertions modified by *dique*

suggested but not all discourse participants were committed to it, than in the context where p has not been suggested at all ($p < .05$). Furthermore, native speakers judged *zhende*(p) as more natural in the context where a discourse participant remained uncommitted to p after p has been suggested, than in the context where all participants accepted p ($p < .05$). The error bars represent 95% confidence intervals.

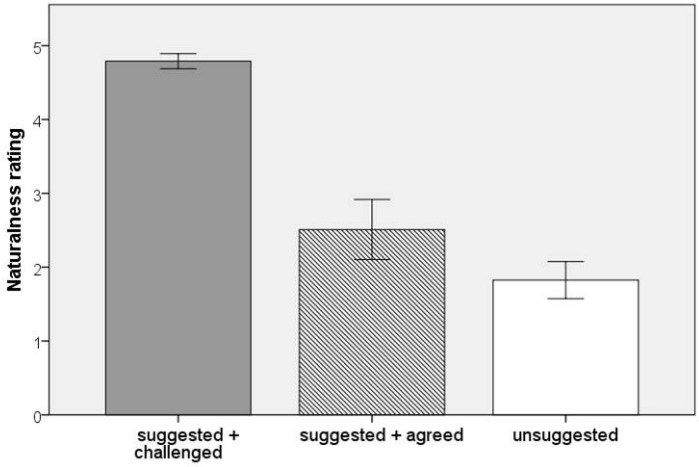

Fig. 2 Average naturalness ratings of assertions modified by *zhende*

The results support the predictions in (41) about the semantics of *dique* and *zhende*.[12]

[12] In this experiment, each participant has seen all target sentences in all kinds of contexts. Hiramatsu (1998) and Snyder (2000) point out that acceptability ratings may be influenced by repeated exposure. The current results can and should be replicated in a follow-up experiment in which separate experimental lists are constructed according to a Latin Square-design, such that each list contains an equal amount of target sentences per context, and each list is judged by an equal number of participants.

2.4 Section Summary

This section provided empirical characterizations of the distributions and interpretations of *dique* and *zhende*. On the basis of introspection-based data and a naturalness rating experiment, we show that *dique* contributes to the update of discourse by indicating that its prejacent is an old issue, while *zhende* indicates that its prejacent is an old issue but remains unresolved.

3 Formal analysis of *dique* and *zhende*

Section 2 showed that *dique* and *zhende* make different semantic contributions using empirical data. In this section, we propose that *dique* and *zhende* are presupposition triggers and provide formal definitions of these discourse markers which capture how they connect the utterances in the discourse. Our analysis is built on the update semantics proposed by Farkas & Bruce (2010). Farkas & Bruce (2010) model the context-change effects of various speech acts and provide a uniform treatment for assertions and questions. Since *dique* and *zhende* contribute to the update of discourse and mark the same discourse effect whether they modify assertions or questions, Farkas & Bruces (2010) model is suitable to describe the distribution and interpretation of *dique* and *zhende*. We first introduce the theoretical background for our proposal in Section 3.1, and then formalize the presuppositions of *dique* and *zhende* in Section 3.2. Section 3.3 shows how the analysis of Mandarin discourse markers offers support for the framework of Farkas & Bruce (2010).

3.1 Theoretical background

Before presenting the definitions of *dique*/*zhende* in assertions and questions, we need to know how assertions and questions are interpreted. The interpretations of assertions and questions are built upon the notions of the Common Ground (Stalnaker 1978), the public belief (Gunlogson 2001), the Table (Farkas & Bruce 2010) and the projected set (Farkas & Bruce 2010) in our study. Assertions and questions are both characterized as contributing to the Table stack and the projected set in Farkas & Bruce (2010), and hence adopting the model of Farkas & Bruce (2010) allows us to unify the semantics of the discourse markers in assertion and questions. *Dique* and *zhende* convey information about how the current utterance is related to the previous discourse, and thus we will propose an analysis of these markers as presuppositions triggers. To pave the way for later discussions, we also introduce the definition of presupposition.

Common Ground and Public Belief In the possible-worlds model of Stalnaker (1978), the Common Ground (hereafter, CG) represents all the mutual beliefs of the discourse participants in the discourse, and it is characterized as a set of propositions:

(44) The Common Ground is a set of propositions representing the common beliefs of all the discourse participants. (Summarized from Stalnaker 1978: 321)

The context set is then construed as a set of possible worlds in which all the propositions in the CG are true. In this model, an assertion uttered by any discourse participant acts as a proposal to change the CG. Gunlogson (2001: 41-43) decomposes the CG into each participant's public beliefs. Each participant is associated with a set of propositions that are

taken as their public beliefs. In a discourse where A and B are the participants, a proposition p is a public belief of the participant A if and only if 'A believes p' is a mutual belief of A and B. The CG in a certain context C is then taken to be the intersection of the public beliefs of the participants in that context, i.e., $\text{CG}(\text{C}) = \text{PB}_{\text{A}}(\text{C}) \cap \text{PB}_{\text{B}}(\text{C})$.

QUD, the Table and the projected set In order to interpret the meaning of questions, Roberts (1996) extends the model of Stalnaker (1978) by proposing a set of questions called the Question Under Discussion (QUD). The QUD is a set of questions representing contextually salient issues and it is temporarily ordered. Questions indicate an update in the QUD, while assertions indicate an update in the CG.

(45) The QUD is an ordered set of questions representing contextually salient issues.
(Summarized from Roberts 1996: 93)

Farkas & Bruce (2010) point out that question and assertion share a similarity that has not received enough attention before. A question raises an issue and brings this issue into the discussion, and so does an assertion. Anne's assertion in (46) and her question in (47) both raise the issue of Sam's whereabouts. We see that the same issue is raised because the addressee Ben can respond to Anne's assertion and her question with the same reaction (either a positive or a negative reaction). The difference is that the assertion in (46) commits Anne to the proposition 'Sam is home', while the question in (47) does not.

(46) Anne: Sam is home.
Ben: Yes/Yeah, he's home./No, he isn't home. (Farkas & Bruce 2010: 83)

(47) Anne: Is Sam home?
Ben: Yes/Yeah, he's home./No, he isn't home. (Farkas & Bruce 2010: 83)

In order to capture the similarities and differences between assertions and questions, Farkas & Bruce (2010) present a model of context structure that contains a discourse component called 'the Table', which is a stack of issues under discussion. The issue at the topmost layer of the Table stack is the issue that was most recently posed, and it is also the most immediate issue under discussion. Here, we represent the Table stack T as an ordered pair, either empty or consisting of an issue and a Table, as defined in (48).[13] An issue is a set of propositions, of type $\langle\langle s, t\rangle, t\rangle$.

(48) Let I be an issue, a set of propositions.
a. $\langle\ \rangle$ is a Table.
b. If I is an issue and T is a Table, then $\langle I, \text{T}\rangle$ is a Table.
c. Nothing else is a Table.
d. If T is a Table, then T[n] is the nth element in the Table (counting from 0 at the top).

[13] See Farkas & Bruce (2010: 86-87) for the original definition of the Table stack. Farkas & Bruce (2010) assume that the items on the Table are syntactic objects paired with their denotations. For example, after Anne's assertion in (46), the syntactic structure (i.e., 'Sam is home'[D], 'D' for the sentential feature of declaratives) and its denotation (i.e., the set {p}, p = 'Sam is home') are both added onto the Table. Having syntactic forms available in discourse together with semantic contents allows conversational moves to have access to both of them. For simplicity, the definition in (48) omits the syntactic structure and hence only the denotation (i.e., an issue I) is added onto the Table. See also Isaacs & Rawlins (2008) who make use of the notion of stack to model a context.

Farkas & Bruce (2010) also define two stack operations 'push' and 'remove' to model the operation of the Table. 'push(I, T)' represents the new stack obtained by adding the issue I to the top of the stack T, as defined in (49) on the basis of (48).

(49) For any issue I and Table T:
push(I, T) = $\langle I, \mathrm{T}\rangle$

For example, the Table T $\langle I', \langle\rangle\rangle$ has the issue I' on its topmost layer, as in (50-a). The push operation adds the issue I onto the top of T, and hence in the output Table, the issue I is the topmost element in push(I, T) (= $\langle I, \langle I', \langle\rangle\rangle\rangle$), as in (50-b).

(50) a.

T:	T[0]	I'

b.

push(I, T):	T[0]	I
	T[1]	I'

In contrast, 'remove(I, T)' represents the stack obtained by removing the topmost occurrence of I from the Table stack:

(51) For any issue I and Table T:
remove(I, $\langle I, \mathrm{T}\rangle$) = T.

The original Table T $\langle I, \langle I', \langle\rangle\rangle\rangle$ has the issue I on its topmost layer, as in (52-a). The remove operation removes the issue I from T, and hence the topmost element of the updated Table remove(I, T) (represented as $\langle I', \langle\rangle\rangle$) becomes I', as in (52-b).

(52) a.

T:	T[0]	I
	T[1]	I'

b.

remove(I, T) :	T[0]	I'

Initiating a conversational move, such as initiating an assertion move or a question move, will add the denotation of the assertion/question onto the Table. When the Table is not empty, the immediate goal of the conversation is to resolve the issue and empty the Table. An issue I is resolved and removed from the Table stack if and only if one proposition in the set I enters the CG, as shown in (53). Here, C_o represents the output context while C_i represents the input context.

(53) $\mathrm{T}(\mathrm{C}_o) = \mathrm{remove}(I, \mathrm{T}(\mathrm{C}_i))$ iff $\mathrm{T}(\mathrm{C}_i)[0] = I$ and $\exists p.(p \in I) \wedge (p \in \mathrm{CG}(\mathrm{C}_i))$.
(Modified from Farkas & Bruce 2010: 99)

Besides comparing between an assertion move and a question move, Farkas & Bruce (2010) also discuss the similarities and differences between reactions to assertions and reactions to questions. As shown in (46) and (47), both the assertion and the question can be responded by 'yes' and 'no'. However, the contextual effects of the negative reaction 'no' in (46) and (47) are different. Ben's negative reaction in (46) creates a conversational crisis, because after Ben's negative reaction, the issue of Sam's whereabouts cannot be resolved until either Ben or Anne retracts a commitment. In contrast, Ben's negative reaction in (47) does not create such a crisis. Anne can accept either one of Ben's responses in (47) and then the issue is resolved. In other words, the negative reaction to an assertion is more marked than the positive reaction to an assertion, whereas both the positive and negative reaction to a question are unmarked.

In order to account for the differences between the reactions to assertions and questions, Farkas & Bruce (2010) propose that a conversational move that places an item on the Table

simultaneously projects a set of future common grounds, called the 'projected set' (PS). PS is a set of future common grounds that reflects canonical ways of resolving the issue on the Table, and each future common ground is a superset of the current common ground. An assertion projects confirmation in that it projects a future common ground that includes the asserted proposition. A question projects resolution in that it projects a set of future common grounds, each of which includes a possible answer to the question. As defined in (54), the operation PS $\bar{\cup}$ P creates a new collection of sets of propositions, and each new set is created by adding one proposition in P to an existing CG_i. If the operation yields an inconsistent set, it will be eliminated. An inconsistent set is defined as in (55). That is, a set of propositions is inconsistent if the propositions in the set cannot be simultaneously all true. Otherwise, it is consistent. We will show how (54) works in defining assertions and questions.

(54) Definition of PS:
Let PS = $\{\text{CG}_1, ..., \text{CG}_n\}$ be a collection of sets of propositions (e.g. possible common grounds) and let P = $\{\text{p}_1, ..., \text{p}_m\}$ be a set of propositions.
PS $\bar{\cup}$ P = $\{\text{CG}_i \cup \{\text{p}_j\} | \ 1 < i < n; 1 < j < m\} - \{\text{CG}' | \text{CG}' \text{ is inconsistent}\}$.
(Farkas & Bruce 2010: 90)

(55) A set of propositions $\{\text{p}_1, \text{p}_2, ..., \text{p}_m\}$ is inconsistent if and only if $\text{p}_1 \wedge \text{p}_2 \wedge ... \wedge \text{p}_m$ is a contradiction.

In this framework, an assertion is defined in (57) on the basis of (56). The function '+' is the update function which adds a proposition into a set of propositions, as defined in (56). The assertive operator ASSERT takes in a proposition and returns a context change potential (i.e., CCP, a function from input contexts C_i to output contexts C_o, see Heim, 1982). The output context $\text{PB}_\text{X}(\text{C})$ + p resembles the input context C in every respect, except that $\text{PB}_\text{X}(\text{C})$ + p contains p.

(56) $\text{PB}_\text{Spkr}(\text{C})$ + p = $\text{PB}_\text{Spkr}(\text{C}) \cup \{\text{p}\}$

(57) ASSERT(p)(C_i) = C_o such that:
a. $\text{PB}_\text{Spkr}(\text{C}_o) = \text{PB}_\text{Spkr}(\text{C}_i)$ + p
b. $\text{T}(\text{C}_o)$ = push($\{\text{p}\}$, $\text{T}(\text{C}_i)$)
c. $\text{PS}(\text{C}_o) = \text{PS}(\text{C}_i) \bar{\cup} \{\text{p}\} = \{\text{CG}(\text{C}_i) \cup \{\text{p}\}\}$
(Modified from Farkas & Bruce 2010: 92)

According to (57), a default assertion changes the context in three ways. First, it adds the propositional content of the assertion into the speaker's public beliefs ($\text{PB}_\text{Spkr}(\text{C}_i)$ + p), (57-a). Second, it adds its propositional content (represented as a singleton set $\{\text{p}\}$) onto the top of the Table, (57-b). Third, confirmation is projected by adding p to each element of the input PS. The input PS only contains one element, i.e., the initial CG at the start of the conversation $\text{CG}(\text{C}_i)$, and hence the updated PS contains only one future common ground which includes the asserted proposition p. For example, Anne's assertion in (46) adds the proposition p 'Sam is home' into Anne's public beliefs, puts the issue $\{\text{p}\}$ onto the top of the Table, and adds p to the initial CG contained in the PS.

The change in (57-a) applies to both a default assertion and an assertion that acts as a confirmation of a previous assertion. The other two changes in (57-b) and (57-c) are redundant for an assertion that confirms a previous assertion. For example, when the addressee uses an assertion to confirm a previous assertion made by the speaker, the addressee simply commits himself to the content of the assertion without raising any new issue or making any change to the PS. For example, Ben's assertion *Yes/Yeah, he's home* in

(46) only adds the proposition p 'Sam is home' into the public beliefs of Ben. According to (53), since all the discourse participants (i.e., Anne and Ben) have p in their public beliefs ($p \in (\mathrm{PB}_{\mathrm{Anne}}(C_i) \cap \mathrm{PB}_{\mathrm{Ben}}(C_i))$, p enters the CG ($p \in \mathrm{CG}(C_i)$) and the issue {p} is resolved and removed from the Table ($\mathrm{T}(C_o) = \mathrm{remove}(\{p\}, \mathrm{T}(C_i))$). Confirmation is the default reaction to an assertion because it reaches the CG projected by the assertion and thus canonically resolved the issue raised.

If Ben remains uncommitted to p after Anne's assertion, for example, if Ben says 'No', 'Maybe no' or 'I don't think so', the issue {p} is not resolved. Ben's assertion adds an inconsistent proposition p′ (p′ can be ¬p, ◇¬p, etc.) to the existing CG in the PS, and hence the PS after Ben's assertion is a set $\{\mathrm{CG}(C_i) \cup \{p\} \cup \{p'\}\}$. Since p and p′ cannot be simultaneously true, the future common ground $\mathrm{CG}(C_i) \cup \{p\} \cup \{p'\}$ is inconsistent and is hence discarded following (54). Thus, the PS becomes an empty set if one discourse participant proposed to add p to the CG while the other participant refused this proposal. The issue remains on the top of the Table and requires further discussion.[14]

Like assertions, questions raise new issues and update the PS, but they do not change discourse participants' commitments. Farkas & Bruce (2010) define the question operator Q as in (58), where Q is a set of propositions that count as possible answers to the question. (58) says that when a question Q is asked, the Hamblin-set of propositions Q has been added onto the top of the Table and each proposition in Q is added to the existing CG in the PS. For example, if Q denotes a set of {p, q}, then the updated Table has the issue {p, q} on its top level and the updated projected set contains two future CGs, each of which includes one proposition in Q ($\mathrm{PS}(C_o) = \mathrm{PS}(C_i) \bar{\cup} \{p, q\} = \{\mathrm{CG}(C_i) \cup \{p\}, \mathrm{CG}(C_i) \cup \{q\}\}$). If the addressee provides a complete direct answer to the question and the speaker accepts this answer, the CG of the conversation becomes equivalent to one of the future CGs in the PS and then the question is removed from the Table.

(58) $\mathrm{Q}(Q)(C_i) = C_o$ such that:
  a. $\mathrm{T}(C_o) = \mathrm{push}(Q, \mathrm{T}(C_i))$
  b. $\mathrm{PS}(C_o) = \mathrm{PS}(C_i) \bar{\cup} Q$ (Modified from Farkas & Bruce 2010: 95)

One difference between question and assertion is that a question adds a non-singleton set of propositions onto the Table and projects a non-singleton set of resolutions, while an assertion adds a singleton set onto the Table and projects one default resolution of the issue. Farkas & Bruce (2010) reconceptualize the QUD (Roberts 1996) as the Table in the definition of questions, because the notion of the Table can apply to both assertions and questions. The term 'QUD' is limited to the definition of questions and hence will not be used in the rest of this paper.

As can be seen, the PS characterizes how an issue can be canonically resolved. When the addressee accepts the speaker's assertion, or when the addressee answers the speaker's question, the CG becomes equivalent to one of the future CGs in the PS and the issue is resolved. In contrast, when the addressee refuses the speaker's assertion, or when the addressee fails to answer the speaker's question, the PS becomes empty because of inconsistent future CGs and the issue is unresolved. That is, the introduction of PS enables one to characterize how the addressee has failed to resolve an old issue. Since the adverb

[14] See Cohen & Krifka (2014) and Krifka (2015, 2017) for a similar theory of speech acts that models both the current CG and its projected continuation. Their framework characterizes various reactions to different speech acts, e.g., acceptance and rejection of assertions or questions, based on the notion of commitment states and commitment spaces.

zhende indicates that its prejacent issue is unresolved, the PS will be adopted to formalize the semantics of *zhende* in Section 3.2.2.

To summarize, Farkas & Bruce (2010) provide a unified analysis of assertions and questions by proposing that both assertions and questions add their contents onto the Table and update the projected set. We will adopt their analysis in Section 3.2 in order to unify the semantics of the discourse markers in assertions and questions.

Presupposition We need to introduce another notion before presenting the definitions of *dique* and *zhende*, that is, the notion of presupposition. As we have shown above, an utterance like an assertion or a question denotes an update of the context. Presuppositions are thus regarded as preconditions on the context. This means that a presupposition must be evaluated in a context that already entails this presupposition. Karttunen (1974) proposes that presuppositions need to be entailed by the local context, as in (59):

(59) Context X satisfies the presupposition of S just in case the presuppositions of each of the constituent sentences in S are satisfied by the local context.
(Karttunen 1974: 187)

In order to formalize (59), we employ a binary presupposition operator '$\langle\ \rangle$' from Beaver & Krahmer (2001), which is called *transplication*.

(60) If ϕ, π are formulae, then $\phi_{\langle\pi\rangle}$ is a formula.
(Beaver & Krahmer 2001: 150)

In (60), π is a presupposition of ϕ. Beaver & Krahmer (2001) provide a truth-conditional definition for transplication. That is, $[\![\phi_{\langle\pi\rangle}]\!]$ is defined only if π is true. Here, we redefine transplication in the dynamic semantics framework:

(61) $[\![\phi_{\langle\pi\rangle}]\!]$ is defined iff $[\![\pi]\!]$ is satisfied in the local context.

In Section 3.2, transplication is adopted to characterize the presuppositions of *dique* and *zhende*.

Summary This section illustrated the formal concepts of the Common Ground, the public belief, the Table, the projected set and presupposition. The semantic analysis of assertion and question in Farkas & Bruce (2010) will be adopted in the following analysis of *dique* and *zhende*, because it allows us to capture how the discourse markers contribute to the update of discourse and unify the semantics of the discourse markers in assertion and question.

3.2 Formal definitions of *dique* and *zhende*

In Section 2, we observed that the discourse marker *dique* marks its prejacent issue as old, whereas *zhende* marks its prejacent issue as old and not resolved. In this section, we formalize this observation and explain the distribution of *dique* and *zhende*.

3.2.1 Formal definition of dique

The discourse marker *dique* marks its prejacent as an old issue. In other words, the use of *dique* presupposes that the prejacent issue is old.

We formalize this presuppositional nature of *dique* in (62) using transplication as defined in (61) above. (62-a) is for the case when *dique* is used in an assertion, while (62-b) is for the case of a question. Let us take a look at (62-a) first. The semantics of *dique* consists of two parts. The first part says that the combination of *dique* with a proposition α and a force head F denotes $F(\alpha)$. If *dique* combines with a certain proposition p and the assertive force head ASSERT, the resulting formula will be $(\lambda\alpha.\lambda F.\lambda \mathrm{C}.F(\alpha)(\mathrm{C}))(\mathrm{p})(\textsc{assert})$ = $\lambda \mathrm{C}.\textsc{assert}(\mathrm{p})(\mathrm{C})$ = $\textsc{assert}(\mathrm{p})$. This formula says that an assertion modified by *dique* has the same assertive component as a bare assertion, i.e., both denote an update of the speaker's public beliefs with p and an update of the Table and the PS. The second part is the formula within the angle brackets. According to the definition in (61), the formula $\mathrm{T}(\mathrm{C})[0] = \{\alpha\}$ says that the content of the presupposition is that the singleton set of a proposition $\{\alpha\}$ is on the top of the Table. That is, *dique* presupposes that the singleton set $\{\alpha\}$ is on the top of the Table. (62-b) says that *dique* presupposes that α, which is a set of propositions, is on the top of the Table.

(62) The semantics of *dique*:

a. $[\![\textit{dique}]\!] = \lambda\alpha.\lambda F.\lambda \mathrm{C}.F(\alpha)(\mathrm{C})_{\langle \mathrm{T}(\mathrm{C})[0]=\{\alpha\}\rangle}$ if α is of type $\langle s,t\rangle$.

b. $[\![\textit{dique}]\!] = \lambda\alpha.\lambda F.\lambda \mathrm{C}.F(\alpha)(\mathrm{C})_{\langle \mathrm{T}(\mathrm{C})[0]=\alpha\rangle}$ if α is of type $\langle\langle s,t\rangle,t\rangle$.

Let us see how (62) implements the informal generalizations of the semantic contribution made by *dique*. First, we illustrate how (62-a) works with (4), repeated here as (63).

(63) A: Li chuguo le.
'Li went abroad.'
B: *Dique*, ta chuguo le.
'Indeed, he went abroad.'

A and B have made two utterances in (63), so we can consider two context change potentials. Let us see how each utterance changes the state of the context. The initial context is C_0. As depicted in (64), C_0 is a context in which: 1) the proposition p 'Li went abroad' is not in the public beliefs of A ($\mathrm{p} \notin \mathrm{PB_A}(\mathrm{C}_0)$); 2) p is not in the public beliefs of B ($\mathrm{p} \notin \mathrm{PB_B}(\mathrm{C}_0)$), 3) the issue {p} is not in the Table (since $\mathrm{T}(\mathrm{C}_0) = \langle\,\rangle$), and 4) the PS includes only $\mathrm{CG}(\mathrm{C}_0)$, the initial CG at the start of the conversation. '{...}' in (64) represents the fact that there could be some propositions in $\mathrm{PB}(\mathrm{C}_0)$ and $\mathrm{CG}(\mathrm{C}_0)$ other than p.

(64) C_0:

$\mathrm{PB_A}(\mathrm{C}_0)$	{...}	$\mathrm{PB_B}(\mathrm{C}_0)$	{...}	$\mathrm{CG}(\mathrm{C}_0)$	{...}

$\mathrm{T}(\mathrm{C}_0)$:		$\mathrm{PS}(\mathrm{C}_0)$:	$\{\mathrm{CG}(\mathrm{C}_0)\}$

A's utterance 'Li went abroad' updates the context C_0 and the updated context is C_1, as shown in (65). As defined in (57), the participant A's assertion, $\textsc{assert}(\mathrm{p})(\mathrm{C}_0)$, updates the context C_0 by adding p into A's public beliefs ($\mathrm{PB_A}(\mathrm{C}_1) = \mathrm{PB_A}(\mathrm{C}_0) + \mathrm{p}$), putting the issue {p} onto the top of the Table ($\mathrm{T}(\mathrm{C}_1)$ = push ({p}, $\mathrm{T}(\mathrm{C}_0)$) and projecting confirmation by adding p to the initial CG in the input PS. The Table $\mathrm{T}(\mathrm{C}_1)$ can be represented as $\langle\{\mathrm{p}\}, \langle\,\rangle\rangle$.

(65) C_1:

$\mathrm{PB_A}(\mathrm{C}_1)$	{p, ...}	$\mathrm{PB_B}(\mathrm{C}_1)$	{...}	$\mathrm{CG}(\mathrm{C}_1)$	{...}

$T(C_1)$:	$T(C_1)[0]$	{p}	$PS(C_1)$:	$\{CG(C_0) \cup \{p\}\}$

The context C_1 is then updated by B's utterance and becomes the context C_2, as in (66).

(66) C_2:

$PB_A(C_2)$	{p, ...}	$PB_B(C_2)$	{p, ...}	$CG(C_2)$	{p, ...}

$T(C_2)$:		$PS(C_2)$:	$\{CG(C_0) \cup \{p\}\}$

B uses *dique*, which triggers a presupposition that the issue {p} is on the top of the Table. Following the definition of presupposition in (61), B's assertion is defined only if the presupposition $T(C)[0] = \{p\}$ is satisfied in the local context. Since *dique* occurs in the matrix clause, the presupposition triggered by *dique* is regarded as a requirement on the utterance context. In other words, the presupposition triggered by *dique* should be evaluated and satisfied in the context set of the context C_1. This amounts to saying that B's assertion is defined only if all of the discourse participants share the belief that the issue {p} has been added onto the top of the Table in the context C_1. Because of A's assertion, the issue {p} is added onto the top of the Table in the context C_1 ($\{p\} = T(C_1)[0]$) and every discourse participant shares this belief, and hence the presupposition triggered by *dique* is satisfied. Once the presupposition is satisfied, B's assertion is defined. When the issue {p} is already on the top of the Table, an assertion of p acts as a confirmation of a previous assertion and only updates the speaker's public beliefs. Hence, B's assertion updates B's public beliefs with p ($PB_B(C_2)$ = $PB_B(C_1)$ + p). Since both participants are committed to p, p is added into the CG in the context C_2 and hence the issue {p} is resolved and removed from the Table.

As discussed in Section 2.1.1, an assertion containing *dique* is also felicitous as a response to an assertion containing epistemic modal adverbs such as *keneng* and *yexu* 'probably':

(67) A: Li keneng chuguo le.
'Li probably went abroad.'
B: *Dique*, ta chuguo le.
'Indeed, he went abroad.'

In (67), A has expressed his bias towards p 'Li went abroad' and hence has brought this issue into the current discussion. We speculate that A's statement has at least two dimensions of meaning. The first dimension is that A believes that p is true in some possible worlds, and the second is that A has added the issue {p} onto the top of the Table. Since the presupposition triggered by *dique* is satisfied by A's statement, the use of *dique* is felicitous.

Now, let us see how the definition in (62-b) captures the contribution of *dique* in questions. Take (24), repeated here as (68), as an example.

(68) Context: Mr. Li and Mrs. Li just had a meeting with their son Xiaoli's teacher. The couple are talking with Xiaoli:
Mr. Li: Shang zhouwu ni qu nali le?
'Where did you go last Friday?'
Mrs. Li: *Dique*, qu nali le?
'Indeed, where did you go?'

A and B have made two utterances in (68). The question I *Shang zhouwu ni qu nali le?* 'Where did you go last Friday?' uttered by Mr. Li denotes a set which contains all the propositions of the form 'Xiaoli goes to x last Friday', where x is a place where Xiaoli can go. For simplicity, we define this question as a set containing n possible answers $\{\mathrm{p}_1, \mathrm{p}_2, ..., \mathrm{p}_n\}$. The initial context c_0 is a context where the question $\{\mathrm{p}_1, \mathrm{p}_2, ..., \mathrm{p}_n\}$ is not in the Table (since $\mathrm{T}(\mathrm{c}_0) = \langle\ \rangle$). Mr. Li asks the question 'Where did you go last Friday?', which adds this question onto the top of the Table in the context c_1, i.e., $\mathrm{T}(\mathrm{c}_1)[0] = \{\mathrm{p}_1, \mathrm{p}_2, ..., \mathrm{p}_n\}$, and adds each possible answer to the existing CG in the PS.

(69) c_1:

$\mathrm{T}(\mathrm{c}_1)$:	$\mathrm{T}(\mathrm{c}_1)[0]$	$\{\mathrm{p}_1, \mathrm{p}_2, ..., \mathrm{p}_n\}$

PS(c_1):	$\{\mathrm{CG}(\mathrm{c}_0) \cup \{\mathrm{p}_1\}, \mathrm{CG}(\mathrm{c}_0) \cup \{\mathrm{p}_2\}, ...\mathrm{CG}(\mathrm{c}_0) \cup \{\mathrm{p}_n\}\}$

Mrs. Li's use of *dique* presupposes that the issue $\{\mathrm{p}_1, \mathrm{p}_2, ..., \mathrm{p}_n\}$ is already on the top of the Table. Since this presupposition is satisfied in the context c_1, the use of *dique* is felicitous and Mrs. Li's question also adds $\{\mathrm{p}_1, \mathrm{p}_2, ..., \mathrm{p}_n\}$ onto the topmost layer of the Table ($\mathrm{T}(\mathrm{c}_2)$ = push $(\{\mathrm{p}_1, \mathrm{p}_2, ..., \mathrm{p}_n\}, \mathrm{T}(\mathrm{c}_1))$, as in (70). That is, both Mr. Li and Mrs. Li are committed to seeking an answer to this question in the context c_2. This accounts for the intuition that questions containing *dique* indicate the speaker's confirmation of the old question and the speaker's agreement with the intention of the previous asker.

(70) c_2:

$\mathrm{T}(\mathrm{c}_2)$:	$\mathrm{T}(\mathrm{c}_2)[0]$	$\{\mathrm{p}_1, \mathrm{p}_2, ..., \mathrm{p}_n\}$

PS(c_2):	$\{\mathrm{CG}(\mathrm{c}_0) \cup \{\mathrm{p}_1\}, \mathrm{CG}(\mathrm{c}_0) \cup \{\mathrm{p}_2\}, ...\mathrm{CG}(\mathrm{c}_0) \cup \{\mathrm{p}_n\}\}$

In a nutshell, *dique* triggers a presupposition that its prejacent issue has been put onto the top of the Table.

3.2.2 Formal definition of zhende

The discourse marker *zhende* marks its prejacent issue as old and unresolved. In other words, *zhende* presupposes that its prejacent issue is old and that some participant y has failed to resolve this issue, as formalized in (71). (71-a) says that *zhende* in an assertion of α presupposes that the issue $\{\alpha\}$ is already on the top of the Table ($\mathrm{T}(\mathrm{C})[0] = \{\alpha\}$) and that the projected set is empty ($\mathrm{PS}(\mathrm{C}) = \emptyset$). As discussed in Section 3.1, when the issue $\{\alpha\}$ is already on the top of the Table, it means that α has been suggested by someone x and hence has been added to the PS: $\mathrm{PS}(\mathrm{C})\ \bar{\cup}\ \{\alpha\} = \{\mathrm{CG}(\mathrm{C}) \cup \{\alpha\}\}$. If some participant y remains uncommitted to α after x's assertion, for example, if y says 'No', 'Maybe no' or 'I don't think so', y's assertion adds an inconsistent proposition α' to the PS, and thus the PS after y's assertion is a set $\{\mathrm{CG}(\mathrm{C}) \cup \{\alpha\} \cup \{\alpha'\}\}$. Since α and α' cannot be true simultaneously, the future common ground $\mathrm{CG}(\mathrm{C}) \cup \{\alpha\} \cup \{\alpha'\}$ is inconsistent and is hence discarded, and thus the projected set becomes empty. (71-b) says that *zhende* in a questioning of α presupposes that α is on the top of the Table and that the projected set is empty. When the issue α is already on the top of the Table, it means that the question α has been asked and hence each possible answer of α has been added to the existing CG in the PS. If some participant y has

failed to resolve α, i.e., y has provided an answer that is not an element in α, then the PS also becomes empty because of inconsistent future common grounds.

(71) The semantics of *zhende*:

a. $[\![\textit{zhende}]\!] = \lambda\alpha.\lambda F.\lambda \mathrm{C}.F(\alpha)(\mathrm{C})_{\langle(\mathrm{T(C)}[0]=\{\alpha\})\wedge(\mathrm{PS(C)}=\emptyset)\rangle}$ if α is of type $\langle s,t\rangle$.

b. $[\![\textit{zhende}]\!] = \lambda\alpha.\lambda F.\lambda \mathrm{C}.F(\alpha)(\mathrm{C})_{\langle(\mathrm{T(C)}[0]=\alpha)\wedge(\mathrm{PS(C)}=\emptyset)\rangle}$ if α is of type $\langle\langle s,t\rangle,t\rangle$.

(71-a) can be illustrated with the example (30), repeated below as (72).

(72) A: Zuowan xiayu le.
'It rained last night.'
B: Meiyou xiayu.
'It didn't rain.'
C (to B):*Zhende*, zuowan xiayu le.
'Really, it rained last night.'

A, B and C have made three utterances in (72). The initial context is C_0 in which the proposition p 'Li went abroad' is not in the public beliefs of A or B or C, the issue $\{\mathrm{p}\}$ is not in the Table and the PS only contains the initial CG. A's utterance updates the context C_0 and the updated context is C_1. In context C_1, A's assertion of p 'It rained last night' updates the initial context C_0 by adding p into A's public beliefs ($\mathrm{PB_A(C_1)}$ =$\mathrm{PB_A(C_0)}+\mathrm{p}$), putting the issue $\{\mathrm{p}\}$ onto the top of the Table ($\mathrm{T(C_1)}$ = push $(\{\mathrm{p}\},\mathrm{T(C_0)})$, and adding p into the existing CG in the PS ($\mathrm{PS(C_1)}$ = $\mathrm{PS(C_0)}$ $\bar{\cup}$ $\{\mathrm{p}\}$ = $\{\mathrm{CG(C_0)}\cup\{\mathrm{p}\}\}$):

(73) C_1:

$\mathrm{PB_A(C_1)}$	{p, ...}	$\mathrm{PB_B(C_1)}$	{...}

$\mathrm{PB_C(C_1)}$	{...}	$\mathrm{CG(C_1)}$	{...}

$\mathrm{T(C_1)}$:	$\mathrm{T(C_1)}[0]$	{p}	$\mathrm{PS(C_1)}$:	$\{\mathrm{CG(C_0)}\cup\{\mathrm{p}\}\}$

Then, B's utterance updates the context C_1 and the updated context is C_2, as in (74). B refuses to believe what A said and commits himself to ¬p. B's assertion adds an inconsistent proposition ¬p to the PS, $\mathrm{PS(C_2)}$ = $\mathrm{PS(C_1)}$ $\bar{\cup}$ $\{\neg\mathrm{p}\}$ = $\{\mathrm{CG(C_0)}\cup\{\mathrm{p}\}\cup\{\neg\mathrm{p}\}\}$. Since p and ¬p are inconsistent, $\mathrm{CG(C}_i)\cup\{\mathrm{p}\}\cup\{\neg\mathrm{p}\}$ is discarded and $\mathrm{PS(C_2)}$ becomes empty. B has failed to resolve the issue $\{\mathrm{p}\}$, and thus the issue remains on the top of the Table and requires further discussion.

(74) C_2:

$\mathrm{PB_A(C_2)}$	{p, ...}	$\mathrm{PB_B(C_2)}$	{¬p, ...}

$\mathrm{PB_C(C_2)}$	{...}	$\mathrm{CG(C_2)}$	{...}

$\mathrm{T(C_2)}$:	$\mathrm{T(C_2)}[0]$	{p}	$\mathrm{PS(C_2)}$:	$\emptyset$

The context C_2, is then updated by C's utterance and becomes C_3. C's use of *zhende* presupposes that $\{\mathrm{p}\}$ is on the top of the Table ($\mathrm{T(C_2)}[0]=\{\mathrm{p}\}$) and that some participant has failed to resolve this issue ($\mathrm{PS(C_2)}$ = $\emptyset$). Since these presuppositions are satisfied in C_2, *zhende* is felicitous and C's assertion indicates an update of C's public beliefs with p

($\mathrm{PB_C}(\mathrm{C_3})$ = $\mathrm{PB_C}(\mathrm{C_2})$ + p). Since C is committed to p but B is uncommitted to p, the assertion containing *zhende* expresses that C is emphasizing the truth of p and C is trying to convince B of p:

(75) $\mathrm{C_3}$:

$\mathrm{PB_A}(\mathrm{C_3})$	{p, ...}	$\mathrm{PB_B}(\mathrm{C_3})$	{¬p, ...}

$\mathrm{PB_C}(\mathrm{C_3})$	{p, ...}	CG($\mathrm{C_3}$)	{...}

T($\mathrm{C_3}$):	T($\mathrm{C_3}$)[0]	{p}	PS($\mathrm{C_3}$):	∅

Let us see how (71-b) implements the contributions of *zhende* in questions by looking at (76).

(76) Context: Mr. Li and Mrs. Li just had a meeting with their son Xiaoli's teacher. The couple are talking with Xiaoli:

Mr. Li: Shang zhouwu ni qu nali le?
'Where did you go last Friday?'
Xiaoli: Wo zai xuexiao.
'I was at school.'
Mrs. Li: Women zhidao ni bu zai. *Zhende*, ni qu nali le?
'We know that you were not. Really, where did you go?'

Suppose that the question I *Shang zhouwu ni qu nali le?* 'Where did you go last Friday?' is a set containing n possible answers {$\mathrm{p_1}$, $\mathrm{p_2}$, ..., $\mathrm{p_n}$}. Mr. Li asks this question, which adds it onto the top of the Table of the initial context $\mathrm{C_0}$, i.e., $\mathrm{T}(\mathrm{C_1})$ = push $(\{\mathrm{p_1}, \mathrm{p_2}, ..., \mathrm{p_n}\}, \mathrm{T}(\mathrm{C_0}))$ and adds each possible answer to the existing CG in the PS, i.e., PS($\mathrm{C_1}$) = PS($\mathrm{C_0}$) $\bar{\cup}$ {$\mathrm{p_1}$, $\mathrm{p_2}$, ..., $\mathrm{p_n}$} = {CG($\mathrm{C_0}$) ∪ {$\mathrm{p_1}$}, CG($\mathrm{C_0}$) ∪ {$\mathrm{p_2}$}, ...CG($\mathrm{C_0}$) ∪ {$\mathrm{p_n}$}}.

(77) $\mathrm{C_1}$:

$\mathrm{PB_{Mr.Li}}(\mathrm{C_1})$	{...}	$\mathrm{PB_{Xiaoli}}(\mathrm{C_1})$	{...}	$\mathrm{PB_{Mrs.Li}}(\mathrm{C_1})$	{...}

T($\mathrm{C_1}$):	T($\mathrm{C_1}$)[0]	{$\mathrm{p_1}$, $\mathrm{p_2}$, ..., $\mathrm{p_n}$}

PS($\mathrm{C_1}$):	{CG($\mathrm{C_0}$) ∪ {$\mathrm{p_1}$}, CG($\mathrm{C_0}$) ∪ {$\mathrm{p_2}$}, ...CG($\mathrm{C_0}$) ∪ {$\mathrm{p_n}$}}

The participant Xiaoli has committed himself to q 'I was at school' in order to answer the issue I but Mrs. Li believes that q does not resolve I (and q is false). Given that Mrs. Li is asking the issue I and she believes that q does not resolve I, q cannot be a possible answer to I. In other words, Xiaoli has committed himself to a proposition in the form of $\neg \mathrm{p_1} \wedge \neg \mathrm{p_2} \wedge ... \wedge \neg \mathrm{p_n}$, and hence the projected set PS($\mathrm{C_2}$) = PS($\mathrm{C_1}$) $\bar{\cup}$ {$\neg \mathrm{p_1} \wedge \neg \mathrm{p_2} \wedge ... \wedge \neg \mathrm{p_n}$} = {CG($\mathrm{C_0}$) ∪ {$\mathrm{p_1}$} ∪ {$\neg \mathrm{p_1} \wedge \neg \mathrm{p_2} \wedge ... \wedge \neg \mathrm{p_n}$}, CG($\mathrm{C_0}$) ∪ {$\mathrm{p_2}$} ∪ {$\neg \mathrm{p_1} \wedge \neg \mathrm{p_2} \wedge ... \wedge \neg \mathrm{p_n}$}, ...CG($\mathrm{C_0}$) ∪ {$\mathrm{p_n}$} ∪ {$\neg \mathrm{p_1} \wedge \neg \mathrm{p_2} \wedge ... \wedge \neg \mathrm{p_n}$}}. Since every possible CG in the PS is inconsistent and is thus discarded, the PS becomes empty.

(78) $\mathrm{C_2}$:

$\mathrm{PB_{Mr.Li}}(\mathrm{C_2})$	{...}	$\mathrm{PB_{Xiaoli}}(\mathrm{C_2})$	{q, ...}	$\mathrm{PB_{Mrs.Li}}(\mathrm{C_2})$	{¬q, ...}

$\mathrm{T}(\mathrm{c}_2)$:	$\mathrm{T}(\mathrm{c}_2)[0]$	$\{\mathrm{p}_1, \mathrm{p}_2, ..., \mathrm{p}_n\}$	$\mathrm{PS}(\mathrm{c}_2)$:	$\emptyset$

Mrs. Li's use of *zhende* presupposes that I is already on the top of the Table ($\mathrm{T}(\mathrm{c}_2)[0] = \{\mathrm{p}_1, \mathrm{p}_2, ..., \mathrm{p}_n\}$) and that it is unresolved ($\mathrm{PS}(\mathrm{c}_2) = \emptyset$). Since these presuppositions are satisfied in c_2, the use of *zhende* is felicitous and Mrs. Li's question also adds I onto the Table ($\mathrm{T}(\mathrm{c}_3) = \text{push}\ (\{\mathrm{p}_1, \mathrm{p}_2, ..., \mathrm{p}_n\}, \mathrm{T}(\mathrm{c}_2))$, as in (79). Since Mrs. Li is seeking an answer to the issue and Xiaoli has failed to resolve it, the question containing *zhende* indicates that Mrs. Li is emphasizing that Xiaoli should truly resolve this issue.

(79) c_3:

$\mathrm{PB}_{\mathrm{Mr.Li}}(\mathrm{c}_3)$	{...}	$\mathrm{PB}_{\mathrm{Xiaoli}}(\mathrm{c}_3)$	{q, ...}	$\mathrm{PB}_{\mathrm{Mrs.Li}}(\mathrm{c}_3)$	{¬q, ...}

$\mathrm{T}(\mathrm{c}_3)$:	$\mathrm{T}(\mathrm{c}_3)[0]$	$\{\mathrm{p}_1, \mathrm{p}_2, ..., \mathrm{p}_n\}$	$\mathrm{PS}(\mathrm{c}_3)$:	$\emptyset$

To summarize, *zhende* triggers a presupposition that its prejacent issue is old and that some discourse participant has failed to commit to an answer to this issue.[15]

3.3 Advantages of Farkas & Bruce's theory

Section 3.2 provided formal definitions for *dique* and *zhende* within the dynamic semantics framework, in particular, the stack model of the Table in a context proposed by Farkas & Bruce (2010). This section further motivates the adoption of Farkas & Bruce's stack model.

In Section 3.1, we show how Farkas & Bruce (2010) formalize the context-change effect of the assertion/question speech-act operator. The Table stack model provides a rich structure in order to define the context-change effects of assertion/question and the discourse behaviors of these speech acts. This model does not just consider the effect of an utterance performing a certain speech act in isolation, but also the various reactions to this speech act, such as confirmation and challenge to an assertion. As shown in Section 2, Mandarin discourse markers *dique* and *zhende* are speech act modifiers, which function to connect the previous speech acts with its reactions and contribute updates in terms of discourse moves. Therefore, Farkas & Bruce's (2010) theory that specifies discourse effects of speech acts is more suitable for our concern, compared with an alternative theory like Gunlogson

[15] *Dique* and *zhende* can either occur at sentence-initial position or VP-initial position. This paper only discussed *dique*/*zhende* at sentence-initial position. Adverbs at these two positions make similar semantic contributions and both can be analyzed as presupposition triggers. For example, both sentences in (i) indicate that the proposition 'Li went abroad' has been suggested, and both sentences in (ii) indicate that p 'Li went abroad' has been suggested and that some discourse participant remains uncommitted to the truth of p. See Appendix and Yuan (2015: 109-130) for the discussion of a subtle difference between sentence-initial and VP-initial *dique*/*zhende*.

(i) *Dique*, ta chuguo le. / Ta *dique* chuguo le.
Indeed he go-abroad PERF / he indeed go-abroad PERF
'Indeed, he went abroad.'/'He indeed went abroad.'

(ii) *Zhende*, ta chuguo le. / Ta *zhende* chuguo le.
Really he go-abroad PERF / he really go-abroad PERF
'Really, he went abroad.'/'He really went abroad.'

(2001) which concerns more about the meaning of a particular construction, namely a rising declarative.[16] As shown in Section 3.2, our analysis built within the framework of Farkas & Bruce (2010) successfully captures how these discourse markers contribute to the update of discourse.

Another advantage of adopting Farkas & Bruce (2010) is that we can avoid having two *dique*'s and *zhende*'s in the lexicon. As discussed in Section 2, *dique* is used in both assertions and questions, and in both speech acts *dique* indicates that its prejacent is an old issue. Similarly, *zhende* indicates that its prejacent is an old issue and not resolved in both assertions and questions. Since the discourse markers make unified semantic contributions across different speech acts, we need a formal model of context which provides a unified treatment of assertions and questions. The hallmark of Farkas & Bruce's (2010) framework is that both assertions and questions add their contents onto the top of the Table stack and update the projected set. Thus, *dique* in both assertions and questions can be defined as indicating that its prejacent has been added onto the top of the Table, while *zhende* in both assertions and questions can be defined as indicating that its prejacent has been added onto the top of the Table and not resolved. In short, the framework of Farkas & Bruce (2010) allows us to unify the use of the Mandarin adverbs in assertions and questions.

In comparison, frameworks that model assertions and questions using different formal devices fail to capture the constant contributions of the discourse markers. For example, if we adopted the models of Gunlogson (2001) and Roberts (1996), *dique* in assertions would be defined as indicating that its prejacent proposition has been added into some individual's public beliefs, whereas *dique* in questions would be defined as indicating that its prejacent question has been added onto the top of the QUD stack. The use of two distinct formal devices (i.e., public beliefs and the QUD) would miss the core characteristics of *dique* as a speech act modifier and be forced to have two distinct definitions for assertions and questions. Therefore, the framework of Farkas & Bruce (2010) is theoretically more economical and thus more desirable in the analysis of *dique*/*zhende* as well as other discourse markers that have unified semantics in different speech acts.

Furthermore, *dique* and *zhende* function to relate the current conversational (i.e., linguistic) move to a prior conversational move. This function naturally fits the Table stack model of Farkas & Bruce (2010) which defines an assertion as a conversational move that raises an issue under discussion. As discussed in Section 2.1.2, *dique* indicates that some individual x has expressed his bias towards the prejacent proposition p verbally or linguistically by making an assertion. The use of *dique* is infelicitous when 'x is biased towards p' is a mere common belief shared by every discourse participant. For example, in (28), repeated here as (80), according to the world knowledge that it is going to rain if there is thunder and lightning, it is reasonable to assume that B believes in the proposition p 'It will rain', and thus it is a common belief that B believes in p. However, B did not express his belief of p explicitly. In this case, the use of *dique* is infelicitous.

(80) Context: There is thunder and lightning outside. A says to B:
A: #*Dique*, yao xiayu le.
indeed will rain PERF
'Indeed, it will rain.'

[16] We would like to thank the editor for reminding us that one of the most important advantages of employing Farkas & Bruce's theory (2010) is that it allows us to analyze *dique* and *zhende* as lexical items that affect the discourse updates.

To our knowledge, other frameworks are incapable of capturing the behavior of *dique* in (80). For example, if we adopted the model of Gunlogson (2001), where an assertion is defined as an update of the speaker' public beliefs, *dique* would be defined as indicating that its prejacent proposition has been added into some individual x's public beliefs. In examples like (80), given that p 'It will rain' is already in B's public beliefs, this would wrongly predict that the use of *dique* is felicitous.

Another possible framework is Potts (2007: 63), which defines the epistemic state of an individual using a subjective probability distribution P. Yuan & Hara (2012: 628) adopt this model and define *dique* as indicating that some individual x's degree of belief in the prejacent proposition is larger than 0.5. Given that B's degree of belief in p 'It will rain' is larger than 0.5 in (80), this also wrongly predicts that *dique* is felicitous in (80). In the Table stack model, in contrast, *dique* is defined as indicating that its prejacent issue has been added onto the top of the Table stack. This means that *dique* is used only when some individual has made an explicit conversational move (i.e., an assertion) that raises the prejacent issue under discussion. Given that no assertion has been made before the use of *dique* in (80), this correctly predicts that the use of *dique* is not felicitous.

Last but not least, in order to account for the different contextual effects of reactions to assertions and questions, Farkas & Bruce (2010) present a model of context structure that contains a novel component, i.e., the projected set, which is indispensable to the characterization of the semantics of *zhende*. As discussed in Section 2, *zhende* presupposes that its prejacent issue is old and some discourse participant has failed to resolve this issue. In the framework of Farkas & Bruce (2010), if one participant has proposed to add a proposition p into the CG and the other participant has refused to accept this proposal, the PS becomes empty because of inconsistent future common grounds. Similarly, if one participant has asked a question and the other participant has failed to resolve it, the PS will also be empty. Therefore, the semantics of *zhende* can be defined as presupposing an empty PS.

Alternative frameworks like Gunlogson (2001) are insufficient in capturing the semantics of *zhende*. Yuan (2015: 53) adopts the public belief (Gunlogson 2001) and defines *zhende* as presupposing that there exists some discourse participant y whose set of public beliefs has no intersection with the prejacent issue $\{\alpha\}$, i.e., $\exists y.\{\alpha\} \cap \mathrm{PB}_y(\mathrm{C}) = \emptyset$. This formal analysis wrongly predicts that C can use *zhende* immediately after A's assertion, before B's assertion in (81). Suppose that A's assertion of p 'It rained last night' updates the initial context and the updated context is C_1, as in (82). In C_1, because B hasn't made any utterance yet, B's set of public beliefs has no intersection with the issue $\{\mathrm{p}\}$. Thus, the presupposition of *zhende* is satisfied and C can use *zhende* in context C_1, which is a wrong prediction. Similarly, if B says something irrelevant after A's assertion, for example, B wasn't paying attention to A's utterance and makes a completely irrelevant remark, B's set of public beliefs also has no intersection with $\{\mathrm{p}\}$. Yuan (2015) would again wrongly predict that the presupposition of *zhende* is satisfied and C is licensed to utter *zhende* in this case.

(81) A: Zuowan xiayu le.
'It rained last night.'
B: Meiyou xiayu.
'It didn't rain.'
C (to B):*Zhende*, zuowan xiayu le.
'Really, it rained last night.'

(82) C_1:

$PB_A(C_1)$	{p, ...}	$PB_B(C_1)$	{...}
$PB_C(C_1)$	{...}	CG(C_1)	{...}
$T(C_1)$:	$T(C_1)[0]$	{p}	PS(C_1):	{CG(C_0) ∪ {p}}
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In contrast, the current formal analysis correctly predicts that C cannot use *zhende* before B's assertion in (81), because the PS in context C_1 is not empty. Similarly, C cannot use *zhende* after B said something irrelevant, because the adding of an irrelevant proposition into the CG in PS will not make the CG inconsistent and hence will not turn the PS to an empty set.[17]

In short, since *dique* and *zhende* contribute to the update of discourse and have constant contributions in both assertions and questions, the current study offers support for Farkas & Bruce's (2010) unified model of discourse structure. Furthermore, Farkas & Bruce (2010) define an assertion as a conversational move, which allows us to formalize how *dique* and *zhende* connect the current conversational move to a prior conversational move. The adoption of the projected set in their framework enables us to characterize the presupposition of *zhende* that its prejacent issue is unresolved.

3.4 Section summary

In this section, we formalized the semantics of *dique* and *zhende* within the stack model of the Table proposed by Farkas & Bruce (2010). *Dique* presupposes that its prejacent issue has been added onto the top of the Table. *Zhende* additionally presupposes that the PS is an empty set. *Dique* and *zhende* modify speech acts and mark specific discourse moves, which supports Farkas & Bruce's (2010) theory of speech acts and discourse moves. Since assertion and question are treated in a uniform fashion in Farkas & Bruce (2010), we can avoid having two definitions of each discourse marker in lexicon. Furthermore, *dique* and *zhende* connect the current and the previous conversational moves, which backs up Farkas & Bruce's (2010) theory where an assertion is defined as a conversational move. The projected set in their framework allows us to capture the unique semantic contribution of *zhende*.

4 Additional evidence: the principle of MAXIMIZE PRESUPPOSITION

Section 3 analyzed *dique* and *zhende* as presupposition triggers, and concluded that *zhende* triggers a more informative presupposition than *dique*. Following the principle of MAXIMIZE PRESUPPOSITION (Heim 1991), this analysis predicts that *zhende* is preferred to *dique* in contexts where the presuppositions of *zhende* are satisfied. This is a correct prediction, which hence provides supporting evidence for our presuppositional analysis.

The principle of MAXIMIZE PRESUPPOSITION (Heim 1991) requires that the speaker choose from a set of competitors the logical form that carries the most informative

[17] The potential of the framework of Farkas & Bruce (2010) is greater than what have been discussed above. Other pieces of work which adopt this model include Farkas (2011) on imperatives, Chernilovskaya (2014) on exclamatives, Müller (2014) on German modal particles, Malamud & Stephenson (2015) on tag questions, etc.

presupposition. For example, (83-a) carries a presupposition that p 'It rained last night' is true, while (83-b) does not carry this presupposition. That is, (83-a) has a more informative presupposition than (83-b). In a context where the presupposition of (83-a) is satisfied, i.e., when p is true, the speaker will choose (83-a) instead of (83-b) in order to be maximally informative.

(83) a. John knows that it rained last night.
b. John thinks that it rained last night.

As discussed in Section 2 and 3, the presupposition of *dique*, that p has been suggested and all the participants recognize that they know about this suggestion, is one of the presuppositions of *zhende*. That is, *zhende* triggers a more informative presupposition than *dique*. This predicts that *zhende* will be preferred to *dique* when the presuppositions of *zhende* are met. For example, in (84), the presuppositions of *zhende* are satisfied: the proposition p 'It rained last night' has been suggested by A and some participant, i.e., B, was uncommitted to p. The principle of MAXIMIZE PRESUPPOSITION predicts that B is preferred to B′. This turns out to be a correct prediction. We presented (84) to ten Mandarin native speakers and asked them which one, B or B′, they would use. Nine participants chose B, while only one participant chose B′.

(84) A: *Zuowan xiayu le*.
'It rained last night.'
(B is not sure. He opens the window and sees that the ground is wet.)
B: *Zhende*, xiayu le.
'Really, it rained.'
B′: *Dique*, xiayu le.
'Indeed, it rained.'

Similarly, native speakers choose to use *zhende* in examples like (85) in order to maximize presupposition. The use of *dique* is unacceptable here.

(85) Context: Mr. Li and Mrs. Li just had a meeting with their son Xiaoli's teacher. The couple are talking with Xiaoli:
Mr. Li: Shang zhouwu ni qu nali le?
'Where did you go last Friday?'
Xiaoli: Wo zai xuexiao.
'I was at school.'
Mrs. Li: Women zhidao ni bu zai. *Zhende*, ni qu nali le?
'We know that you were not. Really, where did you go?'
Mrs. Li': # Women zhidao ni bu zai. *Dique*, ni qu nali le?
'We know that you were not. Indeed, where did you go?'

Native speakers' clear preference for *zhende* in (84) and (85) shows that the use of *zhende* is preferred to *dique* when the presuppositions of *zhende* are satisfied. This supports our analysis of these two words as presupposition triggers.

5 Conclusion

Human languages adopt various discourse markers to mark the relationship between the utterance and the context. In this study, we have seen that *dique* and *zhende* in Mandarin

mark different relationships between the utterance containing them and the previous discourse. *Dique* marks its prejacent issue as old, while *zhende* marks this issue as old and not resolved. These relationships between the utterance and the context are also marked in other languages. For example, English *indeed* marks the information as old (Zeevat, 2003: 102) and English *man* at sentence-final position marks the information as unresolved (McCready, 2008: 706). As pointed out by Zeevat (2003: 103), it is in the speaker's interest to use discourse markers. Without discourse markers, the hearer would not have obvious clues as how to interpret the current utterance with respect to the discourse context, hence the speaker would be misunderstood. For example, if the speaker did not use *dique* to mark the old issue, his utterance might be misunderstood as a new issue. Discourse markers convey information about the previous discourse, and this semantic property is captured by the presuppositional analysis presented in this study.

On the basis of a naturalness rating experiment, we showed that *dique* presupposes that its prejacent issue has been added onto the top of the Table. Therefore, assertions and questions containing *dique* always indicate a reiteration of the old issue. In contrast, *zhende* presupposes that its prejacent issue has been added onto the top of the Table but some participant has failed to resolve this issue. Therefore, assertions and questions containing *zhende* emphasize that the participant should resolve the issue and remove it from the Table.

Our study also shows that in order to analyze discourse markers, we need a framework that models how speech acts update the context, since discourse markers contribute to these updates. Furthermore, *dique* and *zhende* mark the same discourse effect whether they modify assertions or questions. Therefore, the study of *dique* and *zhende* supports Farkas & Bruce's (2010) framework, which models the context-change effects of various speech acts and unifies the effect of assertions and questions.

Acknowledgements We are sincerely grateful to the editors and three anonymous reviewers whose feedback on earlier versions has tremendously helped improve this paper. Special thanks are also due to Satoshi Tomioka and Stefan Kaufmann, who introduced us to Farkas & Bruce's (2010) framework. We are also grateful to Christopher Davis, Michael Yoshitaka Erlewine, Magdalena Kaufmann, Paul S. Law, Po Lun Lee Peppina, E. McCready, Haihua Pan, Kyle Rawlins, Uli Sauerland and Grégoire Winterstein for their constructive criticism and valuable comments. This research was supported by the Fundamental Research Funds for the Central Universities (Grant number 17JNQN007) awarded to Mengxi Yuan and JSPS KAKENHI (C) Grant Number 18K00589 awarded to Yurie Hara.

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Appendix: Adverbs at sentence-initial and VP-initial positions

A difference between sentence-initial and VP-initial *dique*/*zhende* is that VP-initial adverbs can be embedded but the sentence-initial ones cannot:

(86) a. *Zhang xiangxin [*dique*/*zhende*, Li chuguo le].
Zhang believe indeed/really Li go-abroad PERF
'Zhang believes that indeed/really Li went abroad.'
b. Zhang xiangxin [Li *dique*/*zhende* chuguo le].
Zhang believe Li indeed/really go-abroad PERF
'Zhang believes that Li indeed/really went abroad.'

In this paper, a sentence-initial adverb is defined as a sentential force modifier, which takes a force head as its argument. This correctly predicts that sentence-initial adverbs cannot be embedded, as clauses indicating sentential forces cannot be embedded in Mandarin. As pointed out by Han (1998), there are many languages in which embedded clauses cannot express force. This is indeed the case in Mandarin. Mandarin clauses marked as questions or commands cannot be embedded. When it appears that these clauses are embedded, they are in fact direct quotations. For example, *ni xihuan wo ma* in (87) is a direct quotation of the question 'Do you like me' uttered by Li, and *ni lai wo jia ba* in (88) is a direct quotation of the command 'Come to my home' uttered by Li.

(87) Li wen [ni xihuan wo ma]
Li ask you like me Q
Li asks: 'Do you like me?' ('me' = Li)
Li asks if you like me. ('me' = the speaker of the whole sentence)

(88) Li yaoqiu [ni lai wo jia ba]
Li request you come my home BA
Li requests: '(You) come to my home!' ('my home' = Li's home)

In contrast, VP-initial *dique* can be defined as a propositional modifier, which can be embedded:

(89) $\lambda\alpha.\alpha_{\langle \mathrm{T(C)}[0]=\{\alpha\}\rangle}$, and α is of type $\langle s,t\rangle$

The different denotations correctly predict that sentence-initial *dique* can occur in a *wh*-question, whereas VP-initial *dique* cannot, as in (90). According to (89), VP-initial *dique* must take a single proposition of type $\langle s,t\rangle$ as an argument. Semantically, *wh*-questions are composed of a set of propositions (of type $\langle\langle s,t\rangle,t\rangle$) and a force head. Therefore, VP-initial *dique* is not compatible with *wh*-questions, and hence (90-b) is ungrammatical. In contrast, sentence-initial *dique* can take a set of propositions as its argument, and thus (90-a)

is grammatical. See Yuan (2015) for the detailed discussions on the differences between sentence-initial and VP-initial *dique*/*zhende*.

(90) a. *Dique*, ni qu nali le?
indeed you go where PERF
'Indeed, where did you go?'
b. *Ni *dique* qu nali le?
you indeed go where PERF
Literally: 'You indeed went where?'