

The Semantics of Mandarin Assertion Modifiers *Dique* and *Zhende*

Mengxi YUAN — *City University of Hong Kong*

Yurie HARA — *City University of Hong Kong*

Abstract. This study provides an account of the behaviors of *dique* ‘indeed’ and *zhende* ‘really’ in assertions within the framework of dynamic semantics. We argue that *dique* and *zhende* are assertion modifiers, which modify the context change potential by adding presuppositions to the assertions. *Dique* adds to the assertion of p a presupposition that the proposition p has been suggested in the common ground. *Zhende* adds to the assertion of p another presupposition that at least one discourse participant remains uncommitted to the proposition p even after recognizing that p has been suggested in the common ground.

1. Introduction

This paper discusses the semantics of two Mandarin adverbs *dique* ‘indeed’ and *zhende* ‘really’. Typical examples of an assertion containing *dique* or *zhende* are given in (1-a) and (1-b).

- (1) a. *Dique*, Li chuguo le.
indeed Li go-abroad PERF
‘Indeed, Li went abroad.’
b. *Zhende*, Li chuguo le.
really Li go-abroad PERF
‘Really, Li went abroad.’

The presence of *dique* or *zhende* does not affect the truth conditions of the assertions in which *dique* or *zhende* occurs. (2) is true if and only if Li went abroad, so are (1-a) and (1-b).

- (2) Li chuguo le.
Li go-abroad PERF
‘Li went abroad.’

The function of *dique* and *zhende* in an assertion is to modify the assertion by contributing to the presuppositional content of the assertion. Let us illustrate with (1-a) and (1-b).

First, let us take a look at *dique*. (1-a) has the same truth-conditions as (2). However, unlike (2), the use of (1-a) requires that someone has mentioned ‘Li went abroad’ before the utterance of (1-a). The meaning of *dique* is not integrated into the assertion. Rather, *dique* modifies the assertion in a way so that the modified assertion requires that the proposition to which *dique* attaches has been mentioned in the previous discourse. A bare assertion like (2) does not have such a requirement.

Like *dique*, *zhende* serves to modify the assertion. (1-b) implies that ‘Li went abroad’ has been mentioned in the previous context, and the speaker states this again since someone did not quite believe ‘Li went abroad’. The assertion modified by *zhende* not only requires that the proposition to which *zhende* attaches has been mentioned in the prior context, but also requires that some discourse participant did not believe that proposition in the prior context. This indicates that *dique* and *zhende*, both as assertion modifiers, modify the assertion in different ways.

Xu (2009) claims that *dique* and *zhende* both function as a confirmation of old information and are thus interchangeable. Xu’s (2009) analysis fails to explain the difference between *dique* and *zhende* in examples like (3). In (3), since A has asserted *p* ‘It rained last night’, *p* is old information to B. According to Xu’s (2009) claim, B could use either *dique* or *zhende* to confirm this old information. However, it is infelicitous for B to use *zhende* to confirm *p*, indicating that there must be some differences between *dique* and *zhende*.

- (3) A: Zuowan xiayu le.
 last-night rain PERF
 ‘It rained last night.’
 (B heard the sound of raining last night and he knows that it rained.)
 B: *Dique*/#*Zhende* xiayu le.
 indeed/really rain PERF
 ‘It indeed rained.’/#‘It really rained.’

Our analysis in this paper explains the differences between *dique* and *zhende* in (3) and the differences between (1) and (2). Examining the semantics of *dique* and *zhende* in a dynamic semantics framework, we argue that *dique* and *zhende*, as assertion modifiers, contribute to the presuppositional content of the assertions they attach to by modifying the context change potential (CCP, a function taking in a context and returning an updated one, see Heim, 1982). *Dique* and *zhende* differ from each other in the content of the presupposition, resulting in their different behaviors in (3) and the differences between (1) and (2).

This paper is structured as follows: in section 2, we informally characterize the properties of *dique* and *zhende* in assertions, showing that these two adverbs impose different presuppositions on the previous discourse; in section 3, we present the formal definitions of *dique* and *zhende* within a dynamic semantics framework. In forming the formal definitions, we adopt the binary presupposition operator ‘ $\langle \rangle$ ’ in Beaver and Kraemer (2001) to characterize the presuppositions added to the assertion by *dique/zhende*. Section 4 gives a conclusion to this study.

2. The behaviors of *dique* and *zhende* in assertions

This section provides the informal characterization of *dique* and *zhende* in assertions. On the basis of empirical data, we show that *dique* and *zhende* add different presuppositions to the assertions.

2.1. *Dique* in assertions

The combination of the adverb *dique* with a proposition can be represented as *dique(p)*. *Dique(p)* imposes the following two requirements on the previous context:

- (4) The requirements of *dique(p)* on the previous context:
- a. The proposition *p* has been suggested by some individual *x*.
 - b. All of the discourse participants believe that '*p* has been suggested' and recognize that they share this belief.

Let us illustrate these two requirements with examples. First, (4-a) indicates that the proposition *p* to which *dique* attaches must be old information. *Dique* cannot be used in an out-of-the-blue context. For example, one cannot start a conversation with an assertion modified by *dique* such as *Li dique chuguo le* 'Li indeed went abroad'. For *dique* to be felicitous, the context must be one where 'Li went abroad' has already been suggested by some individual *x* in the prior context, as in (5).¹ By using an assertion modified by *dique*, B agrees with A's statement and confirms the old information 'Li went abroad'. Without A's utterance, B's use of *dique* would be infelicitous.

- (5) A: Li chuguo le.
Li go-abroad PERF
'Li went abroad.'
- B: Ta *dique* chuguo le.
he indeed go-abroad PERF
'He indeed went abroad.'

We can see the requirement (4-a) from another example. In (6), Li uses an assertion modified by *dique* at the beginning of a conversation. Li's utterance indicates that someone must have predicted the rain on 1st June some time before 1st June. In other words, the proposition 'It rains on 1st June' 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 the weather reporter). If no one had predicted that it would rain on 1st June, Li's use of *dique* would be infelicitous.

- (6) Context: On 1st June, waking up in the morning, Li looks outside and says to his wife:
Li: *Dique* xiayu le.
indeed rain PERF
'It indeed rains.'

¹*Dique* and *zhende* can occur in sentence-initial position (e.g., (1)) or occur before the verb (e.g., (5B)). *Dique(p)* or *zhende(p)* imposes the same requirements on the previous context in these two positions.

In some cases, it appears that *dique* can be used without the proposition *p* overtly mentioned in the previous context. For example, (7) can be used as the very first utterance of a lecture about the relationship between parents and children. In fact, the proposition *p* ‘Parents all love their children’ has still been suggested in the previous context. The proposition *p* is supposed to be known by all discourse participants by their world knowledge and common sense. Therefore, *p* is also old information, which renders the use of *dique* felicitous.

- (7) *Dique*, fumu dou ai tamen de haizi.
indeed parents all love they GEN children
‘Indeed, parents all love their children.’

In (4-a), ‘*p* has been suggested by *x*’ means that the individual *x* indicates that *x* is biased towards *p*. If *x* is not biased towards *p* in the previous discourse, *dique* cannot be used. For instance, if A’s utterance in (5) was ‘Li didn’t go abroad’ (A is committed to $\neg p$) or ‘Did Li go abroad?’ (A is unbiased), as in (8), the use of *dique* would be infelicitous, since *p* ‘Li went abroad’ has not been suggested.

- (8) A: Li mei chuguo. / Li chuguo le ma?
Li not go-abroad / Li go-abroad PERF Q
‘Li didn’t go abroad.’ / ‘Did Li go abroad?’
B: #Ta *dique* chuguo le.
he indeed go-abroad PERF
‘#He indeed went abroad.’

The first requirement of *dique(p)* (4-a) is also motivated by the fact that *dique* can occur in answers to biased polar questions, but not in answers to unbiased polar questions. Among various types of questions in Mandarin Chinese, *ba* questions (marked by the particle *ba* in sentence-final position) and *shi bu shi* questions (with *shi bu shi* ‘be not be’ located in front of the predicate) are compatible with answers containing *dique*, as in (9) and (10).

- (9) A: Ta xihuan tian shi ba?
he like sweet food Q
‘Does he like sweet food? (I suppose he does)’
B: Ta *dique* xihuan.
he indeed like
‘He likes indeed.’
- (10) 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: Ta *dique* xihuan.
he indeed like
‘He likes indeed.’

Ba questions (Li and Thompson, 1981, 309-310; Liu et al., 2004, 788) and *shi bu shi* questions (Liu et al., 2004, 792) are considered requests for confirmation, where the speaker is biased towards the affirmative answer. *Dique* is felicitous in answers to these questions because the first requirement of *dique(p)* is met: the proposition *p* (i.e., the affirmative answer) has been suggested by someone (i.e., the questioner) in the previous context.

Other types of questions in Mandarin, such as A-not-A questions (disjunctive questions consisting of an affirmative question and its negative counterpart) can only be used in a neutral context and indicate no bias (Li and Thompson, 1981, 550).² *Dique* is banned in answers to A-not-A questions, since the questioner is not biased toward the affirmative answer *p*, as in (11).

- (11) A: Ta xi bu xihuan tian shi?
 he like not like sweet food
 ‘Does he like sweet food?’
 B: #Ta *dique* xihuan.
 he indeed like
 ‘#He likes indeed.’

The second requirement of *dique(p)* is that all of the discourse participants believe that the proposition *p* has been suggested and they all recognize that they share this belief. For example, B’s use of *dique* in (5) not only implies that *p* ‘Li went abroad’ has been suggested by someone, but also indicates that B is aware of this suggestion of *p*. If A uttered *Li chuguo le* ‘Li went abroad’ but B does not recognize that A did so, B’s use of *dique* will also be infelicitous.

Similarly, in (6), Li and his wife both believe that *p* ‘It rains on 1st June’ has been suggested, and they both recognize that they share this belief. If the speaker Li is not aware of the suggestion of *p*, or if Li does not believe that his wife believes that *p* has been suggested, Li’s use of *dique* will be infelicitous. In the above two cases, *p* ‘It rains on 1st June’ 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 (new to Li himself or new to his wife).

(12) is another example which shows the second requirement of *dique(p)*. If a lecturer begins a lecture by (12), and his audience consists of children who never know that light travels faster than sound, the use of *dique* is not appropriate. This is because the addressees, i.e., the children, do not believe *p* ‘Light travels faster than sound’ before the lecture. Therefore, not all discourse participants believe that *p* has been suggested, i.e., the second requirement is not met. The lecturer wrongly assumed that *p* was old information to the children, i.e., *p* was their common belief.

²According to Li and Thompson (1981, 550), *ma* questions (marked by *ma* in sentence-final position) can be used in neutral or nonneutral contexts. When used in neutral contexts, *ma* questions also indicate no bias. As we correctly predict, *dique* cannot be used in the answers to *ma* questions that are used in neutral contexts.

- (12) *Dique*, guang de sudu bi shengyin kuai.
indeed light GEN speed COMP sound fast
'Indeed, light travels faster than sound.'

In summary, *dique(p)* has two requirements on the prior context, as in (4), repeated here as (13).

- (13) The requirements of *dique(p)* on the previous context:
- a. The proposition p has been suggested by some individual x .
 - b. All of the discourse participants believe that ' p has been suggested' and recognize that they share this belief.

2.2. *Zhende* in assertions

Zhende(p) imposes the following three requirements on the previous discourse:

- (14) The requirements of *zhende(p)* on the previous context:
- a. The proposition p has been suggested by some individual x .
 - b. All of the discourse participants believe that ' p has been suggested' and recognize that they share this belief.
 - c. At least one discourse participant y remains uncommitted to p even after knowing that p has been suggested.

As can be seen, the first two requirements of *zhende(p)* are the same as the two requirements of *dique(p)* in (13), while the third requirement of *zhende(p)* is unique and not shared by *dique(p)*.

First, let us illustrate the first two requirements of *zhende(p)* that are shared by *dique(p)*. Like *dique(p)*, *zhende(p)* requires that p has been suggested by some individual in the prior context and all discourse participants recognize that ' p has been suggested' is their shared belief. This requirement is motivated by the fact that it is unacceptable to start a dialogue with *Zuowan zhende xiayule* 'It really rained last night', unless the proposition p 'It rained last night' has been suggested in the prior context, as in (15). Here, A is the suggester x .

- (15) 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: Zuowan *zhende* xiayu le.
 last-night really rain PERF
 ‘It really rained last night.’

If no one suggested p (the first requirement of *zhende*(p) is not met) or if B did not recognize that A suggested p (the second requirement of *zhende*(p) is not met), it would be infelicitous to use *zhende*, as in (16). In (16), ‘It rained last night’ is new information to B and should be expressed using an assertion ‘It rained last night’ without *zhende*.

- (16) Context: B opens the window in the morning and sees that the ground is wet.
 B: #Zuowan *zhende* xiayu le.
 last-night really rain PERF
 ‘#It really rained last night.’

Another example is (17). Here, the first two requirements of *zhende*(p) are both met, i.e., p ‘It rained last night’ has been suggested by A and other participants both recognize this. B does not believe A’s assertion and asserts $\neg p$, and then C indicates C’s commitment to p .

- (17) A: Zuowan xiayu le.
 last-night rain PERF
 ‘It rained last night.’
 B: Meiyou xiayu. C (to B): *Zhende* xiayu le.
 not rain really rain PERF
 ‘It didn’t rain.’ ‘It really rained.’

C’s use of *zhende* in (17) would be unacceptable if no one had suggested p in the previous context, as in (18), since the first requirement of *zhende*(p) that ‘ p has been suggested’ would not be met. If A suggested p but C is not aware of this suggestion, or if A suggested p but C does not believe that B knows that p has been suggested, C cannot use *zhende* either, as the second requirement of *zhende*(p) is not met.

- (18) B: Zuowan meiyou xiayu. C (to B): #*Zhende* xiayu le.
 last-night not rain really rain PERF
 ‘It didn’t rain last night.’ ‘#It really rained.’

Now, let us look at the third requirement of *zhende(p)*. Besides the requirements shared with *dique(p)*, *zhende(p)* imposes another, unique requirement on the prior context: *zhende(p)* requires that at least one participant *y* remains uncommitted to the proposition *p* even though *y* recognized that *p* has been suggested. The participant identified with *y* is determined by the context.

Recall example (15), where *zhende* was felicitous. In that example, A is the suggester *x* and the speaker B is the participant *y*. Initially, B was not committed to *p* ‘It rained last night’ even though he recognized that A suggested *p*. After checking the evidence, B commits himself to *p* 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 (3), repeated here as (19). This is because all the discourse participants have been committed to *p*, and thus the third requirement of *zhende(p)* is not met.

- (19) A: Zuowan xiayu le.
 last-night rain PERF
 ‘It rained last night.’
 (B heard the sound of raining last night and he knows that it rained.)
 B: #*Zhende* xiayu le.
 really rain PERF
 ‘#It really rained.’

Similarly, in (17), B was not committed to *p* ‘It rained last night’ although A suggested *p*. If B were committed to *p* initially or had committed himself to *p* after hearing A’s suggestion, it would be infelicitous for C to use *zhende*, as in (20).

- (20) A: Zuowan xiayu le
 last-night rain PERF
 ‘It rained last night.’
 B: Shide, xiayu le. C (to B): #*Zhende* xiayu le.
 yes rain PERF really rain PERF
 ‘Yes, it rained.’ ‘# It really rained.’

In summary, *zhende(p)* has three requirements on the prior context, as in (14), repeated as (21).³

³The intensifier *zhende* and the VP modifier *zhende* do not have these requirements. The intensifier *zhende* is used to emotionally emphasize the properties denoted by adjectives, as in *Ta zhende shi ge haoren* ‘He is really a nice person’. The VP modifier *zhende* can occur within the scope of negation, and its meaning is truth-conditional, as in (i-b). The assertion modifier *zhende* is higher than negation operators and does not affect truth conditions, as in (i-a).

- (i) a. *Zhende*, Li mei zou. / Li *zhende* mei zou. b. Li mei *zhende* zou.
 really Li not leave / Li really not leave Li not really leave
 ‘Really, Li didn’t leave.’/‘Li really didn’t leave.’ ‘Li didn’t really leave.’

- (21) The requirements of *zhende*(*p*) on the previous context:
- a. The proposition *p* has been suggested by some individual *x*.
 - b. All the discourse participants believe that ‘*p* has been suggested’ and recognize that they share this belief.
 - c. At least one discourse participant *y* remains uncommitted to *p* even after knowing that *p* has been suggested.

2.3. A comparison between *dique* and *zhende* in assertions

As discussed in sections 2.1 and 2.2, both *dique* and *zhende* add specific presuppositions to the assertions they attach to. The presupposition of *dique* is a proper subset of those of *zhende*.

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*. Thus, *dique* and *zhende* can co-occur in one assertion as long as the presuppositions of *zhende* are true in this assertion. For instance, (22) is a context where the presuppositions of *zhende* are true, and thus both *zhende* and *dique* can be used. (See (15) for the basic version of this example with only *zhende*).

- (22) 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: *Dique*, zuowan *zhende* xiayu le. / *Zhende*, zuowan *dique* xiayu le.
 indeed last-night really rain PERF / really last-night indeed rain PERF
 ‘Indeed, it really rained last night.’ / ‘Really, it indeed rained last night.’

Moreover, all felicitous uses of *zhende* can be replaced by *dique*. For instance, *zhende* in (17) can be replaced by *dique*, as in (23). The difference between (17) and (23) is that (23) would still be a felicitous conversation if B’s utterance were deleted, but (17) will be unacceptable without B’s utterance. This is because the presupposition of *zhende* that at least one participant is uncommitted to *p* is not met if B did not assert $\neg p$.

- (23) A: Zuowan xiayu le.
 last-night rain PERF
 ‘It rained last night.’
 B: Meiyou xiayu.
 not rain
 ‘It didn’t rain.’
 C (to B): *Dique* xiayu le.
 indeed rain PERF
 ‘It indeed rained.’

However, *dique* in felicitous utterances cannot always be replaced by *zhende*. *Dique* can be used in (5), repeated here as (24), whereas *zhende* cannot. This is because the presupposition of *zhende* that at least one participant is uncommitted to the proposition *p* is not met.

- (24) A: Li chuguo le.
 Li go-abroad PERF
 ‘Li went abroad.’
 B: Ta *dique*/*#zhende* chuguo le.
 he indeed/really go-abroad PERF
 ‘He indeed went abroad.’ ‘#He really went abroad.’

To summarize, the presupposition of *dique* is a proper subset of the presuppositions of *zhende*.

2.4. Section summary

In this section, we observed that *dique* adds to the assertion of *p* a presupposition that *p* has been suggested and all the discourse participants recognize that ‘*p* has been suggested’ is their shared belief. *Zhende* adds to the assertion of *p* another presupposition that at least one discourse participant remains uncommitted to *p* even after recognizing that *p* has been suggested. Both *dique* and *zhende* can be used when the presuppositions of *zhende* are satisfied.⁴

3. Formal analysis of *dique* and *zhende*

In this section, we provide the semantic definitions for *dique* and *zhende* within the model of discourse context proposed by Stalnaker (1978), and elaborated by Heim (1982), Gunlogson (2003) and Davis (2009). In the formalization, we adopt the binary presupposition operator *transplication* from Beaver and Krahmer (2001) to characterize the presuppositions added by *dique* or *zhende*.

3.1. A binary presupposition operator

This subsection introduces the presupposition operator ‘ $\langle \rangle$ ’ used by Beaver and Krahmer (2001). We will adopt this operator to characterize the presuppositions triggered by *dique* and *zhende*.

In order to give a partial semantics for presupposition, Beaver and Krahmer (2001) introduce the partial logic of Kleene (1952), which is known as *strong Kleene*. Strong Kleene is a language of

⁴English speakers report that the English adverbs *indeed* and *really* have the same requirements on the previous context as *dique* and *zhende* do. See Zeevat (2002) and Lai (2010) for studies on English *indeed* and *really*.

propositional logic defined over a set of propositional constants \mathbb{P} . In order to analyze presuppositions within strong Kleene, Beaver and Krahmer (2001) add to this language a binary presupposition operator ' $\langle \rangle$ ', which is called *transplication*.⁵

(25) DEFINITION

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

In (25), π is an elementary presupposition of ϕ . Elementary presuppositions are presuppositions that are triggered in the lexicon. For example, the verb *regret* triggers an elementary presupposition that the proposition which is regretted is true. Thus, (26) can be represented by a formula $q_{\langle p \rangle}$, where p represents the proposition that Mary is sad, and q is the proposition that Bill regrets that Mary is sad.

(26) Bill regrets that Mary is sad. (Beaver and Krahmer, 2001, 150)

Beaver and Krahmer (2001) provide the formal definition for this strong Kleene propositional logic with transplication in (27).

(27) DEFINITION (Strong Kleene Propositional Logic with transplication)

Let $V: \mathbb{P} \rightarrow \{\text{T}, \text{F}\}$ be some valuation function.

Define $\llbracket \phi \rrbracket_V$ (the interpretation of ϕ under V):

1. $\llbracket p \rrbracket_V = V(p)$, iff $p \in \mathbb{P}$
 2. $\llbracket \neg \phi \rrbracket_V = \neg \llbracket \phi \rrbracket_V$
 3. $\llbracket \phi \wedge \psi \rrbracket_V = \llbracket \phi \rrbracket_V \cap \llbracket \psi \rrbracket_V$
 4. $\llbracket \phi_{\langle \pi \rangle} \rrbracket_V = \text{T}$, iff $\llbracket \pi \rrbracket_V = \text{T}$ and $\llbracket \phi \rrbracket_V = \text{T}$. $\llbracket \phi_{\langle \pi \rangle} \rrbracket_V = \text{F}$, iff $\llbracket \pi \rrbracket_V = \text{T}$ and $\llbracket \phi \rrbracket_V = \text{F}$.
- (modified from Beaver and Krahmer, 2001, 152)

Next, Beaver and Krahmer (2001) specify when a formula presupposes some formula, as shown by the definition in (28). (28) says that if the presupposition is not true, the sentence which carries this presupposition does not have a defined value (i.e., it is neither true nor false).

(28) DEFINITION (Presuppose)

ϕ presupposes π iff whenever π is not True, ϕ is Neither true nor false. (Beaver and Krahmer, 2001, 152)

⁵The name *transplication* was first used by Blamey (1986). Blamey (1986) uses π/ϕ as notation for transplication.

We will use transpication to analyze *dique* and *zhende*. Like a sentence with *regret*, an assertion modified by *dique* or *zhende* expresses two meanings: 1) the content of the assertion; 2) the presupposition added by *dique* or *zhende*. Take (29) as an example.

- (29) *Dique*, Li chuguo le. ('Indeed, Li went abroad.')
- a. Assertion: Li went abroad.
 - b. Presupposition: 'Li went abroad' has been suggested before.

In the next two subsections, we will use transpication to characterize the two dimensions of the meaning of an assertion modified by *dique* or *zhende*.

3.2. Formal definition of *dique*

As discussed in section 2.1, *dique*(p) imposes two requirements on the previous context.

First, *dique*(p) requires that the proposition p has been suggested by some individual x . Here, ' p is suggested by x ' means that x indicates that x is biased towards p . Following Potts (2007), we define the epistemic state of the individual x by a subjective probability distribution P_x . Now, ' x is biased towards p ' is formalized as ' $P_x(p) > 0.5$ ', as shown in (30). Similarly, ' x is committed to p ' is represented as ' $P_x(p) = 1$ ', ' x is unbiased' is reflected as ' $P_x(p) = 0.5$ ', ' x is biased against p ' is represented as ' $P_x(p) < 0.5$ ', etc.

- (30) x is biased towards p , i.e., $\text{biased}(p)(x)$ iff $P_x(p) > 0.5$.
 $x \in I(C)$, where $I(C)$ returns the set of individuals in the domain of discourse in context C ;
 $P_x(p)$ is a probability distribution modeling x 's degree of belief in p .

Second, *dique*(p) requires that all discourse participants believe that p has been suggested and they recognize that they share this belief. This requirement can be formalized based on the concepts of 'the Common Ground' (Stalnaker, 1978) and 'public belief' (Gunlogson, 2003). Stalnaker (1978) interprets the Common Ground (hereafter, the CG) as a set of worlds which represent all the mutual beliefs of the discourse participants in the discourse. In Gunlogson's (2003) model, each discourse participant is associated with a set of propositions that can be taken as their public beliefs (PB), and the CG is taken to be the intersection of the public beliefs of the discourse participants in that context. The public belief is defined in (31).

- (31) Let PB_A and PB_B be sets of propositions representing the public beliefs of A and B, respectively, with respect to a discourse in which A and B are the participants, where:
- a. p is a public belief of A iff ‘A believes p ’ is a mutual belief of A and B
 - b. p is a public belief of B iff ‘B believes p ’ is a mutual belief of A and B
- (Gunlogson, 2003, 42)

Davis (2009) adopts the definition of public belief. Following Davis (2009), we use ‘ $PB_X(C)$ ’ to represent the set which contains the public beliefs of discourse participant X in discourse context C. The CG is then defined as the intersection of the public beliefs of every discourse participant in a context C: $CG(C)$ (abbreviation of $CG_{\{A,B\}}(C)$) = $PB_A(C) \cap PB_B(C)$.

Therefore, the second requirement of *dique*(p) says that ‘ x is biased towards p ’ is the public belief of all participants, i.e., we restate this as proposition ‘ x is biased towards p ’ being in the CG.

When the two requirements of *dique* are met, the assertion modified by *dique* will function just like a bare assertion. Following Gunlogson (2003), we interpret an assertion of p as an update of the speaker’s public beliefs with p , as shown by the definition in (32). In (32), ASSERT stands for the assertive operator (Ross, 1970; Jacobs, 1984) which is construed as a function taking in a propositional argument and returning a CCP. ‘+’ is the update function which adds a proposition to a subpart of a discourse context. Thus, $PB_X(C) + p$ is a context that resembles C in every respect, except that $PB_X(C) + p$ additionally contains the proposition p .

- (32) CCP of assertions:
 $\llbracket \text{ASSERT} \rrbracket = \lambda p. \lambda C. PB_{\text{spkr}}(C) + p$ (Davis, 2009, 335)

Using transplication, the semantics of *dique* is defined intensionally as (33) on the basis of (30):⁶

- (33) $\llbracket \text{dique} \rrbracket = \lambda p. \lambda F. \lambda C. F(p)(C)_{((\exists x. \text{biased}(p)(x)) \in CG(C))}$

The semantics of *dique* consists of two parts. The first part $\lambda p. \lambda F. \lambda C. F(p)(C)$ says that the combination of *dique* with a proposition p and a force head F denotes what $F(p)$ denotes. If *dique* combines with a certain proposition p and ASSERT, the resulting formula will be $\lambda C. PB_{\text{spkr}}(C) + p$. 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 .

The second part is the formula within the angle bracket, i.e., $(\exists x. \text{biased}(p)(x)) \in CG(C)$. This

⁶In (33), F is a variable over force heads, of type $\langle\langle s, t \rangle, \langle c, c \rangle\rangle$, where c represents context type. The assertion modifier *dique* is of type $\langle\langle s, t \rangle, \langle\langle s, t \rangle, \langle c, c \rangle\rangle, \langle c, c \rangle\rangle$.

says that the combination of *dique* with a proposition p and a force head (e.g., ASSERT) requires that the input context C must be one where p has been suggested in the CG.

According to (33), $dique(p)$ combines with ASSERT to form an assertion modified by *dique*. As summarized in (34), the semantics of an assertion modified by *dique* consists of two parts: 1) $\lambda C.PB_{\text{spkr}}(C) + p$, a CCP of type $\langle c, c \rangle$, which denotes the meaning of the assertion; 2) $(\exists x.\text{biased}(p)(x)) \in CG(C)$, which formalizes the presupposition added by *dique*. The formula $dique(p)(\text{ASSERT})$ is true just in case that: 1) p has been suggested in the CG; 2) the speaker updates his public beliefs with p . If the presupposition is not true, $dique(p)(\text{ASSERT})$ is undefined.

- (34) $\llbracket \text{dique}(p)(\text{ASSERT}) \rrbracket = \lambda C.PB_{\text{spkr}}(C) + P_{((\exists x.\text{biased}(p)(x)) \in CG(C))}$
- a. Assertion: $PB_{\text{spkr}}(C) + p$
 - b. Presupposition: $(\exists x.\text{biased}(p)(x)) \in CG(C)$

By this definition, we can see that *dique*, as an assertion modifier, modifies the CCP by restricting the input context to be the one where p has been suggested.

Let us illustrate the use of *dique* with (5). By using an assertion modified by *dique*, B updates PB_B with p ‘Li went abroad’, showing his agreement with A, who suggested p ‘Li went abroad’ in the previous discourse $((\text{biased}(p)(A)) \in CG(C))$. In (6), Li adds p ‘It rains on 1st June’ into PB_{Li} by uttering an assertion modified by *dique*, indicating his agreement with the individual x who suggested p in the previous context $((\text{biased}(p)(x)) \in CG(C))$.

The CCP of a bare assertion can be represented by (35), where the CG is a set of propositions and the assertion of p adds to the CG of the output context a proposition ‘the speaker asserts p ’.

- (35) CCP of a bare assertion:
- | | | |
|----------------|---|------------------------------------|
| Input context: | → | Output context: |
| CG={...} | | CG={..., the speaker asserts p } |

The CCP of an assertion modified by *dique* is shown in (36). An assertion modified by *dique* adds the same proposition to the CG of the output context that ‘the speaker asserts p ’, and also restricts the input context to be one where ‘ p is suggested by some individual x ’ exists in the CG.

- (36) CCP of an assertion modified by *dique*:
- | | | |
|------------------------------------|---|--|
| Input context: | → | Output context: |
| CG={..., p is suggested by x } | | CG={..., p is suggested by x , the speaker asserts p } |

3.3. Formal definition of *zhende*

Zhende(p) requires that at least one discourse participant y remains uncommitted to the proposition p even after recognizing that p has been suggested by some individual x in the previous context. The semantics of *zhende* is defined on the basis of (30) as follows:⁷

$$(37) \quad \llbracket zhende \rrbracket = \lambda p. \lambda F. \lambda C. F(p)(C)_{((\exists x. \text{biased}(p)(x)) \in \text{CG}(C)) \wedge (\exists y. p \notin \text{PB}_y(C))}$$

The semantics of *zhende* consists of two parts. The first part $\lambda p. \lambda F. \lambda C. F(p)(C)$ means that the combination of *zhende* with a proposition p and a force head F denotes what $F(p)$ denotes. If *zhende* combines with a certain proposition p and ASSERT, the resulting formula $\lambda C. \text{PB}_{\text{spkr}}(C) + p$ says that an assertion modified by *zhende* denotes an update of the speaker's public beliefs with p .

The second part is the formula inside the angle bracket, i.e., $((\exists x. \text{biased}(p)(x)) \in \text{CG}(C)) \wedge (\exists y. p \notin \text{PB}_y(C))$. This says that the combination of *zhende* with a proposition p and a force head imposes two restrictions on the input context C : first, the input context should be one where p has been suggested in the CG $((\exists x. \text{biased}(p)(x)) \in \text{CG}(C))$; second, there exists at least one participant y , who does not have p in his public beliefs. $(\exists y. p \notin \text{PB}_y(C))$.

Formally, *zhende*(p) combines with the force head ASSERT to give an assertion modified by *zhende*. As shown in (38), the semantics of this modified assertion is composed of two parts: 1) $\lambda C. \text{PB}_{\text{spkr}}(C) + p$, a CCP of type $\langle c, c \rangle$, which denotes the meaning of the assertion; 2) $((\exists x. \text{biased}(p)(x)) \in \text{CG}(C)) \wedge (\exists y. p \notin \text{PB}_y(C))$, which formalizes the presupposition introduced by *zhende*.

$$(38) \quad \llbracket zhende(p)(\text{ASSERT}) \rrbracket = \lambda C. \text{PB}_{\text{spkr}}(C) + p_{((\exists x. \text{biased}(p)(x)) \in \text{CG}(C)) \wedge (\exists y. p \notin \text{PB}_y(C))}$$

- a. Assertion: $\text{PB}_{\text{spkr}}(C) + p$
- b. Presupposition: $((\exists x. \text{biased}(p)(x)) \in \text{CG}(C)) \wedge (\exists y. p \notin \text{PB}_y(C))$

By this definition, we see that *zhende*, as an assertion modifier, modifies the CCP by restricting the input context to be one in which p has been suggested and not all participants have been committed to p .

Let us illustrate this definition with two examples. In (15), repeated here as (39), B's use of the assertion modified by *zhende* presupposes that someone — here, B himself — is uncommitted to p 'It rained last night' ($p \notin \text{PB}_B(C)$) even though he is aware that A suggested p ($((\text{biased}(p)(A)) \in \text{CG}(C))$). B's assertion modified by *zhende* denotes that he is now committing himself to p .

⁷Like *dique*, *zhende* is of type $\langle \langle s, t \rangle, \langle \langle \langle s, t \rangle, \langle c, c \rangle \rangle, \langle c, c \rangle \rangle \rangle$.

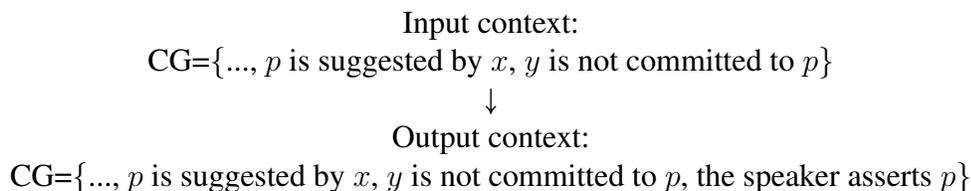
- (39) A: Zuowan xiayu le.
 last-night rain PERF
 ‘It rained last night.’
 (B is not sure. He opens the window and sees that the ground is wet.)
 B: Zuowan zhende xiayu le.
 last-night really rain PERF
 ‘It really rained last night.’

In (17), repeated below as (40), the speaker C’s use of the assertion modified by *zhende* presupposes that one discourse participant, i.e., B, remains uncommitted to p ‘It rained last night’ ($(p \notin \text{PB}_B(C))$) even after recognizing that A suggested p ($(\text{biased}(p)(A)) \in \text{CG}(C)$), and encodes C’s commitment to p . The utterance results in the indication of C’s agreement with the suggester A and disagreement with the participant B.

- (40) A: Zuowan xiayu le.
 last-night rain PERF
 ‘It rained last night.’
 B: Meiyou xiayu. C (to B): *Zhende* xiayu le.
 not rain really rain PERF
 ‘It didn’t rain.’ ‘It really rained.’

The CCP of an assertion modified by *zhende* is depicted in (41). The utterance of *zhende*(p) requires that the input context be one where ‘ p is suggested by x ’ and ‘ y is not committed to p ’ exist in the CG, and also adds to the CG of the output context the proposition ‘the speaker asserts p ’.

- (41) CCP of an assertion modified by *zhende*:



If the participant y is the speaker who uses *zhende*, y has changed his mind and has decided to commit himself to p although he was uncommitted to p initially. Thus, when ‘ y asserts p ’ is added into the CG of the output context, ‘ y is not committed to p ’ must be deleted from the CG of the output context. For example, in example (39), B was not committed to p ‘It rained last night’ initially, i.e., ‘B is not committed to p ’ exists in the CG of the input context. However, B has changed his mind and now commits himself to p . In the output context, if ‘B is not committed

to p ' is not deleted from the CG before 'B asserts p ' is added into the CG, B's belief state will be contradictory, i.e., B is not committed to p but asserts p . Therefore, 'B is not committed to p ' should be deleted before 'B asserts p ' is added into the CG of the output context.

3.4. Section summary

In this section, we adopted a presupposition operator to provide formal definitions for *dique* and *zhende* within the dynamic semantics framework. As an assertion modifier, *dique* imposes a restriction on the domain of the CCP, that the proposition p to which *dique* attaches has been suggested by some individual in the CG, while *zhende* additionally places a restriction on the domain of the CCP, that at least one discourse participant remains uncommitted to the proposition p .

4. Conclusion

The Mandarin adverbs *dique* and *zhende* are assertion modifiers, which modify the CCP by contributing to the presuppositional content of the assertions.

A bare assertion of p encodes an update of the speaker's set of public beliefs with p . If the assertion is modified by *dique*, it presupposes that p has been suggested in the CG; if the assertion is modified by *zhende*, it presupposes that at least one discourse participant remains uncommitted to p even after recognizing that p has been suggested.

As assertion modifiers, both *dique* and *zhende* connect the assertion p with the previous discourse by marking p as old and suggested information. However, *zhende* also marks p as challenged by some discourse participant. Therefore, assertions modified by *dique* generally work as a confirmation of old information, while assertions modified by *zhende* function as a defense for old information against opposing beliefs.

References

- Beaver, D. and E. Kraemer (2001). A partial account of presupposition projection. *Journal of Logic, Language and Information* 10, 147–182.
- Blamey, S. (1986). Partial logic. In D. Gabbay and F. Guentner (Eds.), *Handbook of Philosophical Logic*, Volume 3, pp. 1–70. Dordrecht: Reidel.
- Davis, C. (2009). Decisions, dynamics, and the Japanese particle *yo*. *Journal of Semantics* 26, 329–366.
- Gunlogson, C. (2003). *True to form: Rising and falling declaratives as questions in English*. New York: Routledge.

- Heim, I. (1982). *The semantics of definite and indefinite noun phrases*. Ph. D. thesis, University of Massachusetts, Amherst.
- Jacobs, J. (1984). Funktionale satzperspektive und illokutionssemantik. *Linguistische Berichte* 91, 25–58.
- Kleene, S. (1952). *Introduction to Metamathematics*. Amsterdam: North-Holland.
- Lai, C. (2010). What do *really* really mean?: Evidence, standards and probability in dialogue. Philadelphia. NELS 41.
- Li, C. N. and S. A. Thompson (1981). *Mandarin Chinese: A Functional Reference Grammar*. Berkeley: University of California Press.
- Liu, Y., W. Pan, and W. Gu (2004). *Practical Modern Chinese Grammar*. Beijing: Commercial press. Revised edition.
- Potts, C. (2007). Logic for linguists. Course for LSA institute. Retrieved from <http://www.christopherpotts.net/ling/teaching/lisa108P/>.
- Ross, J. R. (1970). On declarative sentences. In R.A.Jacobs and P.S.Rosenbaum (Eds.), *Readings in English transformational grammar*, pp. 222–272. Washington: Georgetown University Press.
- Stalnaker, R. (1978). Assertion. *Syntax and Semantics* 9, 315–332.
- Xu, J. (2009). The research on the affirmative connector *dique* from different perspectives. Master's thesis, Southwest University of China.
- Zeevat, H. (2002). Particles: presupposition triggers, context markers or speech act markers. In R. Blutner and H. Zeevat (Eds.), *Optimality Theory and Pragmatics*, pp. 91–111. Palgrave McMillan.

Acknowledgement: The presented research is partially supported by City University of Hong Kong College Research Grant (Project No. 9610227) and Strategic Research Grant (Project No. 7002795) awarded to the second author. The work has been improved from the discussions with Christopher Davis, Michael Yoshitaka Erlewine, Magdalena Kaufmann, Paul Law, Haihua Pan, Satoshi Tomioka, and the audience at SuB17. All remaining errors are ours.