Temporal patterning of speech and iconic gestures in conversational discourse

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Abstract

This paper investigates how speech and iconic gestures are patterned temporally in conveying information in Chinese conversation with reference to temporal phases, pauses, fluency of speech, and stroke synchrony. The results reveal different timing relations. First, in the onset phase, speakers overwhelmingly start to gesture during fluent speech rather than during a pause. When speakers encounter verbalizing difficulty, onsets tend not to occur in silence, yet they mostly come before the affiliated words. In the stroke phase, however, speakers are not inclined to produce strokes before affiliated speech units. A substantial portion is produced simultaneously with related words without onsets, suggesting that the verbalizing obstacle is not always resolved by manual movement. On the other hand, just like the onsets, strokes mainly take place where speech is fluent. Finally, the strokes are equally likely to synchronize with, be prior to, or follow speech, be the related words carry new or old information.

Keywords: Gestures; Iconic gesture; Temporal patterning; Pause; Fluency of speech; Information state; Conversational discourse; Chinese

1. Introduction

When people talk face-to-face, they often produce spontaneous gestures through the use of hands and arms, the head and the face, and the gaze of the eyes. These bodily movements play an important role in communication as they cooperate with speech to express meaning. In example (1), speaker C narrates an incident in which she mentions a stray dog that appeared to be crying. She noticed the dog when her brother was giving her a ride on a motorcycle. The information about transportation is not realized in speech, but rather expressed in the form of hand movement: both C's hands rise to chest level and are held in a fist at each side of the body at the moment of uttering the verb zai 'give someone a ride', as if to grip the handles of a motorcycle. Thus, regarding the same speech event, gesture and words both bear different kinds of information: the movements of the hands depict the means of transportation while speech conveys the action of taking a ride. This example supports McNeill's (1992: 2) claim that "gestures are an integral part of language as much as are words, phrases, and sentences." The

linguistic data alone do not always provide a complete view of the message that the speaker intends to convey.

(1)   C: [[Wo jiu gen wo ge]]   jiang shuo%,_
                         1SG then with 1SG older brother say   COMPL
                         ...Ge=/
                         older brother
                         ...na gou,\
                         that dog
                         ..zai   ^ku ei,_
                         PROG cry PRT
      →   ...Yinwei   wo ge   ^zai   wo,\
                         because   1SG older brother give someone a ride 1SG

                C: 'I then said to my older brother, "Brother, that dog is crying."
                     (It happened) when my older brother was giving me a ride.'

The gestures to be examined in the present study are the idiosyncratic spontaneous movements of hands and arms, which accompany a speech event with context-dependent meaning and use. Since gestures are associated with speech, the question is how gestures are patterned temporally in conveying information. Butterworth and Beattie (1978) find that in relatively fluent phases of speech, iconic gestures tend to have their onsets (i.e., the preparation phase) in pause, and hence precede the onset of the related speech. Morrel- Samuels and Krauss (1992), and Hadar and Butterworth (1997) also note that the onset of iconic gestures comes before the affiliated words. Another timing relation concerns hand movements and the stroke phase. Schegloff (1984) claims that not just the gesture onset, but also the stroke of iconic gestures is typically prior to the related words. In contrast, McNeill (1985, 1992) has shown that the strokes overwhelmingly coincide with the speaker's actual speech articulation rather than with pause. Finally, Butterworth and Hadar (1989) find that when speech is not fluent, the onset of iconic gestures predominantly occurs in hesitation pauses due to lexical selection difficulty. Despite the fact that these previous studies have produced different results, the factors that they suggest are all relevant to examining the temporal relation between speech and gesture, which is the focus of the present article. This focus includes the questions of how speech coordinates with different phases of gesturing, whether gesture tends to be performed when the speaker is not articulating, and whether the speaker encounters verbalizing obstacle in gesturing.

While the general belief (to put it succinctly) is that hand movements are in close temporal synchrony with the flow of speech, yet past research has not presented a complete and consistent scenario showing the precise patterning of a gesture in relation to speech units. Furthermore, most of the studies did not investigate gestures in natural discourse, based on real data. In order to understand speakers' spontaneous linguistic and gestural behavior, this paper will study how speech and iconic gestures are patterned in actual Chinese conversational discourse with respect to *temporal phases*, *pauses*, *fluency of speech*, and *stroke synchrony*.

The next section introduces the database used in this study. Section 3 analyzes and discusses temporal patterning at both the onset and the stroke phase. Section 4 considers gesturing in non-fluent speech. A general discussion will be provided in the final section.

2. The database

The data used here include four casual, not premeditated, multi-party conversations, which took place in 1994 and 1995 among college students who knew each other. The subjects were free to find topics of common interest; they were not told the particular focus of our research. Subjects were filmed for approximately an hour, with a visible camera and in full-body shot. One section from each conversation, about 20 minutes of talk, in which students were more comfortable in front of the camera, was then extracted. Gestures were analyzed by computer, using MediaStudio Pro, a program package which features frame-by-frame advance and varying slow-motion capabilities with no muting, so that the sound could be heard as the images were advanced. Thus, movement at a given moment in time could be matched with a simultaneously uttered syllable or with silence.

The four stretches of conversation yield 303 iconic gestures associated with single words, such as the hand movement signifying giving someone a ride for the verb *zai* in (1).[1]

3. Temporal phases

According to McNeill (1992: 83), there are mainly three phases of gesticulation: 'preparation', 'stroke', and 'retraction'. The preparation phase (also known as 'onset') refers to "the limbs mov[ing] away from their rest position to a position in gesture space where stroke begins." In the following excerpt, (2), about a cockroach getting into a bag, the manual movement starts from the second word *baobao* 'bag' in speaker A's turn ('IU1'; see Appendix B for the definition of IU), as her left hand faces downward and moves to the right, preparing for the next phase. In the stroke phase, "the meaning of the gesture is expressed." (McNeill, ibid.) This refers to the nominal referent *lalian* 'zipper' in (IU2), as the speaker moves the left hand from side to side four times as if to zip a bag open and shut. Finally, the

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[1] In the present corpus, 14 iconic gestures are related to idea-sized speech units rather than to single words. Because of their rarity, these gestures were excluded from this study. In addition, whenever the same iconic gesture was being used more than once to depict the meaning of the same word, it was only counted once in the present tabulation.

retraction phase is the "return of the hand to a rest position" (ibid.): speaker A's left hand goes back to the thigh at the moment of uttering the conjunction *ranhou* 'then' in IU3.

(2)　1　→　A:　...<A Ta　**bao**bao% A> --
　　　　　　　　3SG　bag
　　　2　→　　　...**lalian** shi　kai　de　ma,\
　　　　　　　　zipper EMP open PRT PRT
　　　3　→　　　...**Ranhou,**\
　　　　　　　　then
　　　4　　　　　..wo　benlai　　xiang shuo,_
　　　　　　　　1SG originally think COMPL
　　　5　　　　　...(.8) zheyang pa　　jinqu　　le　　zenmeban,\
　　　　　　　　like this climb go inside PRF what to do

　　　　　A:　'(As to) his bag, its zipper was open. Then, I was thinking what to do if (the cockroach) were to climb into (the bag).'

　　　Both the preparation and the retraction are optional; the stroke is obligatory. The subject for conversation in the following turn (3) has to do with where cockroaches usually appear. The excerpt comprises two gestures: one for the verb *xizao* 'take a bath', and one for the nominal form *chushuikou* 'water outlet'. *Xizao* includes the first two phases of gesticulation, while *chushuikou* involves the last two. In gesturing *xizao* 'take a bath', speaker C's both hands rise up from the thighs, preparing for the stroke phase: both hands with closed fingers appear to hold something and pour water onto the body by rotating the hands inward. In fact, the lack of retraction for *xizao* coincides with the absence of preparation for the next hand shape, so that starting from the nominal *cesuo* 'toilet', speaker C makes a circle with the fingers of both hands to depict the round shape of the water outlet. Then, the hands descend to waist level and sweep up for one time, as if the water rushing out of the outlet. The left hand first returns to the rest position, while the right hand again performs the same gesture, when the first morpheme *chu* of *chushuikou* is uttered. The hand returns to the thigh after the whole compound has been verbalized.

(3)　　C: ...(1.)^Lirushuo,_
　　　　　　　　for example
　　→　　　...^**xizao,**\
　　　　　　　take a bath
　　　　　...huozhe,_
　　　　　　or
　　→　　　...^**cesuo** de　　nage%,\
　　　　　　toilet POSS that
　　→　　　...**chu**shuikou,\
　　　　　　water outlet
　　　　　...<DIM na　ge　difang a DIM>,_
　　　　　　　　that CL place　PRT

　　　C: 'For example, the kind of water outlet place of the bathtub or of the toilet.'

This section will present the findings concerning the temporal patterning of speech and gesture vis-à-vis the preparation and the stroke phase during fluent and non-fluent speech production. Whether the hands return to the rest position right after the stroke (in the retraction phase) is not considered in the present study.

3.1. The preparation (onset) phase

The preparation phase being optional, not every hand shape includes this phase. Out of a total of 303 gestures, only 73 instances (24.1%) have onsets. The preparation whereby speaker A moves her left hand to the right to gesture *lalian* 'zipper' in (2) occurs when the speaker utters the word *baobao* 'bag'. The following turn, (4), describes the way the speaker's sister deals with cockroaches; here, the preparation starts in a pause: the speaker has formed the shape of the tip of a correction pen with the thumb and the index finger of her right hand at chest level while uttering *jiushi* 'that is' in IU3. Then, preparing to gesture the action of dropping correction liquid onto a cockroach, speaker A starts to move during the silence after the verb *yong* 'use' (IU6), as indicated by the three dots at the beginning of IU7: she raises her left hand to chest level to meet the right hand, after which both hands move downward to signify the dropping action at the time the first word *di* 'drop' is produced.

At issue here is the question: Do speakers tend to initiate manual movement during speech or in pause? Our conversational data show that gesturing without speech is rare; only five instances (6.8%) were found to have their onsets in silence.

```
(4)  1       A:  ..Xianzai wo   jie
                   now      1SG older sister
     2           ...ta    dou  hai yong,\
                   3SG all    still use
     3  →        ...jiushi,\
                   that is
     4           ..fanzheng,_
                   anyway
     5           ...di   dongxi,_
                   drop thing
     6  →        ...yong,\
                   use
     7  →        ...yi di  yi  di   di   de  a./
                   one drop one drop drop PRT PRT

             A: 'Now my older sister, she still uses, that is, anyway, (she) drops
                 something...drops (something, i.e., correction liquid, onto a cockroach),
                 drop by drop.'
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Moreover, gesture onsets may occur in non-fluent speech with self-repair; sometimes they are accompanied by a hesitation pause. In (5), the speaker is talking about how hard her part-time job was at the library: she had to handle five books of accounts, each of which included more than a hundred data entries. In IU8, the speaker intends to talk about

handling all the data as a whole, but this idea is abandoned and the clause is cut off at the adverbial *quanbu* 'all'. Instead, she seeks to justify how hard her work was by explicating how time-consuming it was to retrieve data from the computer (IU9, 10, 11, 13). It is right after the speaker has abandoned the idea of speaking about handling all the data in IU8 that she turns both of her hands up while (in IU9) uttering the conjunction *yinwei* 'because' as the beginning of a repairing clause. This movement is the preparation for raising both hands upward a single time to signify the action of retrieving data, *jiao chulai* 'retrieve', in IU10.

Of all the 68 iconics being performed during speech, the preparation phases predominantly take place during fluent phases of speech at 92.6% (63 instances out of 68).

(5) 1   A: ...(1.3) Ta   de   zhangmu you wu ^ben. \
                          3SG POSS account   have five CL

    2   B: ..Hm,_
                    BC

    3   A: ...(.6) Wu ben,\
                          five CL

    4   ...Mei yi ben limian,_
                        every one CL inside

    5   ...you   yi bai   duo bi.\
                        there.be one hundred more entry

    6   B: ..Hm=,_
                    BC

    7   A: ....^Da-si   le%,/
                         enter.exhaust PRT

    8   →   ..**Ranhou ni   quanbu%,**
                        then   2SG all

    9   →   ...**Yinwei ni   yao   yi bi,_**
                        because 2SG have to one entry

    10   →   ..**^jiao   chulai ma.**
                        retrieve out   PRT

    11   →   ...**[Yi   ^jiao].**
                        once   retrieve

    12   B: [uh=],_
                     BC

    13   →   A: ..**jiu yao ^jiao   hen jiu.**
                      then will retrieve very a long time

          A: 'She has five books of accounts.'
          B: 'Hm.'
          A: 'Five books (of accounts)! In each book, there are more than one hundred entries (for data).'
          B: 'Hm.'
          A: '(I was) exhausted entering (the data). Then, you all...because you have to retrieve each entry. Once (you) retrieve (the data)...'
          B: 'Uh.'
          A: 'then (it) will take a very long time.'

The findings presented in this section do not match with the results of previous studies (Butterworth and Beattie, 1978; Butterworth and Hadar, 1989), since iconic gestures in Chinese conversation do not have their onsets mainly in silence. Nor do they tend to occur in hesitation pauses. The overwhelming majority start at the moment the speaker is producing an utterance. (Hand movements during non-fluent speech will be taken up again in Section 4.)

3.2. The stroke phase

This section examines the temporal relationship among iconic gestures, pauses, and fluency of speech at the obligatory stroke phase. Do speakers tend to produce strokes during speech or in pause? Are they prone to difficulties in verbalizing when strokes are gestured? Finally, the temporal synchrony of gestural stroke and its affiliated word will also be discussed.

First, just as in the case of onsets, strokes may take place during speech production or in silence. The former can be evidenced by all the examples presented so far. As to strokes in pause, speaker A in (6), while talking about the power struggle between a teacher and students in classrooms, performs a gesture of balancing during the 0.7-second pause (IU7), as she moves her left hand levelly leftward, palm facing down, for the verb-to-be-uttered *pingheng* 'balance'. The statistics in the present study evidence that the overwhelming majority of hand movements were formed along with speech (97.7%, 296 instances out of a total of 303).

(6)	1	A:	...Nanguai renjia dou gen wo shuo,_
			no wonder people all to 1SG tell
	2		..jiaoshi shi yi ge quanlichangyu,\
			classroom COP one CL power arena
	3	D:	(0)<P M= P>,_
			BC
	4	A:	(0)Ni%,\
			2SG
	5		..jiu[shi%],\
			that is
	6	D:	[Hm],\
			BC
	7	→ A:	...(.7)yao qu **pingheng** ta,_
			have to go balance 3SG

A: 'No wonder people all tell me (that the) classroom is a power arena.'
D: 'Mm.'
A: 'You, that is,'
D: 'Hm.'
A: 'have to balance it.'

Moreover, the stroke can be performed when speech is fluent, as in the case of the hand shape of unzipping and zipping a bag for the co-expressive nominal *lalian* 'zipper' in (2). On the other hand, the gestural stroke in (7)—a container shape formed by the speaker's right hand for a kind of shampoo–shower gel—rather takes place in non-fluent speech, right after

the speaker has repaired the adverbial *gong* 'both' in IU4. Out of a total of 296 gestural strokes performed during speech, 89.9% (266) occur without difficulties in verbalizing. Again, hand movements that are performed during non-fluent speech will be discussed in Section 4.

(7)   1   B: ...Wo   shi   yong na   zhong,\
                           1SG COP use   that kind

        2   ...jiushi xi-tou,_
                               that is wash:head

        3   ..xizao%,\
                               take a shower

        4   →   ...**gong**% --
                               both

        5   →   ...**gong**-yong yi   zhong de   na   zhong,_
                              both:use   one kind   ASSC that kind

                      B: 'I use that kind, that is, the kind that (can be) used to wash both the hair and the body.'

3.2.1. Gesture synchronizing with speech

Gestural strokes can further be distinguished into three types, based on their temporal realization vis-à-vis the accompanying words: those synchronizing with related words (henceforth 'synchronizing' gestures), those coming before the related words (henceforth 'preceding' gestures), and those following related words (henceforth 'following' gestures). Their respective frequency distribution among all the 303 iconics is shown in Table 1.

Table 1
Synchronization of gesture and speech

	n	%
'Synchronizing' gesture	182	60.1
'Preceding' gesture	108	35.6
'Following' gesture	13	4.3
Total	303	100.0

The simultaneous realization of speech and gesture comprises a great many instances of gesture, such as the 'frying' hand shape for the co-expressive verb *jian* 'fry' in (8). As the speaker is mentioning the place in which to hold a departmental gathering, every time she verbalizes *jian*, her right hand at shoulder level sweeps downward to the left side one time with the fingers closed in, as if to fry something in the appropriate cooking utensil.

(8)   C: ..Women xianzai xiang yao huandao,\
                1PL   now   think want change

              ..^qixianlou,_
                Qixian Building

              ...Yinwei qixianlou,_
                  because Qixian Building

→   ..keyi **jian** dan%,\
     can fry egg
→   ...**jian** huotui,\
     fry   ham

C: 'Now we want to change (the place) to the Qixian Building,
    because (we) can fry eggs and ham at the Qixian Building.'

For gesture and speech to be produced at the same time is plausible, because gesture is semantically associated with its affiliated word, without which it would be quite impossible to interpret the hand movement. But if this is the case, then why does the speaker perform the stroke either before or after the related word? This question will be discussed in the following sections.

3.2.2. Gesture preceding speech

Sometimes the stroke phase, even the complete hand gesture, precedes the related speech. In the turn below, (9), the speaker is giving a general description of what it is like to work part-time at the library, running from one place to another to make copies. The gesture of both of her hands moving back and forth to signify running is performed at the moment the speaker verbalizes the second person pronominal subject *ni* and the first morpheme *yi* of the adverbial *yizhi* 'continuously', prior to the co-expressive referent *pao* 'run'.

(9)   A: ...Ranhou%,_
        then
→   ...yi tian **ni** jiu zheyangzi,\
     one day 2SG then like this
→   ..<A **yizhi**   **pao**,\
       continuously run
    ..yizhi   pao.\
     continuously run

A: 'Then, you keep running and running the whole day.'

As mentioned above, Schegloff (1984) has noted that the stroke phase of iconic gestures typically comes before the affiliated words. However, this is not borne out by Chinese conversation, as this type of iconics merely constitutes 35.6% of the total (see Table 1).

What is the difference between gestures performed simultaneously with associated speech and those coming before speech? One of the basic functions of communication being to 'convey information', we will now consider the information state of nominal and verbal referents in the main clause. Here, as the speaker unfolds information, the given-new distinction might affect the temporal ordering of gesture and speech. However, the flow of information throughout a discourse is a dynamic process, in that the varied aspects of information may change in the course of communication. Thus, a referent was analyzed as

Table 2
Information state of 'synchronizing' and 'preceding' gestures

	'Synchronizing' gestures		'Preceding' gestures	
	n	%	n	%
Given	54	32.7	34	32.7
New	111	67.3	70	67.3
Total	165	100.0	104	100.0

'new', if it had never been brought up in the previous context at the moment of speaking; a referent was analyzed as 'given', if it had already been brought up previous to the moment of utterance. Since, as we saw above, the meaning of a gesture is far from clear without its concomitant speech, the question is whether the 'preceding' gestures function to announce to the hearer that some new information is going to be conveyed by the anticipated speech units? In this study, only nouns and verbs were analyzed and combined for tabulation. Table 2 presents the frequency distribution of given and new words vis-à-vis the two different gestural positions. The 'synchronizing' gestures were then compared to the 'preceding' gestures; the differences were found statistically insignificant in each gesture type.[2] In other words, whether the gesture is performed simultaneously with or prior to the affiliated word is not related to whether the related words carry new or old information.

3.2.3. Gesture following speech

Turn (10) exemplifies strokes taking place after their associated speech. During a discussion about twins, the gesture for *tiaoxin* 'provoke' is not performed at the time the verb is uttered. It is rather produced at the end of the turn, after the whole clause has been finished: the speaker raises both of her hands from the thighs to the chest level with palms facing one another, and then the hands sweep slightly across twice.

```
(10)  A:   ...Renjia jiu    shuo%,\
            people then  say
          ...<A ni    bu    yao    gen  tamen chaojia A>,\
              2SG  NEG should with 3PL   argue
          ...Ni   ^gen yi  ge   chao,\
            2SG  with one CL  argue
          ..dengyu gen  <@ liang ge   chao @>.\
            equal   with     two  CL argue
       ((NINE IUS OMITTED))
          ...(.8) Dui   a,_
               right PRT
          ...Suoyi tamen jiu   hui  juede%,\
            so      3PL   then will feel
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[2] The χ^2-test for new affiliated words with 'synchronizing' gestures and new affiliated words with 'preceding' gestures yields $\chi^2_{.95(1)} = 0.802$.

→ ...jianzhi shi   gen wo <@ **tiaoxin**   ma @>],\
   clearly EMP with 1SG   provoke PRT

A: 'People say (that) you should not argue with them (i.e., the twins).
   Arguing with one equals you arguing with both....(Nine IUs omitted)
   Right, so they will feel (that you) clearly provoke them (to argue with them).'

Table 3
Information state of 'following' gestures

	n	%
Given	6	46.2
New	7	53.8
Total	13	100.0

For gestures to be performed after the related words have been uttered is not a common occurrence in conversation. The distribution of given and new nouns and verbs accompanied by this type of iconics is shown in Table 3. Comparing the statistics to those in Table 2, again, there were no significant differences among 'synchronizing', 'preceding', and 'following' gestures.[3] Synchrony of speech and gesture is thus not related to the information state.

4. Gesturing in non-fluent speech

As mentioned in Section 1, Butterworth and Hadar (1989) have suggested a different temporal relation between speech and gesture when the speaker encounters a difficulty in lexical selection. The purpose of this section is to examine gesturing in non-fluent speech. 'Non-fluent speech' here is not restricted to occurrences of difficulties of lexical selection, but refers to all kinds of obstacles to verbalization, such as manifested by repetition or hesitation. In excerpt (11) whose topic is a departmental gathering, the speaker, for whatever reason, cuts off at the word *yao* 'need'; the speech is resumed by repeating the subject *ni* 'you', the negative *bu*, and *yao* after some hesitation (as indicated by the 0.8 hesitation pause and the filled pause *jiushi* 'that is'). The gesture for the verb *nong* 'make things' takes place within this non-fluent clause: the speaker's hands sweep outward one time at both sides of the body to signify the action of preparing things for a party.

(11)   B: ...Keshi%,\
             but
             ..<A ruguo ni% A>‿

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[3] The χ^2-test for new affiliated words with 'following' gestures and new affiliated words with 'synchronizing' gestures yields $\chi^2_{.95(1)} = 1.014$. The χ^2-test for new affiliated words with 'following' gestures and new affiliated words with 'preceding' gestures yields $\chi^2_{.95(1)} = 1.673$.

```
                       if    2SG
                 ...zhi  yao  changdi,\
                   only need place
   →             ...ni    bu    ^yao,\
                   2SG NEG need
   →             ...(.8) jiushi%,_
                     that is
   →             ..ni    bu    yao  ta   ^nong shenme dongxi de^hua%,\
                   2SG NEG need 3SG make  any     thing   if
                 ...(.7)^jiu   yao  wu  qian      kuai.\
                     then  need five thousand dollar
```

> B: 'But, if you just need the place, you don't...that is...you don't
> need him to make anything, then (the rent) is five thousand dollars.'

Gestures may also be produced when the speaker has a retrieval problem. In the following turn, (12), concerning payment of a tuition fee, before speaker A performs the iconic gesture for *duli* 'separate from' by moving her left hand outward at chest level while verbalizing the whole co-expressive compound verb in IU4, she has difficulty retrieving *duli* in the previous IU3.

```
(12)  1      A:  ...Tamen% <A yao      shou%,\
                    3PL           have to collect
      2          ..Yinwei   ta   shi% A>--
                   because 3SG EMP
      3  →       ..ta   shi    du,_
                   3SG EMP   REPAIR
      4  →       ..duli     chulai,\
                   separate come out
      5          ..eh%,\
                   PF
      6          ..gei nimen fuxisheng,_
                   for 2PL   minor student
```

> A: 'They (i.e., the department) have to collect (the tuition fee),
> because (access to the program is organized) on a separate (basis)...
> eh...for the minor students.'

The last type of non-fluent speech found in the corpus results from problems of planning, as the speaker in (13) abandons the unfinished clause about using something to deal with cockroaches (IU7). After a 0.7-second pause, she starts a new construction about not daring to use a pesticide (IU8), during which two iconic gestures are produced. One takes place at the pronominal subject *wo* 'I': her right hand rises from the thigh to chest level, with thumb and index finger forming the action of being about to press the nozzle of a can of pesticide; the whole gesture signifies *shachongji* 'pesticide'. A further gesture is performed for the verb *pen* 'spray' at the time the first

syllable, *wei*, of the next question word (*weishenme* 'why') is uttered: the right hand, still shaped like the nozzle of a can of pesticide, moves downward one time, as if pressing the nozzle.

(13) 1   A: ...Women%,_
                      1PL
      2   ..de   yuanze shi,\
                      POSS principle COP
      3   ...juedui   bu   neng,_
                       absolutely NEG can
      4   ...jiechudao,\
                       come into contacts with
      5   ...zhanglang._
                      cockroach
             ((FOUR IUS OMITTED))
      6   ..^Xiang,\
                       for instance
      7   →   ...**wo   lian yong na   ge,_**
                      1SG even use   that CL
      8   →   ...(.7) **Wo weishenme bu   gan pen   shachongji,**
                       1SG why   NEG dare spray pesticide
      9   ...ni   zhidao ma?/
                      2SG know QST

          A: 'Our principle is absolutely not to come into contacts with
             cockroaches. (Four IUs omitted) For instance, I even use that....
             Do you know why I don't dare to spray pesticide?'

Non-fluent speech is usually accompanied by a long silence (exceeding 0.6 seconds), such as the 0.8-second pause in (11) and the 0.7-second pause in (13), by filled pauses like *jiushi* 'that is' in (11), or by various types of self-repair (Chui, 1996). In the present study, these different types of non-fluent speech are not distinguished, but rather consolidated for tabulation. Gestures occurring in this kind of situations constitute a distinct minority in the corpus, 9.9% (30 out of 303). The question here is: Are speech and gesture patterned differently, in that gesture can be performed prior to speech to help overcome difficulties with verbalization?

Note first that eight instances of iconic onsets were found during non-fluent speech in the corpus. Half of these occurred during speaker speech repair; another half were further accompanied by hesitation pauses. These results do not conform to Butterworth and Hadar's (1989) claim. Moreover, concerning speech–gesture synchrony, five out of the eight onsets (62.5%) come before the related words. The percentage is reduced to 30.8% when the onsets occur in fluent speech (see Table 4). In short, when they encounter obstacles to speech, Chinese speakers do not always initiate hand movement in pauses.

As shown in Table 4, the percentages are about the same for strokes (40% versus 34.4%), suggesting that strokes do not necessarily precede their affiliated words in non-

Table 4
Do gesture onsets and strokes tend to come before affiliated words?

	Non-fluent speech			Fluent speech		
	Total	n	%	Total	n	%
Onsets	8	5	62.5	65	20	30.8
Strokes	30	12	40.0	273	94	34.4

Table 5
Types of strokes in non-fluent speech

	n	%
Onset with 'preceding' stroke	6	20.0
Onset with 'synchronizing' stroke	3	10.0
'Preceding' stroke without onset	6	20.0
'Synchronizing' stroke without onset	14	46.7
'Following' stroke without onset	1	3.3
Total	30	100.0

fluent speech. In fact (except for one gesture that followed the affiliated word), it is intriguing to note that the remaining seventeen gestures in non-fluent speech (56.7%) had their strokes occur simultaneously with speech.

Why don't hand movements come before the related words, so as to facilitate lexical retrieval (Morrel-Samuels and Krauss, 1992; Hadar and Butterworth, 1997), or to overcome other verbalizing difficulties? To answer this question, it is necessary to divide the thirty gestures in non-fluent speech into five groups (see Table 5). The first group includes six instances in which there are onsets and where the associated strokes precede the related words. The second group comprises three instances where there are gesture onsets, but where the strokes occur simultaneously with the related words. For six instances in the third group, there are no onsets, yet gestures are performed before speech. These fifteen instances reveal gestures that were initiated prior to speech, and which thus could have been performed in order to overcome speaking obstacles. However, these problems do not necessarily trigger hand movements. Nor are they always resolved by gesturing, since the fourteen instances of group four do not include onsets; here, the corresponding strokes are performed simultaneously with speech. Fifth and finally, there is one additional instance, which is produced after the related word.

5. Discussion

This study has attempted to provide a complete overview speech and gestures in actual Chinese conversation in order to account for their patteming. The results reveal different timing relations. First, in the onset phase, speakers overwhelmingly start to gesture during fluent speech rather than in pauses. Nor do the onsets tend to occur in silence, when speakers encounter verbalizing difficulty. Compared to onsets in fluent speech, those occurring in non-fluent speech mostly come before the affiliated words, probably in order

to facilitate lexical retrieval or to overcome a possible obstacle to speech. However, such a difference is not found in the stroke phase, in that speakers are not inclined to produce the stroke before the affiliated speech unit when they meet an obstacle in verbalizing. There is even a substantial portion of gestures that are produced without onsets, and simultaneously with their related words, as obstacles to verbalization not always are, or can be, resolved by hand movement. Moreover, just like onsets, manual strokes also mainly take place where speech is fluent. These results conform to McNeill's (1985, 1992) finding that 90% of English narrative gestures are produced when the speaker is actually articulating. Finally, the strokes are equally likely to synchronize simultaneously with, prior to, or following speech, whether the related words carry new or old information. What kind of function these various positions of gestural strokes fulfill, is a question awaiting future research.

The above findings provide some linguistic details that may help formulate a computational model of gesture–speech performance in real discourse, one that simulates the way the Chinese speakers use gestures along with language in face-to-face communication. It is my hope that in the future, more data will be available to attest to the findings concerning gesturing in non-fluent speech, as well as to distinguish different kinds of verbalizing problems and their relationship with gestures.

Acknowledgment

Appendix A. Abbreviations of Linguistic Terms

1PL	First person plural
1SG	First person singular
2PL	Second person plural
2SG	Second person singular
3PL	Third person plural
3SG	Third person singular
ACMPL	Accomplishment aspect
ASSC	Associative morpheme
BA	The morpheme BA
BC	Backchannel
CL	Classifier
COMPARE	Compare morpheme
COMPL	Complementizer
COP	Copula verb
DLM	Delimitative aspect
EMP	Emphatic adverbial
EXP	Experiential aspect
NEG	Negative morpheme
PF	Pause filler

POSS	Possessive
PRF	Perfective aspect
PROG	Progressive aspect
PRT	Discourse particle
QST	Question particle
REPAIR	Repair phoneme(s)
SELF	Reflexive morpheme

Appendix B. Transcription Conventions

An 'Intonation Unit' (IU) is defined as a stretch of speech uttered under a single coherent intonation contour, which tends to be marked by a pause, a change of pitch, and a lengthening of the final syllable (Du Bois et al., 1993).

Relevant expressions in examples are in boldface; the lines where the relevant expressions in question appear are marked by the arrow sign '→'.

<u>Units</u>
{carriage return}	Intonation unit
--	Truncated intonation unit
{space}	Word
-	Truncated word

<u>Speakers</u>
| : | Speaker identity/turn start |
| [] | Speech overlap |

<u>Transitional continuity</u>
.	Final
,	Continuing
?	Appeal

<u>Terminal pitch direction</u>
\	Fall
/	Rise
_	Level

<u>Accent and lengthening</u>
| ^ | Primary accent |
| = | Lengthening |

Pause

...(N)	Long
...	Medium
..	Short
(0)	Latching

Vocal noises

(H)	Inhalation
%	Glottal stop
@	Laughter

Quality

<@ @>	Laugh quality
<A A>	Allegro: rapid speech
<P P>	Piano: soft
<DIM DIM>	Diminuendo: gradually softer

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