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Event Counting with Chinese *Ci*[*]

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This paper studies the uses of Chinese *ci*, the most general verbal classifier in Chinese, in order to understand the ontology of events and how they may be counted. In the literature, a verb may be viewed as mass, as in Moltmann (1997), and so event counting must rely on time to get discrete event units based on temporal separation. Alternatively, it may be assumed that a verb denotes a set of events, and so time counts events directly, as in Landman (2004). To understand how events are divided and counted, the paper explores the uses of *ci*, the Chinese counterpart of English *time*, because this item displays two ways of counting. Through this study, I argue that instances of an event type at different temporal spans are discrete event units by default; and among these event units, *ci* may select the minimal or maximal ones for the counting, and the choice is determined by whether the speaker should specify the number of individual events or the number of distinct temporal intervals for the realization of the event type described. If the analysis is on the right track, its precise semantic analysis can be the basis for us to understand further how events can be divided and counted in various ways and how other verbal classifiers work.

Key words: event counting, verbal classifier, event type, event token, minimal events

1. Introduction

Mandarin Chinese is a language rich in verbal classifiers, which have been classified into different types (cf. Chao 1968, Lü 1980, Shao 1996, and Zhang 2002, among many others). Roughly speaking, classifiers can be body parts (e.g., *yan* 'eye' and *quan* 'fist'), instrument words (e.g., *dao* 'knife', *qiang* 'gun'), and concomitant verbal classifiers (e.g., *bu* 'step' and *sheng* 'voice'). Many classifiers function to provide individualized units for event counting. For example, *kan Lisi* 'see Lisi' in (1) is a continuous activity. In this case, the classifier *yan* 'eye' defines the event units for counting so multiple occurrences of the overall activity can be counted. Specifically, it divides the whole seeing event into different units by the movement of Zhangsan's eyes so that each unit is defined as a single movement of his eyes toward and then away from Lisi. With the number *san* 'three', (1) thus conveys the following: There are three movements of Zhangsan's eyes toward and then away from Lisi in the event of Zhangsan seeing Lisi (cf. Deng 2013 for a similar idea on the counting of subevents).

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(1) Zhangsan kan-le Lisi san yan.[1]
Zhangsan see-PFV Lisi three eye
Lit.: 'Zhangsan saw Lisi three eyes.'

Although event units can be inferred from the lexical meanings of verbal classifiers in many cases, as illustrated by *yan* 'eye', this is not always the case. Consider for example, *ci*, a general verbal classifier in Chinese. Because of its wide use, demonstrated by its acceptance in both (2) and (3), and its abstract semantics, *ci* is classified as a 'special verbal classifier' in the literature.

(2) Zhangsan kan-le Lisi san yan/*tang/ci.
Zhangsan see-PFV Lisi three eye/round/time
Lit.: 'Zhangsan saw Lisi three eyes/*rounds/times.'

(3) Zhangsan qu-le Taibei san *yan/tang/ci.
Zhangsan go-PFV Taipei three eye/round/time
Lit.: 'Zhangsan has been to Taipei three *eyes/rounds/times.'

San ci in (2) and (3) is translated as 'three times' in English. Since in English *time* can have a temporal meaning, as in the phrase *I enjoyed the time with you*, one may assume that *ci* counts temporal spans. However, even for the English word *time*, it is often unclear what exactly this word is counting, as demonstrated by (4).

(4) John left three times.

With the numeral *three*, sentence (4) seems to express that there are three distinct events, each of which involves John leaving. However, as there should be three discrete times that John leaves, it is also possible to claim that *three* refers to the number of distinct temporal points at which John left. These interpretations are reflected in the two different proposals concerning event counting of the English word *time* in the literature: the temporal analysis, as in Moltmann (1997), and the event analysis, as in Landman (2004). So it is not entirely clear what *ci*, the Chinese counterpart of English *time*, should count.

The current paper aims to demystify how *ci* as a very general verbal classifier does the counting. I review the main analyses of English adverbial *time*-expressions and those of the various ways of event counting by Chinese verbal classifiers, and

[1] The abbreviations used in this paper are defined as follows: ASP: aspect; CLF: classifier; PFV: perfective aspect; VCl: verbal classifier; ER-VCl: event-related verbal classifier; OR-VCl: occasion-related verbal classifier.

discuss their explanatory power for the uses of *ci*. I argue that these previous analyses do not fully explain the semantics of *ci*. Therefore, this paper proposes a new analysis, where the numeral-*ci* sequence works like an event quantifier to count minimal or maximal event tokens of an event type. If on the right track, my analysis could help us to understand better the ontology of events and possible cross-linguistic variation in event counting. Furthermore, it could be used as the basis for further study on other verbal classifiers, especially in Chinese or other languages with multiple verbal classifiers.

The paper is organized as follows. In Section 2, I review four previous analyses on event counting and argue that none of them account for the uses of *ci*. To better account for the uses of *ci*, I propose a new analysis in Section 3. I argue that the numeral-*ci* sequence works like an event quantifier to count minimal or maximal event tokens of the event type described. I also explain how context affects the choices between minimal and maximal event tokens. Crucially, I show that the choice between minimal events and maximal events is determined by whether the speaker should specify the number of individual events or the number of distinct temporal intervals for the realization of the event type described. Then in Section 4, I discuss cases which seem to be counterexamples of the event quantifier analysis of the numeral-*ci* sequence. For these apparent counterexamples, I use covert grouping as an explanation and keep the event quantifier analysis. Finally, the paper is concluded in Section 5.

2. Previous studies and the issues

2.1 A temporal analysis versus an event analysis

As mentioned above, there are two different analyses for English adverbial *time*-expressions. I first present Moltmann's (1997) temporal analysis, arguing that this cannot explain the uses of English *time* and that Landman's (2004) event analysis is seemingly more accurate. However, some data from Chinese *ci* presented in the next section will point out the weaknesses of the event analysis.

I will start with a discussion of events and entity types, as these notions play a crucial role in previous analyses of event counting. Since Davidson's (1967) introduction of event arguments, it is commonly assumed that there are two domains: the domain of individual entities, including things like people or objects, and the domain of event entities. Both domains contain at least singularities and pluralities. Predicates (i.e., expressions which can describe some sort of property, state, event, or situation for some entity) may include in their denotation either singular entities or singular and plural entities. For example, in the domain of individuals, it is commonly assumed that the nominal predicate *boy* denotes a set of atomic individuals who are both male and young, like the set {a, b, c} in a scenario where three individuals are young males.[2] As for the plural form, *boys* denotes a set containing not only singular individuals but also plural individuals, such as the set {a, b, c, a⊕b, b⊕c, c⊕a, a⊕b⊕c}, where the notation a⊕b, for instance, refers to a plural individual with a and b as its parts; or put in another way, a⊕b refers to the sum of a and b, a sum formed by the sum operator ⊕ (cf. Link 1983, among many others).[3]

In addition to singular common nouns and their plural forms, natural languages also contain group terms like *committee* (as in *committee of senators*) or *deck* (as in *deck of cards*). These terms denote sets of another type of entities: group atoms. Group atoms are "groups" in that they are made of members, but they are also atomic as argued in Link (1983, 1984) and Landman (1989, 2000), meaning that each of them is viewed as one whole entity, with non-accessible members.

Entity types play a crucial role in the analyses of event counting. First, Moltmann (1997) presents evidence to argue that verbs are mass, and a verb phrase denotes an event group, which is an integrated whole and has no part structure. Accordingly, counting cannot be done unless some extra step is taken to form a part structure for the group event. *Time* is argued to perform this function, as it is required in event counting, illustrated by its obligatory presence in (5). The exact function of *time* is shown in (6), where $<_s$ is a part relation in situation s.

(5) John left three *(times).
(6) $[times]^S = \lambda e\,[\mathrm{METRIC}(m_t, \{e' \mid e' <_s e\}, s)]$
(Moltmann 1997:230)

In (6), *time* introduces a metric relation between $\{e' \mid e' <_s e\}$ (i.e., a set of parts of the group event) and m_t (i.e., the measurement of temporal distance) in situation s. Consequently, to make the metric relation hold, event parts derived from the whole event must be temporally separated in s.[4] In other words, *time* helps to get a set of event parts which are separated by time. It can thus be inferred that the number of distinct temporal spans for the event members determines the number of events to be counted.

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2 In fact, it is a controversial issue of how singular common nouns should be analyzed semantically. Readers are referred to Kratzer (2007) for the discussion of various proposals of these items' semantics.
3 Such a denotation for plural nouns is proposed in works like Sauerland (2003) and many others.
4 Readers are referred to Moltmann (1997:147) for the exact definition provided for METRIC, the metric property. The exact definition will not be provided here, as it is not related to the paper's proposal of event counting.

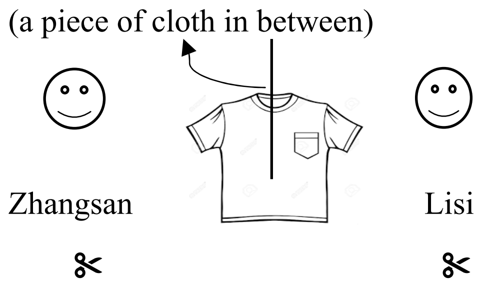
Even though Moltmann's analysis accounts for the required use of *time* in event counting, it faces a fatal problem: There are cases where the counting by *time* is not based on temporal separation. This was pointed out in Rothstein (1995), and is emphasized by Landman (2004) through the following Example (7).

(7) [A big panel with thousands of little lamps. In front of it Amos W. Steinhacker (from Marten Toonder: De Bovenbazen).]
AWS: Every time a light goes up, I am exactly $10 billion richer.
[Five lights light up simultaneously.]
AWS: Another $50 billion.
(Landman 2004:222)

In the above scenario, five lights light up simultaneously. This makes the proposition "(at least) one light went up" hold at one temporal point only. If the counting is based on the number of distinct temporal spans for the lighting up events, the resulting number should be 1, and then AWS should only get $10 billion. However, the felicity of AWS's second utterance shows that the counting on the lightening events gets the number "5". That is, simultaneous events of the same type can be counted individually, contra to Moltmann's proposal of *time*.

Even though the above example challenges Moltmann's analysis, it examines a sentence with *every time*, a definite *time*-phrase. The question remains whether direct event counting is possible for indefinite *time*-phrases. For the current study to address this, seven native English speakers were surveyed and asked to imagine the following scenario:

(8) Zhangsan and Lisi were asked to cut one particular T-shirt with their own scissors. They could not work together to do the cutting, as a piece of cloth was between them to prevent them from seeing what the other was doing. It turned out that they each made a cut at the same time t_1 (i.e., they did the cutting actions individually but **simultaneously)**, and then at t_2, 5 minutes after t_1, they cut the T-shirt again **simultaneously**.



In response, six of the seven people chose (9) but not (10) to describe the scenario in (8), while only one accepted both (9) and (10).

(9) The T-shirt was cut four times.
(10) The T-shirt was cut twice.

Note that in this scenario there are only two distinct temporal intervals, i.e., t_1 and t_2, for the cutting actions. So if English *time*-phrases necessarily count events based on temporal separation, (10) should have been chosen instead of (9). However, the overwhelming majority chose (9), posing a serious problem for Moltmann's temporal analysis.

As an alternative to Moltmann's proposal, Landman (2004) argues that *time* is not used to divide events by temporal separation. Instead, following his idea of "counting intuition" stated in (11), he proposes that *time* makes event counting possible via the formation of group atoms.

(11) The counting intuition (Landman 1989)
Sums cannot be counted directly. Only atoms can be counted.
Classifier time parcels a set of non-countable sums into a set of countable Atoms.
(Landman 2004:242)

In his proposal, pluralities must be turned into groups before counting occurs. This group formation can be done by applying to a sum a group formation operator, symbolized by $\uparrow$, which was originally introduced by Link (1984), and is defined in (12).

(12) Group formation $\uparrow$:
If $\alpha \in$ SUM - IND, then $\uparrow(\alpha) \in$ GROUP
If $\alpha \in$ IND, then $\uparrow(\alpha) \in \alpha$
(Landman 2004:240)

Example (12) states that if something, say α, is a plural entity, then the application of $\uparrow$ to α will turn it into a group. Further, an individual will not change its denotation after the application of $\uparrow$.

To provide a concrete example, consider the plural NP *the cows*. If *the cows* denotes $a \oplus b \oplus c$, the application of $\uparrow$ will turn the sum to $\uparrow(a \oplus b \oplus c)$, a group with a, b, and c. This optional application is desirable, because regular plural NPs in English have either plurality denotations or group denotations, as argued in works like Link (1984) and Landman (1989, 2000).

The application of $\uparrow$ is crucial for event counting in Landman's (2004) analysis. As mentioned previously, event counting must be done with respect to countable atoms. To ensure counting can be done, *time* is used, requiring its argument to be a set of groups, which are atomic. The semantics of *time* is presented in (13), where type d is the type for individuals and type e is for events:

(13) The semantics of classifier *time*:

Let z be a variable of type $<\uparrow, <a,t>>$ (a either type d or e).

$[_{\text{classifier}}\ time] \rightarrow \lambda z.\ {}^{\downarrow}z$ of type $<<\uparrow, <a,t>>,<a,t>>$

(Landman 2004:243)

As shown in (13), *time* is a function to take some z of type $<\uparrow, <a, t>>$. To understand the correspondence between the type and its meaning, look at (14). If α is an expression of type $<a, t>$ to denote a set of individuals or events, ${}^{\uparrow}\alpha$ will be of type $<\uparrow, <a, t>>$ to denote a set of atomic groups corresponding to the set of sums denoted by α, as in the last line of (14).

(14) The counting operator ${}^{\uparrow}$:

Let a be type d or e.

If $\alpha \in EXP_{<a, t>}$, then ${}^{\uparrow}\alpha \in EXP_{<\uparrow, <a, t>>}$

$[|{}^{\uparrow}\alpha|]_{M,g} = \{\uparrow(x): x \in [|\alpha|]_{M,g}\}$

(Landman 2004:242)

So by (14), z with the type $<\uparrow, <a, t>>$ denotes a set of atomic groups. After the function of *time* takes z, it returns to us ${}^{\downarrow}z$, which in Landman's framework is the same as z in terms of their denotations.[5]

This proposal can be illustrated by (15), a concrete example provided by Landman. The constituent [*two girls kissed Dafna*] in (15) has the meaning stated in (16).

[5] ${}^{\downarrow}z$ differs from z in types: z is of type $<\uparrow, <a,t>>$, but ${}^{\downarrow}z$ is of type $<a,t>$. In (13), the semantic value after the functional application must be ${}^{\downarrow}z$ so that the resulting meaning takes a regular $<a,t>$ type, which is good for subsequent semantic composition.

(15) Three times, two girls kissed Dafna.

(16) λe.*KISS(e) $\wedge$ *GIRL(*Ag(e)) $\wedge$ |*Ag(e)| = 2 $\wedge$ *Th(e)=DAFNA

The set of sums of kissing events with two girls as plural agent and Dafna as theme (meaning that each atomic part event has one of these girls as agent, and each atomic part event has Dafna as theme)

(Landman 2004:254)

The semantic representation in (16) is based on an assumption of universal cumulativity made in Krifka (1992, 1998), Landman (1996, 2000), Kratzer (2007), and several others. The assumption is that all simple predicates are cumulative from the very start, i.e., closed under sum formation by the sum operator *. This operator is introduced by Link (1983) and is used to get the plural meaning of a predicate. For example, with the plural operator *, the plural NP *boys* denotes a set with all the boy atoms as well as all the sums formed by the atoms. Thus, if the boy individuals are members in {a, b, c}, ||boys|| = *BOY = {a, b, c, a$\oplus$b, b$\oplus$c, c$\oplus$a, a$\oplus$b$\oplus$c}. With this plural operator, the sentence *John and Bill are boys*, for example, will be true, if and only if *BOY(John$\oplus$Bill), i.e., the sum John$\oplus$Bill is in the set of *BOY.

By the universal cumulativity assumption, verbal predicates and thematic role predicates should also be pluralized from the very start to include atoms and their sums. For example, ||run|| = λe[*RUN(e)], which denotes a set with atomic as well as plural running events, like the set {e_1, e_2, e_3, $e_1 \oplus e_2$, $e_2 \oplus e_3$, $e_3 \oplus e_1$, $e_1 \oplus e_2 \oplus e_3$}. Then *RUN(e) means that e is a member of this set and could be an atomic member like e_1 or a sum event like $e_3 \oplus e_1$. As for pluralization of thematic role predicates, let us take *Agent as an example. *Agent should not only map each of the atomic events involved to its agent, but also map the sum events to the corresponding sum agents. For instance, in a scenario with only two atomic events, if a is the agent of e_1 and b is the agent of e_2, then *Agent(e_1) = a, *Agent(e_2) = b, and *Agent($e_1 \oplus e_2$) = a$\oplus$b (or represented as an agent relation that *Agent = {<e_1, a>, <e_2, b>, <$e_1 \oplus e_2$, a$\oplus$b>}) (cf. Krifka 1986).

With this explication, the formal representation in (16) should be more readable. It refers to a set of events such that for any event e in the set, (i) it must be a member of *KISS; (ii) *Agent(e), namely the sum agent of the event e, should be girls, and there should be two members in the sum; and (iii) the theme of the event e must be Dafna.

To know whether (15) holds in some situation s, we need to count the number of events in the set defined in (16) in s. If there are three such events, (15) is true. However, in Landman's theory, these events cannot be counted directly, as every event in the set is a sum. Therefore we have to turn the pluralities into group atoms and then count those atoms. This is where *time* comes in. As shown in (13), *time* takes something of type <$\uparrow$, <a,t>>, forcing the application of the counting operator $\uparrow$ to its argument, thereby resulting in a set of atomic groups which correspond to the sum events in (16).[6]

Illustration (17) demonstrates the crucial derivation for (15).

(17)

$$\begin{array}{ccccc} & e_1\oplus e_2\oplus e_3 & & \ldots\ldots\ldots & \\ \multicolumn{4}{|c|}{e_1\oplus e_2 \quad e_2\oplus e_3 \quad e_3\oplus e_4 \quad \ldots\ldots\ldots} & \\ e_1 & e_2 & e_3 & e_4 & \ldots\ldots\ldots \end{array}$$

Each of the event atoms in (17), namely e_1, e_2, e_3, …., is a kissing event with one girl as the agent and Dafna as the theme. For (15) to be true, there should be three sums, each of which has two atomic events, like those put in a big rectangle in (17). However, sums cannot be counted directly in Landman's framework. To do the counting, groups corresponding to these sums must be formed, as in (18):

(18) $\uparrow(e_1\oplus e_2)$ $\quad\quad$ $\uparrow(e_2\oplus e_3)$ $\quad\quad$ $\uparrow(e_3\oplus e_4)$

Time then takes a set with these group atoms, and returns to us the same set. Finally, the set undergoes pluralization to derive a set containing the group atoms and their sums, as shown in (19):

(19)

$$\uparrow(e_1\oplus e_2)\oplus\uparrow(e_2\oplus e_3)\oplus\uparrow(e_3\oplus e_4) \quad \ldots\ldots\ldots$$

$$\uparrow(e_1\oplus e_2)\oplus\uparrow(e_2\oplus e_3) \quad \uparrow(e_2\oplus e_3)\oplus\uparrow(e_3\oplus e_4) \quad \ldots\ldots\ldots$$

$$\uparrow(e_1\oplus e_2) \qquad\qquad \uparrow(e_2\oplus e_3) \qquad\qquad \uparrow(e_3\oplus e_4) \quad \ldots\ldots\ldots$$

After all the above operations, the truth conditions of (15) are derived. The sentence is true in situation s, if and only if there is a sum of events with three group atoms in s, like the sum "$\uparrow(e_1\oplus e_2)\oplus\uparrow(e_2\oplus e_3)\oplus\uparrow(e_3\oplus e_4)$" in (19). This final meaning is formally represented in (20):

[6] Landman's analysis makes the use of *time* redundant for simple sentences. For example, in the simple sentence *Dafna jumped two times*, *time* turns a set of singular atomic events of Dafna's jumping into a set of group atomic events. As singular atomic events are countable per se, the use of *time* to turn them into group atoms is redundant, though logically possible.

(20) $\exists e[|e|=3 \wedge [^{*\downarrow\uparrow}\lambda e.{*}KISS(e) \wedge {*}GIRL(Ag(e)) \wedge |Ag(e)|=2 \wedge Th(e)=DAFNA](e)]$
There is a sum of three atomic group events and each of these atomic group events corresponds to a sum of events of two girls kissing Dafna.
(Landman 2004:254)

Even though the above mechanical operations may appear dry and complicated, Landman's (2004) analysis makes a clear and crucial point. Namely, a verb denotes a set of atomic events and their sum events. In other words, atomic events exist before the word *time* comes in. Since *time* does not divide a group event into event parts by temporal separation, it is possible to view simultaneous events of the same type as separate event units. Therefore, it is possible to account for the preference of (9) over (10) in Landman's analysis. However, crucial data from Chinese presented below shows that this analysis cannot account for the uses of *ci*, the Chinese counterpart of English *time*.

2.2 Counting of Chinese *ci* and the minimal and maximal event tokens

While Landman's event analysis seems to be stronger than Moltmann's temporal analysis, its weaknesses are revealed by the uses of *ci*, the Chinese counterpart of *time*. In the Chinese survey for scenario (8), eight out of ten consultants accepted both (21) and (22). Crucially, the wide acceptance of (22) is in contrast with the unacceptance of the English sentence (10) for scenario (8). This contrast makes it impossible to directly extend Landman's analysis of English *time* to Chinese *ci.* Some sort of temporal analysis must be used to explain the acceptance of (22).

(21) T-shirt bei jian-le si ci.
T-shirt BEI cut-PFV four time
'The T-shirt has been cut four times.'
(22) T-shirt bei jian-le liang ci.
T-shirt BEI cut-PFV two time
'The T-shirt has been cut twice.'

The two-way counting of *ci*-phrases seems to suggest that an event counter can function either under Moltmann's temporal analysis or under Landman's event analysis. However, as discussed above, Moltmann and Landman have different assumptions on the denotations of verbs and on what *time* takes as its argument. For Landman, atomic events exist at an early stage in the semantic computation (cf. Dowty 1979, Rothstein 2004, and many others for such an assumption). Thus, in the sentence *John and Bill cut the T-shirt twice*, before combining with *twice*, the constituent *John and Bill cut the T-shirt* denotes a set of sums of atomic events. In contrast, under Moltmann's theory, the constituent *John and Bill cut the T-shirt* has no parts. What is denoted by the constituent is a group event, an integrated whole. Only after *time* comes in is a set of event parts formed. As the two analyses are based on different assumptions of the ontology of events, they cannot be adopted together to account for the two-way counting of Chinese *ci*.

To account for the two-way counting of *ci*, I first detail the general function of *ci*, then discuss how its functions vary.

Let us first consider what sort of event modifiers *time*-phrases and the numeral-*ci* sequence are. Event modifiers are subclassified into two types in Moltmann (1997): event predicates and event quantifiers. An example of an event predicate is the preposition phrase *in Paris* in (23a), which modifies the event of John studying by specifying the location of the event, as in (23b).

(23) a. John studied in Paris.
b. $\exists$e[*Studied(e) $\wedge$ *Agent(e, John) $\wedge$ *In(e, Paris)]

In addition to event predicates, event modifiers can work as event quantifiers, like the *time*-phrase in (24). As an event quantifier, *three times* can take the widest scope to result in the meaning that there are three instances of John's marrying a French woman. In this reading, it can be that John marries different French women in different instances.

(24) Three times, John married a French woman.
(Moltmann 1997:220)

Landman (2004) also takes adverbial indefinite *time*-phrases as event quantifiers. This is revealed in (20), the semantic representation of sentence (15). In (20), the phrase *three times* specifies that three event tokens of the even type described by (16), namely the event type of "two girls kissing Dafna", are realized in some situations. Here, the *time*-phrase is treated as an event quantifier.

In addition to *time*-phrases, the numeral-*ci* sequence in Chinese also functions like an event quantifier. This has been claimed by Jeong (2002) in her generalization that *ci* is "used to count an event denoted by VP as a whole" (5). This analysis of *ci* is supported by the current paper as follows. Take sentence (25) as an example. If the numeral-*ci* sequence in Chinese works like an event quantifier, (25) should express that there were four instances of the event type described. That is, there were four instances of a T-shirt cutting event with Zhangsan and Lisi as the sum agent. In contrast, if the numeral-*ci* sequence works like an event predicate, (25) should mean that in the whole cutting event, Zhangsan and Lisi are the sum agent, and there were four event parts involved in the whole event.

(25) Zhangsan han Lisi jian-le si ci T-shirt.
Zhangsan and Lisi cut-PFV four time T-shirt
'Zhangsan and Lisi have cut this T-shirt four times.'

With this difference in meaning in mind, consider another survey about scenario (8). In this survey, seven native Chinese speakers were consulted for the acceptability of sentences (25)–(26) for scenario (8).

(26) Zhangsan han Lisi jian-le liang ci T-shirt.
Zhangsan and Lisi cut-PFV two time T-shirt
'Zhangsan and Lisi have cut this T-shirt twice.'

Of the seven people, five accepted (26) only, while the other two hesitated about giving a judgment, meaning (26) is generally preferred over (25). The preference of *liang ci* 'twice' over *si ci* 'four times' for the scenario suggests that the numeral-*ci* sequence functions like an event quantifier. Note that in scenario (8), there are two instances of a T-shirt cutting event with Zhangsan and Lisi as the sum agent, namely the one at t_1 and the other one at t_2. In this scenario, there are four atomic events: the two cutting events of Zhangsan and two cutting events of Lisi. So, the choice of the number "2" but not "4" makes it clear that the numeral-*ci* sequence works like an event quantifier rather than an event predicate; thus, *ci* counts event tokens of the event type described, instead of the subevents involved.

Now let us discuss the two-way counting of *ci* under the event quantifier analysis. Consider first (21). The acceptance of *si ci* 'four times' in (21) for scenario (8) implies that simultaneous events are viewed as separate units for counting. However, if considering the events more carefully, one will find that there are six event tokens, not four, as detailed in (27). The three event tokens at t_1 and the three at t_2 should be counted, as the event type described in (21) is the T-shirt being cut without any specific agent identified. The six event tokens in (27) are all of this event type. So, if all qualified event tokens are counted, *liu ci* 'six times' instead of *si ci* 'four times' should be uttered. But this is counter to the native speakers' intuition.

(27) Events in the scenario described in (8)

At t_1: e_1, the event of Zhangsan's cutting the T-shirt at t_1

e_2, the event of Lisi's cutting the T-shirt at t_1

e_3, the event of cutting the T-shirt with Zhangsan and Lisi as the sum agent at t_1 (namely, $e_3 = e_1 \oplus e_2$)

At t_2: e_4, the event of Zhangsan's cutting the T-shirt at t_2

e_5, the event of Lisi's cutting the T-shirt at t_2

e_6, the event of cutting the T-shirt with Zhangsan and Lisi as the sum agent at t_2 (namely, $e_6 = e_4 \oplus e_5$)

The use of the numeral *si* 'four' instead of the numeral *liu* 'six' tells us that *ci* in this case is used to count atomic events, which only include e_1, e_2, e_4, and e_5. On the other hand, sentence (22) with the numeral *liang* 'two' can also be uttered to describe scenario (8), suggesting that *ci* can also be used to count the sum events in (27), i.e., e_3 and e_6. Therefore, *ci* can be used to count either atomic events or sum events. However, the preference of (26) over (25) tells us that *ci* does not always count atomic events; instead, it looks at units of the event type denoted by its sentence. Therefore, instead of saying that *ci* is used to count atomic or sum events, I argue that *ci* is used to count either "minimal" or "maximal" event tokens of the event type denoted by its sentence.[7] In (27), for the event type of the T-shirt being cut, the

[7] I identify the two-way counting of *ci* by considering a tricky case where two agents simultaneously did the same sort of action over the same patient, namely the T-shirt in scenario (8). A reviewer wonders how the counting of *ci* should work in an opposite situation, namely the situation where one agent does the same sort of action over two patients/themes simultaneously. One concrete scenario provided is the following: Zhangsan pushed two shopping carts, one cart using one hand, for a while, and then he pushed another cart using both hands. The question is whether *ci* should take the numeral two, three, or either of them in sentence (i) to describe this scenario.

(i) Zhangsan tui-le liang/san ci tuiche.
Zhangsan push-PFV two/three time cart
'Zhangsan pushed a cart two/three times.'

After a small survey, it is found that most Chinese native speakers only accepted the numeral *liang* 'two' for this scenario. The unacceptance of the numeral *san* 'three' seemingly suggests that the counting of the so-called "minimal event tokens" is impossible for this case. This is an interesting result. Honestly, I cannot be completely sure why the counting cannot return the numeral three. I speculate, however, that cognition affects how event tokens are divided. When the same agent does some action to two patients simultaneously, it is hard for us to perceive the situation as one that two separate event tokens, instead of one single token, are realized. Therefore, when *ci* counts minimal event tokens, it gets only one token for this time span. This is in contrast with scenario (8), where two agents do something simultaneously, and for each agent, there is an event token realized. In other words, "agents" play a significant role in our perception of event units.

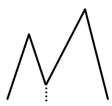
The above speculation is supported by English *time*, since it shows the same agent effect. For example, two English native speakers consulted did not accept sentence (ii) for a scenario where John took two pieces of paper and tore them "in one motion".

(ii) John tore a piece of paper **twice**.

The unacceptance of sentence (ii) lets us infer that with one agent, the simultaneous paper-tearing actions cannot be mapped to two separate event units, either. So there is only one event unit, and thus minimal event tokens are e_1, e_2, e_4, and e_5, and the maximal ones are the sum events e_3 and e_6; as for the event type of "Zhangsan and Lisi cut the T-shirt" (as in sentences (25) and (26), where agents are identified), both the minimal and the maximal event tokens are e_3 and e_6, which results in the use of the numeral 2 but not 4 for the counting of *ci* with respect to this event type.

The two-way counting with respect to event types described above will be formally explained in Section 3. Before any formal treatment, however, the nature of the two-way counting of *ci* should be clarified. In particular, as pointed out by a reviewer, it is very tempting to associate the two-way counting of *ci* with the following sort of vagueness shown in the nominal domain.

(28)
a

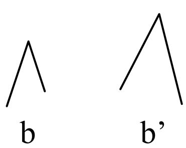


b b'

(Chierchia 2010:122)

The illustration (28) is provided by Chierchia (2010) to demonstrate the vagueness in the atomicity of some countable nouns. The whole image can be treated as a single mountain atom, represented by (28a), or as two separate mountain atoms, represented by (28b) and (28b'). In other words, there are two possible ways to determine atomicity. However, this vagueness is affected by context. For example, as pointed out by a reviewer, the spatial configuration in (29) makes it much more likely to view (29b) and (29b') as two separate atoms, instead of parts of one single mountain atom (cf. Moltmann 1998 for the contextual effect on integrity and atomicity).

(29)
a



b b'

Interestingly, the relationship between spatial proximity and atomicity vagueness is reminiscent of scenario (8), where there is temporal overlapping of the cutting actions. It is tempting to claim that temporal proximity causes vagueness in event atomicity, and then results in two possible numbers in the counting of *ci*. Take t_1 in

English *time* should not take the numeral two. Such an account surely needs to be supported by psycho-semantic experiments in the future.

scenario (8) as an example. The events could be perceived as two separate event atoms (e_1 and e_2), or as a single event atom (e_3). The two-way counting of *ci* could thus be considered to reflect two different ways of event atomicity, rather than two different functions of *ci*. In this account, *ci* would always count minimal event tokens.

This analysis is seemingly simple and is desirable for its parallel treatment of the verbal and the nominal domain. However, it is in fact obscure. To see this, consider the counting difference between Chinese *ci* and English *time*. To describe scenario (8), *ci* can take the numeral 2, as shown in the acceptance of the Chinese sentence (22), but *time* cannot. This difference is not predicted by the account of atomicity vagueness. Such vagueness is dependent on context, an effect that is arguably universal. For example, when a mountainous object has a spatial configuration as shown in (28), the vagueness in atom numbers emerges not only for the English noun *mountain*, but also for the Chinese noun *shan* 'mountain'. By similar reasoning, simultaneous actions in scenario (8) with temporal overlapping should be able to form either one single event or two events in Chinese as well in English. But in fact, the forming of one single event atom at t_1 and at t_2 is not allowed in English, revealed by the unacceptance of sentence (10) with the numeral 2. Thus, a more plausible account is that simultaneous actions in scenario (8) do not form a single event atom. That is, e_1 and e_2 in (27) are always taken as two separate event atoms, as are e_3 and e_4 at t_2.

To conclude, based on this language variation, I argue that the two-way counting of *ci* cannot be accounted for by contextual vagueness in atomicity. Instead, there must be two different functions of *ci*.[8] Before presenting the precise semantics of *ci*, I will explain why some recent papers on multiple ways of event counting in Chinese cannot be adopted to account for the uses of *ci*.

2.3 Multiple ways of event counting in recent works: Deng (2013) and Donazzan (2012)

There are different sorts of event counting attributed to a variety of event frequentatives, as pointed out in Cusic (1981), Andrews (1983), Lasersohn (1995),

[8] I use two functions of *ci* to deal with the two-way counting of *ci*. However, I admit that there is another possible account. It is possible to assume that Chinese *ci* always works like English *time* to count minimal event tokens, but it differs from the latter in its triggering of a covert grouping operator in its scope. That is, a *ci*-sentence has the following structure: …[*ci* [GROUP ….]]. The grouping operator operates for events and takes context into consideration. With temporal proximity of actions as in the case of (27), the operator may turn e_1 and e_2 in (27) into one event unit or keep them as separate units. With such an operator assumed, one can propose that *ci* always counts minimal units in the denotation of its argument. This account is possible, but it needs more support because of its use of a covert operator. The paper will leave it for future studies to evaluate whether the current proposal or the alternative account is a more plausible analysis for *ci*.

Cinque (1999), Jeong (2002), Cabredo Hofherr (2010), Donazzan (2012), Deng (2013), Zhang (2017), and several others. One common way of categorization is to subclassify event frequentatives into event-external ones and event-internal ones, which seems to reflect the distinction between event quantifiers and event predicates. However, such a distinction is irrelevant to the two-way counting of *ci*, as it has been argued that the numeral-*ci* sequence should always function like an event quantifier. In fact, I will clarify that the two-way counting of *ci* examined in the current paper has not been identified or accounted for, by discussing the analyses in Deng (2013) and Donazzan (2012).

Deng (2013) proposes that there are three types of event counting: the counting of sum events/occasions, that of atomic events, and that of subevents. Different verbal classifiers may count different sorts of things. For example, *bian* 'time' is argued to count atomic events, *hui* 'time' to count occasions, and *bi* 'stroke' as in *xie-le liang bi* 'wrote two strokes' to count subevents. Deng also agrees with my claim that the verbal classifier *ci* has two uses; however, our claims differ in that he specifically maintains that *ci* can count either occasions or atomic events.

Deng's analysis for *ci* is flawed in two ways. First, Deng claims that *ci* can count atomic events. But I have shown that even though there are four atomic events in scenario (8), *si ci* 'four times' in (25) was not accepted by those surveyed. Therefore, it is problematic to claim that *ci* can count atomic events, without basing the counting on the event type described.[9]

Second, Deng follows Bach (1986) in assuming that telic predicates denote atomic events, but atelic predicates do not. Telic predicates, such as accomplishments and achievements, have inherent endpoints, like *draw a circle* (cf. Vendler 1957, Smith 1997, among many others). In contrast, activities without inherent endpoints are atelic predicates. As Deng assumes that telic and atelic predicates are different in event ontology, it follows that activities do not denote atomic events for *ci* to count. For such predicates, the only counting possibility left is the counting of occasions. But this is not true. Consider a scenario where there is a maze with two entrances, entry A and entry B. First, John entered the maze and left it. Afterwards Bill and Jack, who were not in a group, entered entry A and entry B of the maze respectively, and they entered the maze at the same time and left it also at the same time. Then finally, Ray tried the maze, too. To describe this scenario, one can utter sentence (30) with either the number *san* 'three' or the number *si* 'four'. It should be clear that *san* 'three' in (30) refers to the number of distinct temporal spans where the maze was visited, while

[9] Even though Deng uses the term "event quantifiers" to refer to phrases with verbal classifiers, he does not take into consideration the distinction between event quantifiers and event predicates. Because of the lack of this distinction, his analysis is vague in places.

si 'four' refers to the number of the maze-visiting events. Crucially, *wan migong* 'lit. playing maze' is an activity, but *ci* still has two counting possibilities. How the number *si* 'four' is gotten is left unexplained in Deng's analysis.

(30) Migong bei wan-le san ci/ si ci.
maze BEI play-PFV three time/four time
'The maze has been visited three times/four times.'

Like Deng (2013), Donazzan (2012) also claims that there is counting of occasions, which are defined as individualized non-overlapping intervals of time. In addition to the counting of occasions, she proposes that event counting can also be done with respect to "minimal units" of events. The two different kinds of counting are done through two types of verbal classifiers, namely event-related VCls (henceforth ER-VCls) and occasion-related VCls (henceforth OR-VCls), for the picking of different sorts of counting sets. These are presented in (31)–(32).

(31) $\text{ER-VCl}(P) = \{\varepsilon : P(\varepsilon)\ \&\ \forall\varepsilon_1\ [\forall\varepsilon_1 \in P\ \&\ \varepsilon_1 \leq \varepsilon \rightarrow \varepsilon_1 = \varepsilon\}$
(32) $\text{OR-VCl}(P) = \{\omega : \omega(P) = 1\}$
(Donazzan 2012:230)

As represented above, an ER-VCl forms a set of event tokens in the denotation of the predicate P and requires that the tokens be minimal ones (through the requirement that event tokens in the set have no parts except itself). In contrast, an OR-VCl forms a set of distinct temporal intervals where an event of P unfolds. Then, after taking a numeral, the former tells us how many minimal event units there are, and the latter tells us the number of occasions/temporal spans where at least one event of the type described has been instantiated.

Chinese is an interesting case for Donazzan as it clearly possesses the two types of verbal classifiers. *Ci* in (33) for example is taken as a representative of OR-VCls, and *jiao* in (34) is an ER-VCl. In (33), *ci* counts distinct temporal spans where door-knocking actions have been taken. Each temporal span may contain a series of knocks. This demonstrates a characteristic of OR-VCls, which allow plural events in each of the counting units. Different from *ci*, *jiao* as an ER-VCl must count minimal units. For example, when it takes *liang* 'two' in (34), there are exactly two kicking actions taken.

(33) Wo qiao-le san ci men.
I knock-ASP three ORVCl door
'I knocked three times at the door (each time giving an underspecified number of strikes).'
(Donazzan 2012:231)

(34) Wo ti-le yi jiao/ liang jiao/ ji jiao.
I kick-ASP one VCl/two VCl/few VCl
'I gave one/two/a few kick(s).'
(Donazzan 2012:232)

It should be noted that Donazzan attempts to provide a simple account of event counting of activities which lack clear boundaries. Therefore, in Donazzan's analysis, minimal units are taken as "onsets" of an activity, i.e., minimal instances which can count as events of the activity in question (cf. Dowty 1979),[10] and to count them, these minimal units must be clearly divided. It then follows that it is possible to do the counting for semelfactive activities (cf. Rothstein 2004, 2008), like door-knocking, because they have clear minimal units. However, it is difficult to do the counting for activities like *deng* 'wait' due to their lack of a well-defined atomic structure. Her analysis then explains why an ER-VCl may get different counting results when applied to different activities.

Crucially, in Donazzan's analysis an ER-VCl is applied to count minimal units which are onsets of activities but cannot be applied to telic events. This analysis makes it impossible to claim that *ci* can work as an ER-VCl, and thus we cannot attribute the two-way of counting of *ci* to its ER-VCl and OR-VCl uses. To see this, consider the following scenario. Some students, including Billy, Amy, and Jamie, were asked to practice a new song. At first, their teacher Mary heard Billy in Room A sing the whole song. Then five minutes later, Mary heard Amy in Room A and Jamie in Room B individually but simultaneously sing the whole song. Lastly, five minutes later, Mary heard Jamie sing the whole song again. To describe this scenario, Mary can utter (35), where the VP is telic and the telicity is emphasized by the adverb *congtoudaowei* 'from the beginning to the end'. If *ci* is to count minimal events as defined in Donazzan's paper, i.e., to count activities only, the numeral-*ci* sequence should not be able to express the number of events in (35). But it is clear that the number 4 in (35) refers to the number of the song-singing events, instead of the

[10] For example, a minimal unit of the predicate *walk* is an event which is involved with the fewest motions, but still can be perceived as a walking event.

number of occasssions. So, Donazzan's account of minimal events cannot work to fully explain the uses of *ci*.

(35) Na shou ge congtoudaowei chang-le si ci.
that CLF song from.the.beginning.to.the.end sing-PFV four time
'That song was sung from the beginning to the end four times.'

I have shown that neither the atomic events in Deng (2013) nor the minimal events in Donazzan (2012) are what *ci* counts. In the next section, I will present a new proposal. I will argue that *ci* may count the minimal or the maximal event tokens of the event type described. Even though my proposal will still use the term "minimal events", these events do not refer to onsets of activities. The details are provided below.

3. The proposal

3.1 Two meanings of Chinese *ci*

Here, I propose that event counting using Chinese *ci* can be done with respect to minimal or maximal event tokens of the event type described. To show that this proposal works, I will present some crucial mechanical details for how *ci* is used for counting.

First of all, I will present the semantic composition of *ci*-sentences based on the syntactic analysis of verbal classifiers in Zhang (2017). Zhang, following previous research, divides verbal classifiers into event-external ones and event-internal ones. She then argues that external verbal classifiers appear in the head position of a higher UnitP, which takes vP as its complement, whereas internal verbal classifiers appear in the head position of a lower UnitP, which takes VP as its complement. *Ci*, conforming to the claim in this paper, is treated as an external verbal classifier in Zhang's work. Thus, *ci* is in the head position of the higher UnitP and takes vP as its complement, as shown in (36). Note that the numeral *si* 'four' is in the specifier position of UnitP, which means that technically speaking, the numeral and the verbal classifier do not form a phrase, i.e., a constituent.

(36)

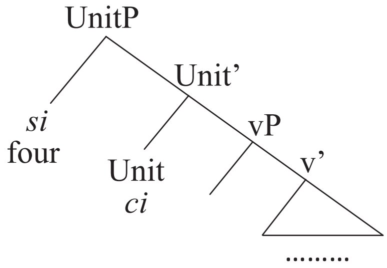
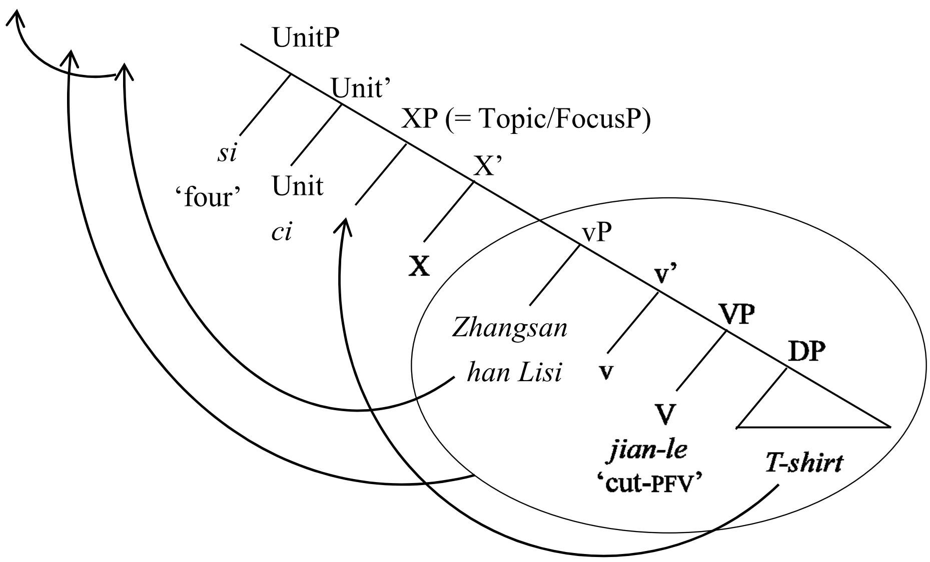


Illustration (36) shows the underlying structure of a *ci*-sentence. This structure surely does not directly give us the surface word order shown in *ci*-sentences like (21)–(22) or (25)–(26). To derive the surface word orders of *ci*-sentences, Zhang claims that the derivational process is involved with the movements of the subject NP, vP and the object NP, as in (37) for the surface word order of sentence (25).[11]

(37)



Readers are referred to Zhang's work for details and for supporting evidence of the movements. This syntactic analysis is adopted because not only does it provide an explicit account of how the classifier *ci* is located relative to other expressions in a sentence, but it is also advantageous in that it can explain the s-selection relationship between external verbal classifiers and types of events. Furthermore, it explains why the distribution of "*ci*-phrases" is different from that of other adjunct phrases in Mandarin, and it makes the structure for event counting more similar to that of

[11] The numeral-*ci* sequence can also appear after the object NP. For example, *si ci* 'four times' in (25) can be put in the sentence final position. To know how *ci*-sentences show variation in word ordering, readers are referred to Zhang (2017).

nominal counting. Therefore, I adopt Zhang's proposed structure, and assume that the counting of *ci* is done at LF, where the moved constituents are reconstructed to their base-generated positions as in (36).[12]

With the structure in (36) assumed, let us turn to the semantics of *ci*-sentences starting from the counting of minimal event tokens. The semantics of *ci* is in (38) for its counting on minimal events. It takes some p denoted by the vP as its argument, and then combines with some numeral n.

(38) $||ci_{min}|| = \lambda p \lambda n[|\{e: p(e) \wedge Min(e)\}| = n]$
where Min(e) iff (i) and (ii) hold.
(i) $\neg\exists i_1,i_2,i_3[i_1 < i_2 < i_3 \wedge i_1 \subset \tau(e) \wedge i_3 \subset \tau(e) \wedge i_2 \not\subset \tau(e) \wedge long_c(i_2)]$
There are no intervals i_1, i_2, and i_3 such that i_1 and i_3 are included in $\tau(e)$, i.e., the running time of e, but i_2, which is long in a contextual standard, is not so.
(ii) $\neg\exists e'[e' \leq e \wedge e' \neq e \wedge p(e') \wedge \tau(e') = \tau(e)]$
There is no event e' such that it is a part of e, but not e itself, and it is an event token of p, with the same running time as e.

As shown in (38), *ci* will eventually return to us the meaning that n is the number of minimal event tokens of the event type denoted by p. Crucially, minimal event tokens must be defined, and two conditions are presented for its definition.

The condition in (38i) is a condition against temporal discontinuity. By (38i), $\tau(e)$, the running time of e, derived by applying the temporal trace function τ to the event e (cf. Link 1987, Krifka 1998), cannot be distributed in two separate temporal spans, with an interval in between such that the interval is not included in $\tau(e)$ and the interval is long in a contextual standard.

Example (38i) uses temporal separation instead of an atomic property to define minimal events because as mentioned in Section 2.3, it is commonly assumed that activities do not denote discrete events by themselves (as in Bach 1981, Mourelatos 1981, Bunt 1985, Krifka 1986, Langacker 1987, Talmy 1988, Pelletier & Schubert 1989, and Doetjes 1997). This assumption is based on the idea that the nominal domain and the verbal domain are quite similar in the count/mass distinction, and countability in the verbal domain is linked to the telicity property of VPs. Telic

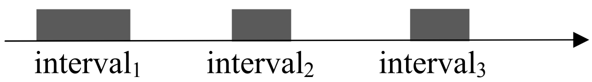
[12] Even though the semantics of *ci*-sentences in this paper was computed on the basis of the syntactic structure proposed in Zhang (2017), it does not have to be tied to this particular syntactic structure. It is possible to adopt a more traditional syntactic analysis of frequency phrases, such as to treat the numeral-*ci* sequence as an adverbial phrase located in V', as proposed in Huang, Li & Li (2009). As long as this adverbial phrase is assumed to move upward to take scope over vP at LF and to have the higher copy interpreted for semantic composition, most of the semantic processes presented here can be kept. In particular, the numeral-*ci* sequence will still work like an event quantifier, and the two-way counting of *ci* can be accounted for in a very similar way.

predicates like accomplishments and achievements have clearer boundaries, and consequently, these verb phrases denote a set of atoms (e.g., Zhang 2013 for the relation between boundaries and count). In contrast, atelic activities have no clear boundaries, and so it is claimed that they are similar in nature to mass nouns. However, individualization of entities to be counted is essential in counting, and these minimal units must be well defined as emphasized in Chierchia (2010). In the nominal domain, Chierchia uses partition and context to make the counting of mass nouns possible. In the verbal domain, I argue that temporal separation is the basic, default way to get discrete entities for events. To see how this works, consider a simple sentence below.

The sentence *Mary danced twice* could be uttered in the scenario in (39a), where Mary danced in two temporal intervals, but not in (39b), a scenario where Mary performed the dancing activity in three temporal spans. It is evident why (39b) is a problematic scenario. With three distinct temporal intervals for the dancing activity, there are three distinct units for the dancing. Thus temporal separation helps to determine the number of event units for the counting of *time*-phrases over activities.

(39) a. Both interval$_1$ and interval$_2$ in the time axis below are the temporal spans where Mary danced.

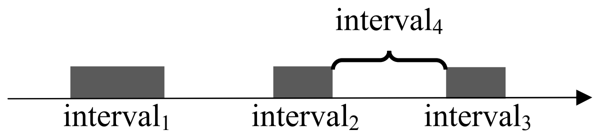
b. Interval$_1$, interval$_2$, and interval$_3$ in the time axis below are the temporal spans where Mary danced.



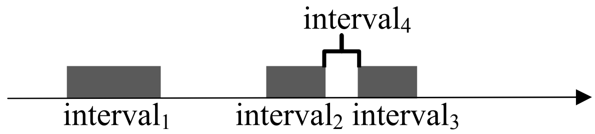
With temporal separation, we can get a set of discrete event tokens not only for the counting of *time*-phrases over activities but also for their counting over telic events. For example, in a scenario where John left a room at 1pm, at 5pm, and at 7pm, by temporal separation of the three leaving actions, there must be three minimal event tokens of John's leaving a room. Therefore, it should be uttered that *John left a room three times* instead of *John left a room twice*. This case counts a telic action that describes temporally separate events, i.e. the minimal events defined in (38i). Therefore, (38i) can be applied to both atelic and telic events.

One difference between the telic and atelic cases is that telic events have inherent endpoints to make the boundaries of events very clear, but atelic events cannot avoid vagueness in event individualization. It is hard to specify how temporally distant distinct event tokens of activities must be. Take (40)–(42) as examples. In (40), with a long interval, namely interval$_4$, located between Mary's two dancing intervals, it is not very likely to view interval$_2$ and interval$_3$ as the running time of one single event token. There should be two separate event tokens corresponding to the two dancing intervals. However, if the interval between interval$_2$ and interval$_3$ is shorter, as in (41) or (42), it is unclear whether the dancing at interval$_2$ and that at interval$_3$ must belong to distinct event tokens. It seems possible to utter either *Mary danced three times* or *Mary danced twice* for (41) and (42), meaning temporal separation between interval$_2$ and interval$_3$ is sometimes significant (when "three times" is uttered), but sometimes not (when "twice" is uttered). This is the reason why i_2 in (38i) should be long "in some contextual standard" to work as an interval to separate events.

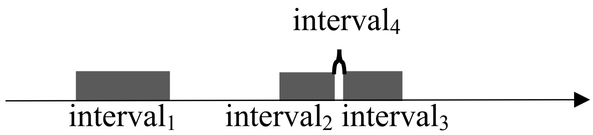
(40) Interval$_1$, interval$_2$, and interval$_3$ in the time axis below are the temporal spans where Mary danced.



(41)



(42)



Note that this vagueness is the same sort of ambiguity shown in (28) for the nominal domain. (28) shows that vagueness in the number of minimal units emerges when there is proximity in space for an object. Examples (41) and (42) show that if a number of actions done by a single agent have temporal proximity, it can be difficult to determine the number of minimal units. So, proximity plays a role in atomicity, and the vagueness in atomicity as a result of contextual effect eventually affects counting in the verbal as well as the nominal domains.

In addition to the temporal separation condition in (38i), minimal events must also satisfy the condition in (38ii) that an event e is minimal, if and only if $\neg\exists e'[e' \leq e \wedge e' \neq e \wedge p(e') \wedge \tau(e') = \tau(e)]$, which says: There is no event e' such that it is a part of e, but not e itself, and it is an event token of p, with the same running time as e. With this condition in mind, the meaning of sentence (21) can be computed as in (43). The resulting meaning is that there are four events of cutting the T-shirt, and the four events are minimal.

(43) $||(21)|| = ||ci_{min}||(||vP||)(||si||)$
$= \lambda p \lambda n[|\{e: p(e) \wedge Min(e)\}| = n](\lambda e \iota y[\text{T-shirt}(y) \wedge {}^*Cut(e) \wedge {}^*Patient(e, y)])(4)$
$= |\{e: \iota y[\text{T-shirt}(y) \wedge {}^*Cut(e) \wedge {}^*Patient(e, y)] \wedge Min(e)\}| = 4$

Now consider scenario (8). Is sentence (21) true in this scenario? First, under the condition in (38i), the events to be counted by *ci* should be temporally separate. For example, the event of Zhangsan's cutting the T-Shirt at t_1 must be distinct from the event of Zhangsan's cutting the T-shirt at t_2. Next, by the truth conditions in (43ii), the events to be counted must be the event tokens of the event type of the T-shirt being cut. As said above, the six events in (27) are such events and should be considered when counting. Among these events, only the minimal ones should be counted. There are four minimal events: e_1 and e_2 are minimal events for they have no parts other than themselves among the tokens at t_1; and e_3 and e_4 are also minimal for they are such events among the tokens at t_2. With these four minimal events, it is acceptable to utter sentence (21) in scenario (8). And indeed it was judged to be so by these Mandarin speakers consulted.

Interestingly, sentence (22) is also true in scenario (8). To account for the two-way counting, *ci* is proposed to count either minimal events or maximal events. That is, in addition to the counting of minimal events, *ci* has another meaning related to maximal events, as in (44).

(44) $||ci_{max}|| = \lambda p \lambda n[|\{e: p(e) \wedge Max(e)\}| = n]$
where $Max(e)$ iff $\exists i \in i_c[\tau(e) \subseteq i \wedge \forall e'[[p(e') \wedge \tau(e') \subseteq i] \rightarrow e' \leq e]]$

In (44), Max(e) holds if and only if $\exists i \in i_c[\tau(e) \subseteq i \wedge \forall e' [[p(e') \wedge \tau(e') \subseteq i] \rightarrow e' \leq e]]$, namely that $\tau(e)$, the running time of e, is included in a temporal interval i, which in turn is a member in i_c, a set of salient temporal intervals in the context, and for any event e', e' has to be a part of e, as long as e' is also an event token of the event type p and its running time is also included in i. In other words, for each contextually salient interval, the maximal event in that interval must be the sum of all the event tokens in that interval.

With this meaning of *ci*, the semantics of sentence (22) should be as in (45), where the final meaning is: There are 2 maximal event tokens of a cutting event on the T-shirt.

(45) $||(22)|| = ||ci_{max}||(||vP||)(||liang||)$
$= |\{e: \iota y[{}^*\text{T-shirt}(y) \wedge {}^*Cut(e) \wedge {}^*Patient(e, y)] \wedge Max(e)\}| = 2$

Does this proposal correctly predict that (22) is a proper statement to describe scenario (8)? The answer is yes. As explained above, the event tokens satisfying "ιy[*T-shirt(y) ∧ *Cut(e) ∧ *Patient(e, y)" are the six listed in (27). Among them, maximal events are picked with respect to contextually salient intervals. In the description in (8), no temporal intervals are mentioned, except t_1 and t_2. So arguably, the two time points are contextually salient temporal intervals. With respect to time point t_1, the maximal event is e_3 since all the qualified event tokens at t_1 are parts of e_3. As for time point t_2, every event token is a part of e_6, and so e_6 is the maximal event for t_2. With two events qualified for counting, the number of the event counting is two. Therefore, (22) is true in scenario (8).

From the definition of ci_{max} and the illustration above, it should be clear that by using *ci* to count maximal events, it can count temporal intervals where at least one event token of the type described has instantiated. In other words, the counting of maximal events can be viewed as temporal counting. Note that this is the sort of counting proposed in Moltmann (1997) and is similar to the counting of occasions in Donazzan (2012) and Deng (2013). Therefore, it is possible to define *ci* in a way that temporal intervals are counted directly. While I do not oppose such an alternative definition of *ci*, I will keep the proposed definition of ci_{max} because the two uses of *ci*, ci_{max} and ci_{min}, differ only in the type of events picked, and so the overall analysis of *ci* is arguably simpler in the current treatment.

This proposal regarding *ci* also makes accurate predictions for sentences (25)–(26). The possible meanings of sentence (25) and (26) are presented in (46) and (47) respectively.

(46) $|\{e: \iota y[\text{*T-shirt}(y) \wedge \text{*Cut}(e) \wedge \text{*Agent}(e, \text{Zhangsan} \oplus \text{Lisi}) \wedge \text{*Patient}(e, y)] \wedge \text{Max}(e)/\text{Min}(e)\}| = 4$

(47) $|\{e: \iota y[\text{*T-shirt}(y) \wedge \text{*Cut}(e) \wedge \text{*Agent}(e, \text{Zhangsan} \oplus \text{Lisi}) \wedge \text{*Patient}(e, y)] \wedge \text{Max}(e)/\text{Min}(e)\}| = 2$

In scenario (8), the event tokens of the event type "ιy[*T-shirt(y) ∧ *Cut(e) ∧ *Agent(e, Zhangsan⊕Lisi) ∧ *Patient(e, y)]" are e_3 and e_6 in (27). At t_1, e_3 is the only event token of the current event type. Thus, it is the maximal as well as the minimal event at this time point. The same holds for e_6 with respect to t_2. In other words, regardless of whether the counting is on maximal or minimal events, the events in the counting set are e_3 and e_6. With two maximal event tokens and two minimal event tokens, the truth conditions in (47) but not those in (46) are satisfied in scenario (8). This means that (26), but not (25), can be properly uttered for scenario (8). This result reflects the intuition of most of the Mandarin speakers consulted.

3.2 Contextual effects on event counting

One may wonder whether it is necessary to base maximal events on contextually salient intervals. In fact, the consideration of contextually salient intervals is an interesting property of *ci* in its ci_{max} use. Look at (48).

(48) Zhangsan likai-le jiaoshi san ci.
     Zhangsan leave-PFV classroom three time
     'Zhangsan left the classroom three times.'

Sentence (48) can be uttered in a scenario where there are three leaving actions done by Zhangsan at three different time points. However, the sentence can also be uttered when Zhangsan has actually left the classroom more than three times. This use of *ci* is allowed, especially when (48) is uttered to describe a scenario such as (49):

(49) In an experiment, Zhangsan's behavior was observed. The experiment was to discover whether Zhangsan would leave a classroom when told not to do so. The experiment consisted of four sessions. It turned out that Zhangsan left the classroom three times in session one, once in session two, and once in session three, while in the last session, he stayed in the classroom the whole time.

When asked to summarize what has happened in the experiment, the Mandarin consultants accepted the uses of both (50) and (51).[13]

(50) Zai zhe si ci ceshi li, Zhangsan likai-le jiaoshi wu ci.
     in this four time test inside Zhangsan leave-PFV classroom five time
     'In the four tests, Zhangsan left the classroom five times.'
(51) Zai zhe si ci ceshi li, Zhangsan likai-le jiaoshi san ci.
     in this four time test inside Zhangsan leave-PFV classroom three time
     'In the four tests, Zhangsan left the classroom three times.'

Example (50) is surely a good sentence for scenario (49), as there were five leaving actions in the experiment. The number "three" in (51) is more crucial for the purpose of the discussion here. With the four sessions mentioned in the beginning of

[13] The phrase *zhe si ci ceshi* 'the four tests' in (50)–(51) reveals that the verbal classifier *ci* also can function as a nominal classifier. Readers are referred to previous works like Zhu (1982), Shao (1996), and Deng (2013) for the multiple functions of Chinese verbal classifiers. Due to limits of space, the current paper will focus on the adverbial use of *ci*. The issue of how verbal classifiers systematically shift their meanings to become modifiers of NPs will be left for future studies.

sentence (51), these temporal intervals arguably become more salient. If event counting is done with respect to these salient intervals, the use of $ci_{\max}$ should get "three" as the event number, as there are a total of three sum events in the four intervals: the sum of all the three event tokens in session one, the sum of the single event token in session two, and the sum event in session three. Since there are three sum events corresponding to the first three sessions, the number of maximal events is "three".

In many cases the saliency of temporal intervals may depend on the perspective of the individual speaker. Therefore, there could be more than one event number in the use of ci_{max}. To see this, let us suppose that (8) has described only part of a more complex scenario, the rest of which is described in (52).

(52) Suppose that there was a game with three sessions. In each session, no one but Zhangsan and Lisi were asked to cut one particular T-shirt with their own scissors. They could not work together to do the cutting, as a piece of cloth was between them to prevent them from seeing what the other one was doing.
In session one: Zhangsan and Lisi each made a cutting action at some time t_1, i.e. they did it simultaneously, and then at t_2, which was 5 minutes after t_1, they did a cutting action on this T-Shirt simultaneously again.
In session two: Zhangsan alone cut the T-shirt.
In session three: No one cut the T-shirt.

To describe scenario (52), consider the three possible numerals for *ci* shown in (53).

(53) Zai zhe san ci youxi li, T-shirt bei jian-le wu/san/liang ci.
in this three time game inside T-shirt BEI cut-PFV five/three/two time
'In the three sessions of the game, the T-shirt was cut five/three/two times.'

The adverbial phrase *wu ci* 'five times' should be appropriate here, as there are five event tokens of the T-shirt's being cut in the whole game, and thus counting by ci_{min} should get "five" as the event number. If instead the counting is done via ci_{max}, two different sets of contextually salient temporal intervals will return to us different event numbers. First, it is possible that the sentential initial phrase *zai zhe san ci youxi li* 'in the three sessions of the game' makes the three sessions salient for some people. Based on these salient intervals, there are two sums of events for the scenario: the sum of the four event tokens in session one, and the sum of the single event token in session two. So *liang ci* 'twice' is the right counting modifier for this case. The other possibility is to take the cutting times as the most salient moments in the scenario. As there are three temporal intervals where cutting actions are conducted, i.e., two cutting time points in session one and one cutting time point in session two, *san ci* 'three times' then is a right counting modifier. So, the choice between *san* 'three' or *liang* 'two' for scenario (52) depends on what salient intervals are in the speakers' mind when they utter (53).

The above discussion reveals that event counting by *ci* can result in different numbers for two reasons. First, the semantics of *ci* allows the flexibility of selecting either maximal or minimal events in counting. Second, the counting of maximal events is based on contextually salient intervals, and different speakers may have different sets of intervals in mind. On the one hand, it follows that there could be cases like (53), where several different numbers are possible to describe one scenario. On the other hand, the context could provide more clues to make irrelevant some of the counting possibilities, and thus only one event number is accepted for some scenarios. One example is provided below for illustration.

Consider the scenario described in (54):

(54) In a math class, a teacher teaching algebra asked students to raise their hands any time to ask questions. It turned out that hands were raised for questions at three time points: at time point t_1, two students raised their hands; at time point t_2, one student raised his hand; and at time point t_3, two students raised their hands.

To describe this scenario, it is possible to use *wu ci* 'five times' or *san ci* 'three times', as in (55)–(56).

(55) Xiaopengyou ju-le wu ci shou.
kid raise-PFV five time hand
'The kids raised their hands five times.'

(56) Xiaopengyou ju-le san ci shou.
kid raise-PFV three time hand
'The kids raised their hands three times.'

To understand the counting, first consider the event type in the two sentences. That is, consider the semantics of (57a). Although (57a) takes a bare NP *xiaopengyou* 'kid' instead of an existentially quantified NP, it can be uttered in cases where only one of the kids has raised his/her hand. Thus, it is assumed that (57a) has the truth condition in (57b), which says that there exists at least one kid who functions as the agent of a hand-raising event.

(57) a. Xiaopengyou ju-le shou.
kid raise-PFV hand
'The kids have raised their hands.'
b. $\exists e \exists x[{}^*\text{kids}(x) \wedge {}^*\text{hand-raise}(e) \wedge {}^*\text{Agent}(e, x)]$

Then, with *wu ci* 'five times' or *san ci* 'three times' added to (57a) as the adverbial modifier, the meaning should roughly be: there are five/three event tokens of the event type described in (57b). The more precise meanings are shown in (58a) and (58b).

(58) a. $|\{e: \exists x[{}^*\text{kids}(x) \wedge {}^*\text{hand-raise}(e) \wedge {}^*\text{Agent}(e, x)] \wedge \text{Min}(e)\}| = 5$
b. $|\{e: \exists x[{}^*\text{kids}(x) \wedge {}^*\text{hand-raise}(e) \wedge {}^*\text{Agent}(e, x)] \wedge \text{Max}(e)\}| = 3$

Example (58a) is true in scenario (54), as there are five separate hand-raising tokens in the whole scenario, and thus it is right to get "five" as the event number by ci_{min}. Example (58b) is also true in scenario (54), based on the following inference. There are three time points at which hands are raised, and so three sums of events can be gotten in the counting set. Each of the sum events in the set is a qualified event token, i.e., an event token of the event type described. To see this, take the sum event at t_1 as an example. Suppose that at t_1, e_1 is the hand-raising event by student A, and e_2 is the hand-raising event by student B. The sum event at t_1 should be $e_1 \oplus e_2$. This plural event is still a hand-raising event with kid A and kid B as the sum agent. Note that if kid A and kid B both raise their hands, it follows that at least one kid raises a hand. So, this sum event is an event of the type that at least one kid raises a hand. By similar reasoning, the other two sum events corresponding to the other hand-raising moments should also be event tokens of the type described. Thus, when ci_{max} is used to count qualified sum events, the number is three. So the analysis correctly predicts that (56) is a proper statement for scenario (54).

Although both (55) and (56) can be properly uttered to describe scenario (54), if more contextual details are added to this scenario, one of the two sentences may become odd. For example, suppose that the teacher in scenario (54) is a new math teacher, and he wants to make everything taught in class as clear as possible. With this intention, he might express (56) to a senior math teacher in order to specify that there are parts of his lesson that are still not completely clear to the students, based on the observation that there are three moments in the class when hands are raised, corresponding to the three hand-raising sum events. In other words, his utterance of (56) is meant to imply that he needs to clarify three parts of his lecture. In such a context, it does not make sense to count minimal events. Consequently, (55) is unlikely to be uttered.

On the other hand, there are cases where (55) is the only reasonable utterance. If instead the context is one where the teacher aims to encourage the students to ask questions by promising a small gift to every student who asks a question, he would utter (55) instead of (56) to convey that five gifts in total will be distributed.

To sum up, while the semantics of *ci* may allow us to get several possible event numbers in a scenario, contextual details will affect the choice among the event numbers. As a general rule, when individual event entities need to be specified, minimal events are counted; when instead the number of occurrences of the event type should be informed, maximal events are counted.

4. Grouping and event counting

Thus far, I have provided a simple analysis to account for the various counting possibilities by the use of *ci*. I have shown that the proposed truth conditions of *ci*-sentences can explain their (in)appropriateness in context. However, one type of sentence has yet to be discussed, namely those where the numeral-*ci* sequence seemingly does not work like an event quantifier, i.e., it does not give us the number of instances of the event type described. One example is the acceptance of sentence (25) for scenario (59).

(59) Scenario: Zhangsan and Lisi were asked to cut one particular T-shirt with their own scissors. Zhangsan cut it at time points t_1 and t_3. Lisi did it at time points t_2 and t_4. The four time points t_1-t_4 were all temporally distant from one another, with the temporal order being $t_1 < t_2 < t_3 < t_4$.

If the numeral-*ci* sequence works as an event quantifier, sentence (25) with the expression *si ci* 'four times' should describe a scenario where there are four minimal or maximal event tokens of the type described. But in scenario (52), at each of the four cutting time points, there is only one agent for the cutting action. There cannot be four instances of the type "Zhangsan and Lisi cut the T-shirt". So, (25) should sound odd in this context. However, this prediction is wrong. Of five Chinese native speakers consulted, while one hesitated, four people readily accepted (25) for scenario (59).

How can this be explained? *Si ci* 'four times' in (25) seems to state the right event number for scenario (59) because there are four event units in the scenario: 2 cutting events by Zhangsan and 2 cutting events by Lisi. If *si ci* 'four times' in (25) can work like an event predicate to specify that there are four subevents within the event type described, as in (60), (25) will be predicated to be good for scenario (59). But it is impossible to propose an event predicate analysis for *ci*, as was discussed in 2.2 and 2.3. The crucial judgment is that (25) with *si ci* 'four times' cannot properly describe scenario (8), where there are four atomic events. This is the reason why Deng's (2013) proposal becomes problematic for the numeral-*ci* sequence. Therefore, under the event quantifier analysis of *ci*, it is unclear why (25) is accepted for scenario (59).

(60) $\exists e[|\{e': e' \leq e \wedge atom(e')\}| = 4 \wedge *Cut(e) \wedge *Agent(e, Zhangsan \oplus Lisi) \wedge \iota y[*T\text{-}shirt(y) \wedge *Patient(e, y)]]$

There is a sum event e, consisting of four atomic event members, and this sum event is a cutting event, with Zhangsan and Lisi as the sum agent and with a unique T-shirt as the patient.

To account for the acceptance of (25) for scenario (59), let us first consider the various readings available for sentences with plural agents and numeral expressions by focusing on the first clause of (61).

(61) Daming han Xiaoming mai-le san dong fangzi, Lisi mai-le liang dong.
Daming and Xiaoming buy-PFV three CLF house Lisi buy-PFV two CLF
'Daming and Xiaoming bought three houses; Lisi bought two houses.'

The most salient reading of this clause is the collective reading, in which for each of the three house-buying events, Daming and Xiaoming performed them together. As an alternative, a distributive reading is also available in the following scenario. A sales person looked at a spreadsheet on the selling of houses in the year, pointing out that Daming and Xiaoming both were people who bought three houses. In other words, Daming and Xiaoming each bought three houses. Crucially, there is yet another reading for this clause that is available when Daming and Xiaoming were in one group in some sense. For example, it can be that Daming and Xiaoming were brothers; Daming himself bought two houses, and Xiaoming himself bought one house. In this case, (61) expresses that the two brothers as a group bought three houses in total, without conveying that they bought any houses together.

Other similar cases also have these different readings, unless some of the readings are pragmatically odd. For example, for the first clause of (62), the collective reading is odd, as one mouthful of rice usually is not eaten by two people. Other than that, the distributive reading and the third reading are available. That is, it can be that Zhangsan and Lisi each ate 10 mouthfuls of rice, or that the two people as a group had 10 mouthfuls of rice in total.

(62) Zhangsan han Lisi chi-le shi kou fan, Wangwu chi-le san kou.
Zhangsan and Lisi eat-PFV ten CLF rice Wangwu eat-PFV three CLF
'Zhangsan and Lisi had ten mouthfuls of rice; Wangwu ate three mouthfuls of rice.'

Now, let us turn to a case crucial for our purpose. Consider the first clause of (63). As mentioned above, by the event quantifier analysis of *ci*, (63) is true when there are four instances of a T-shirt cutting event with Zhangsan and Lisi as the sum agent. These truth conditions can be satisfied in two different situations. It can be that the two people made a cut together in each of the instances, and it also can be that in all the instances, they each made a cut. In either situation, there is a T-shirt cutting event with two people as the sum agent. So this clause can have a collective or distributive reading. Importantly, this clause also has a third reading, just like the first clauses of (61) and (62). That is, it can express that Zhangsan and Lisi as a group cut the T-shirt four times. As in (61) and (62), using this reading, the two people in the group did not have to do the events in question together. The paper argues that this group reading enables the acceptance of sentence (25) for scenario (59).

(63) Zhangsan han Lisi jian-le si ci T-shirt, Wang jian-le liang ci.
Zhangsan and Lisi cut-PFV four time T-shirt Wang cut-PFV two time
'Zhangsan and Lisi cut the T-shirt four times; Wang cut it twice.'

For this group reading, I assume that the covert group-formation operator $\uparrow$ proposed in Link (1983) and Landman (1989, 2000, 2004) is applied to turn a sum into a group. Thus, sentence (25) has the semantics in (64), where the sum of Zhangsan and Lisi is turned into a group.

(64) $|\{e: \iota y[*\text{T-shirt}(y) \wedge *\text{Cut}(e) \wedge *\text{Agent}(e, \uparrow(\text{Zhangsan}\oplus\text{Lisi})) \wedge *\text{Patient}(e, y)] \wedge \text{Max}(e)/\text{Min}(e)\}| = 4$

Even though the counting in (64) still regards event tokens of the event type described, there is an important consequence of the grouping. It is noted in Landman's work that in the group reading, not everyone in the group must be involved in the action denoted by the verbal predicate (cf. Scha 1981, among many later works on the collective interpretation). For example, the sentence *The boys carried the piano upstairs* under the grouping reading can be true in a scenario where some boys in the group did not take part in the piano carrying activity. As long as the piano carrying task has been accomplished by some boys in the group, this sentence can be properly uttered. With this property of the group reading considered, (64) can be true when the four event tokens are events with only Zhangsan or only Lisi performing a cutting action. As a result, with the truth conditions in (64), (25) can be true in scenario (59), even though the two people did not conduct a cutting action together for any of the four events in the scenario.

The grouping analysis is further supported by the following case. Consider (65).

(65) Zhangsan and Lisi were asked to cut one particular T-shirt with their own scissors. At time point t_1, Zhangsan alone cut it. At time point t_2, Zhangsan and Lisi each cut the T-shirt. At time point t_3, Lisi cut it alone.

In this scenario, there are also four cutting actions, two by Zhangsan and two by Lisi. However, sentence (25) cannot be properly uttered in this scenario. Based on a survey of five native speakers, (66) but not (25) was chosen to describe scenario (65). Note that there are three moments of cutting. If Zhangsan and Lisi are in one group, for each of these moments, there is an event token of the type that this group cut the T-shirt. The tokens differ in that the tokens at t_1 and t_3 were events which were actually performed by only one of the group members, while the token at t_2 was an event performed by both members. This difference will not prevent us from getting three event tokens of the event described. So, sentence (66) is correctly predicted to be true for scenario (65).

(66) Zhangsan han Lisi jian-le san ci T-shirt.
Zhangsan and Lisi cut-PFV three time T-shirt
'Zhangsan and Lisi have cut the T-shirt three times.'

To sum up, I have examined some apparent counterexamples for the event quantifier analysis of *ci*-phrases. I argue that the covert grouping operation can account for these examples. So the proposal can keep the idea that *ci* is used to count tokens of the event type described.

5. Conclusion

The paper studies the verbal classifier *ci*. *Ci* is the most general verbal classifier in Chinese, but it has a relatively vague meaning in terms of what it counts. One possible treatment is to consider the temporal meaning revealed in its English counterpart, namely the word *time*, and treat both Chinese *ci* and English *time* as verbal classifiers over temporal intervals in some way. This sort of counting is adopted by Moltmann

(1997) and is similar to the counting of occasions in Donazzan (2012) and Deng (2013). The other possible analysis is to treat Chinese *ci* and English *time* as basic event counters that directly count event units. This analysis is proposed in Landman (2004) and is more like the counting of atomic events in Deng (2013).

The paper claims that both of the above analyses are right in some way, as Chinese *ci* has two ways of counting. However, it is important to clarify how events are divided for this general verbal classifier to count and what exactly *ci* counts. In this paper, I have attempted to make the semantics in the event counting as precise as possible. First, I argue that *ci* does not target subevents or atomic events. Instead, instances of an event type at different temporal spans are discrete event units by default, and among these event units, *ci* may count the minimal or maximal events. Second, I point out that the contextual effects in the counting of *ci*. I argue that *ci* should contain a variable for salient contextual intervals in the counting of maximal events. I also propose that for the uses of *ci*, the choice between the minimal events and the maximal events is determined by whether the speaker should specify the number of individual events or the number of distinct temporal intervals for the realization of the event type described.

If my analysis is on the right track, it can be applied to further studies on the many other verbal classifiers in Chinese with the aim to better understand the ontology of events and the counting, pluralization, and measurement in the verbal domain.

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漢語『次』的事件計數

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關鍵詞：事件計數、動量詞、事件類型、事件個體、最小事件