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REPAIRS IN MANDARIN CONVERSATION

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ABSTRACT

This paper reports statistical data on the use of syntactically and prosodically defined variables in speech repairs in Mandarin Chinese. These variables include structural types of Chinese repairs, their part of speech distribution and their syllabic characteristics regarding the retracing distance. With respect to the prosodic features of Chinese repairs, results on articulation rate of the overall data and the repair data are presented as well as a durational analysis of the reparandum and the alteration of frequent words. Pitch value, amplitude and duration are analyzed on the beginning positions of the to-be-corrected, the corrected, the to-be-repeated and the repeated words. Among the findings are a number of significant results in terms of the syntactic and prosodic variables within the re-initiation process of Chinese repairs and their relationship to intonation units.

KEYWORDS: speech repairs, Mandarin Chinese, spoken corpora

1. INTRODUCTION

Repairs often result in disfluent speech, but also allow listeners more time to digest the content of the information conveyed by the utterance. While they are less common in monologues and read speech, speech repairs are frequent in conversation (Schegloff et al 1977). A number of issues in language production and processing are relevant to speech repairs including their grammatical representation in human grammar and their prosodic phrasing in speech production. As interest in spoken language and spoken dialogue systems has dramatically increased over the last decade (Gibbon et al 1997), explorations into linguistic representations of spontaneous speech phenomena such as discourse particles, discourse markers, disfluency and speech

repairs have accordingly attracted special attention from linguists, computer scientists, psychologists and sociologists.

Individual studies usually define their own range of phenomena as well as their own framework of identifying phenomena they are interested in. A number of speech corpora such as the Map Task Corpus (Anderson et al 1991), the Switchboard Corpus (Greenberg 1996), the TRAINS corpus (Heeman & Allen 1999) and the BAUFIX Corpus (Sagerer et al 1994) have been collected for analysing typical spontaneous speech phenomena. Especially in spontaneous speech, speech repairs result in serious problems for parsing and correcting spoken utterances (Hindle 1983). Corpus-based studies on repairs such as those done by Levelt (1983), Hirschberg and Litman (1993) and Nakatani et al (1995) have obtained empirical evidence as to how repairs in Dutch and in English are produced and how systems should be designed to handle repairs. For human understanding, disfluency may not always hinder comprehension. As reported in Fox Tree (1995), repetitions are neither advantageous nor disadvantageous for comprehension, while a false start in the middle of a sentence may cause more processing trouble than a false start in the beginning. For psycholinguistic studies, investigations into linguistic characteristics of speech repairs and how human beings process repairs also provide empirical evidence for the theoretical and practical linguistic issues of production (Laver 1973) as well as perception (Lickley & Bard 1998).

By adopting a quantitative method, the study presented in this paper illustrates a variety of linguistic aspects of Mandarin Chinese repairs used in spontaneous dialogues, focusing on the syntax and the prosody. This paper is mainly concerned with a descriptive study of Mandarin Chinese speech repairs. Chinese is lacking in inflectional morphology. There is no agreement necessary between any two adjacent syntactic categories in Chinese, either. Word order is flexible. Ellipsis is used quite frequently in conversation. These linguistic characteristics of Chinese lead to the consequence that syntactic structures in Chinese have a high degree of freedom and thus cannot be used as a clear indication for judging the correctness of the sentence structure. This may significantly influence the identification and the formation of repairs. Because we are concerned with Mandarin Chinese spoken in Taiwan, the Taiwanese Putonghua Corpus (TWPTH) was used for our analyses (cf. Section 5.1). This paper presents a series of corpus-based studies on Chinese repairs, which have

both the reparandum part and the alteration part. Simple disfluency such as filled pauses and discourse particles (Schiffrin 1987) are only mentioned in the context of speech repairs. For the reason why discourse particles in Chinese are regarded as one type of disfluency please see Section 3.5. The empirical data and analysis presented here, we hope, can provide a good basis for further applications in other research fields.

2. RELATED WORKS

In this section, related works on repairs are introduced, including how repairs are classified and what the linguistic features of repairs look like.

2.1 Classification of Speech Repairs

Most models of repair structures apply a template-based approach (Levelt 1983). In principle, a template model has three components: reparandum (Rep), editing terms (Et) and alteration (Alt). The reparandum designates a speech sequence, which is erroneous or inappropriate, while the alteration represents the correction of the problematic sequence. Between the reparandum and the alteration, there may be editing terms like silent pauses, filled pauses, such as “uh” in English, or other lexical items (Levelt 1983). These three elements are typically identifiable in any speech repair, and these concepts have been applied to a current Chinese conversational corpus project (Tseng & Liu 2001). On the basis of classification systems in the literature, five basic repair types are here distinguished:

- *deletion repairs*

好像 是 建造(Rep) 建(Alt) 合法 以後 (TWPTH)
hao3xiang4 shi4 jian4zao4(Rep) jian4(Alt) he2fa3 yi3hou4
seems BE construct(Rep) construct(Alt) legal afterwards
It seems that it was after the legal construction construct-.

- *addition repairs*

會 影響 到 整個 的(Rep) 整個 企業 的(Alt) 投資 意願 (TWPTH)
hui4 ying3xiang3 dao4 zheng3ge5de5(Rep) zheng3ge5qi4ye4de5(Alt)
tou2zi1 yi4yuan4
will influence upon the whole structural-PARTICLE(Rep) the whole industry

structural-PARTICLE(Alt) investment interests

It will influence the whole the whole industry w.r.t. their investment strategy.

- substitution repairs

跟 小孩子 都 有 一種(Rep) 那種(Alt) 好像 隔閡 (TWPTH)

gen1 xiao3hai2zi5 dou1 you3 yi4zhong3(Rep) na4zhong3(Alt) hao3xiang4 ge2he2

to kids you always have a kind(Rep) that kind(Alt) of estrangement

We keep a that kind of distance to our children.

- repetition repairs

你(Rep) 你(Alt) 太太 是 做 什麼 的 (TWPTH)

ni3(Rep) ni3(Alt) tai4tai4 shi4 zuo4 she2me5 de5

you/r(Rep) you/r(Alt) wife is doing what structural-PARTICLE

What is your your wife doing?

- fresh start

你 那個 呵- 你 沒有 習慣 (TWPTH)

ni3 na4ge4 HE- ni3 mei2you3 xi2guan4

you that HE- you are not used to it

You well uh- you are not used to it.

In addition to the above repair types, repairs of more complex structures are also frequently observed in conversation. For instance, the utterance 三歲就去讀讀讀了讀幼稚園 (three years-old already go go-to-school go-to-school go-to-school aspect-PARTICLE go-to-school kindergarten) "san1sui4 jiu4 qu4 du2 du2 du2 le5 du2 you4zhi4yuan2" has a repetition repair part *du2 du2 du2* and has also an addition repair part *le5*. The reason why *le5* is NOT classified as the reparandum corresponding to the alteration *you4zhi4yuan2* is that *le5* is an aspect particle indicating the past tense, while *you4zhi4yuan2* is the direct object of the verb *du2*. In other words, these two words categorise different syntactic roles and therefore cannot be used to correct each other. This article only deals with immediate speech repairs located within one sentence with clearly identifiable reparandum and alteration parts. For this reason, the fifth category, *fresh start* is not considered further.

2.2 Syntactic Patterns

Immediate speech repairs usually appear to a certain degree in regular speech forms. To take German as example, German immediate speech repairs are mostly re-initiated at phrasal boundaries and often they are modelled based on phrasal structures (Laubenstein 1995). This can be explained by the strong grammatical congruence in gender, number and case within German phrases. This makes the concept of a "phrase" in German a rather "tight" grammatical unit. Results provided by Tseng (1999) clearly supported the significant role of phrasal boundaries in the production of German speech repairs by examining a large task-oriented dialogue corpus (Sagerer et al 1994). I found that phrasal boundaries seem to be privileged positions for starting/ending German speech repairs. The speech repair found in the utterance "Ich (I) habe (have) einen (one) Würfel (cube) mit (with) einer (a[feminine, singular, dative, indefinite])(Rep) mit (with) einem (a[neuter, singular, dative, indefinite]) Gewinde (bolt)(Alt)" clearly demonstrates this fact. *Mit einer* is a phrasal fragment (which is not an ellipsis due to the flat and continuing intonation around the end segment) and *mit einem Gewinde* is a complete phrase repairing the previous phrasal fragment. In addition to German repairs, in the production of Dutch repairs, Levelt also mentions the importance of phrasal boundaries (Levelt 1984) since phrasal structure was respected in 66% of the delayed interruptions. In the algorithm of parsing sequences containing English repairs, Hindle adopted "phrase" as one of the comparison units for processing repairs (Hindle 1983). Lee and Chen (1997) classified Chinese speech repairs into patterns and developed a language model for their language recognition system to cope with speech repairs. However, they did not carry out any further investigations on the linguistic structure of repairs. In her study on repairs in Chinese spoken conversations, Chui (1996) proposed that syntax seems to play a less important role than the lexical complexity and the size of words in the production of Chinese speech repairs. That is to say, it is not the constituent boundaries, but rather the completeness of the lexical content and quantity of the words that are the major factors influencing the production of repairs.

Tseng (2000) also discusses the role semantics plays in the production of repairs. In contrast to Levelt and Cutler, Tseng focused more on the influence of semantic content on the production of speech repairs. Chinese speech repairs are most likely to be found in verb and noun phrases. They account for 37.7% and 41.2% of the

total speech repairs found in her data, respectively. The most likely position for Chinese speech repairs to be initiated is the phrasal boundary. One thing to note is that the analyzed repairs are mainly direct repetitions such as “I I” in which the reparandum and the alteration constitute independent phrases. Among the more complex repairs, the second most likely re-initiation position is the morpheme with the central semantic content of the problem word involved. As subjects in a judgement experiment reported, 這本藍藍色的書 (this CLASSIFIER blue blue colour structural-PARTICLE book) “zhe4ben3 lan2 lan2 se4 de5 shu1” is a more appropriate repair than 這本藍色色的書 (this CLASSIFIER blue colour colour structural-PARTICLE book) “zhe4ben3 lan2 se4 se4 de5 shu1” (Tseng 2000). *Lan2* (blue) is the morpheme carrying the central semantic content of the word *lan2se4* (blue-coloured) relative to the morpheme *se4* (colour). This indicates that semantic factors may play a role in the production of repairs. In different languages, pragmatic, semantic, syntactic and lexical factors may interact with each other differently to various extents and thus be of differential importance.

2.3 Prosodic Features

2.3.1 Reset Hypothesis

With regard to the pitch contour of repairs, one important hypothesis is the reset hypothesis. The reset hypothesis says that spoken utterances obey the baseline declination. When repairs are produced within utterances, an F0 value of the beginning of the alteration part is approximately reset to the value of the beginning of the reparandum part. Levelt (1984) proposed the suspension theory to deal with this phenomenon. His theory predicts that acoustically the new utterance should fit seamlessly into the original utterance, even for longer delays (Levelt 1984: 113). This theory implies that once the problem items in the reparandum are deleted, one will see natural utterances that obey normal F0 declination. In the context of prospective and retrospective repetitions in English, the reset hypothesis has also been empirically confirmed in Shriberg (1995).

2.3.2 Duration

As far as spoken languages are concerned, temporal features such as duration and articulation rate are crucial factors, because they directly reflect the linguistic representation and the emotional intentions of speakers. Blackmer and Mitton (1991),

for instance, have analyzed disfluencies in terms of their temporal distribution. They measured the duration times of (1) the interval between the beginning and the end of the reparandum, (2) the interval between the end of the reparandum and the beginning of the alteration and (3) the interval between the beginning of the reparandum and the beginning of the alteration. Blackmer and Mitton found that repairs of 0 msec from the interruption of the reparandum to the initiation of the alteration appeared in 12.4% of the overall samples and in 19.2% of the overt repairs. In most of the language production models, it is supposed to be observable that speakers need time to mentally process and organise their speech when errors have been made. The fact that one-fifth of the overt repairs was realised without being accompanied by a processing time contradicts the idea that speakers need to re-process and re-build their erroneous sequences. From the temporal viewpoint, Shriberg (1995) has done an interesting study on the duration of repetitions to distinguish retrospective repeats and prospective repeats as suggested in Hieke (1981). Shriberg made use of the durational intervals of repeated words and found clear evidence supporting this distinction.

2.3.3 Semantic Emphasis

Levelt and Cutler (1983) have investigated the interaction of prosody and semantic content in the context of Dutch repairs. They found that erroneous utterances are more often prosodically marked than inappropriate ones. Erroneous utterances often contain lexical errors such as “green” instead of “blue”, while utterances such as “and right of that one – of that purple …” contain no errors, but specify vague word usages (Levelt & Cutler 1983: 211). Moreover, prosody may serve to alert the listener to a troublesome term and so help him/her with the problem posed by it. Levelt and Cutler mentioned that semantic factors should influence the prosodic marking of repairs. When the interruption is delayed, the number of words repeated in the original utterances decides how much accent the speaker wants the listener to perceive. The retracing is located at an earlier position to make the emphasis clearer. Furthermore, they tried to convey the different degrees of prosodic marking on erroneous items and inappropriate items. 53% of speech errors were marked by perceptually stronger prosodic emphasis in pitch or amplitude, whereas only 19% of inappropriate items were prosodically marked. They concluded that semantic contrasts influence the frequency of using prosodic means to emphasize repair items. Levelt (1984) furthermore explored the correlation between editing terms and prosodic markedness.

55% among those “contrast establishing” editing terms such as *nee* (no), *of* (rather), and *sorry* (sorry), whereas only 32% among the “neutral” editing terms *eh* (er) and the non-contrasting *dus* (therefore) were prosodically marked in the corpus.

3. CHINESE LANGUAGE AND CHINESE REPAIRS

Two kinds of factors may influence the organization of repair: language-specific factors and communication-oriented factors. Linguistic features of a given language determine how sentences should be processed and produced. Thus, they also play a role in how repairs are formed within the framework of a given linguistic structure. However, the spontaneous reaction of a speaker in conversation can involve communicative and strategic considerations, too. At the moment of processing erroneous or inappropriate speech sequences, the speaker may also take into account what information s/he wants to deliver and in which way s/he wants the information to reach the recipient. A treatment of the communication factors falls outside the scope of this paper, but I will deal with the language specific aspects in detail. In this section, some basic facts about Chinese language with a special focus on issues related to the production of speech repairs will be summarized. Based on these facts, a number of working hypotheses on Chinese repairs will be introduced in the subsequent section.

3.1 Word Order

Word order in Chinese varies according to sentence structure and topics. For instance, the sentence “I bought a book/books” can be translated into Chinese in the following ways.

(1)

我	買	書	了
Wo3	mai3	shu1	le5
I	bought	book	aspect-PARTICLE

I bought a book/books.

(2)

我	書	買	了
Wo3	shu1	mai3	le5
I	book	bought	aspect-PARTICLE

I, the book was bought.

(3) 書 我 買 了
Shu1 wo3 mai3 le5
book I bought aspect-PARTICLE
The book, I bought it.

In (1), it is a SVO sentence, where (2) shows a SOV structure, a completely acceptable Chinese sentence. Topics can be placed at the beginning of a sentence irrespective of word category such as in (3) to emphasize certain matters.

3.2 Ellipsis and Special Syntactic Constructions

Ellipsis is used quite frequently in conversation. Subjects can be omitted, if they are mentioned previously and if the context is available.

(4) 我 開 車 到 故宮. 在 那裡 吃 中飯, 然後 去 參觀.
Wo3 kai1 che1 dao4 Gu4gong1. Zai4 na4li3 chi1 zhong1fan4, ran2hou4 qu4 can1guan1.
I drive car to Palace Museum. At there have lunch, then go visit.
I drove to the Palace Museum and had lunch there. Then I visited the Museum.

In Chinese, there are a large number of fixed syntactic constructions whose surface form may appear to be ungrammatical in other languages. For instance, **V bu4** (not) **V** is a common way of expressing doubt or forming a question. However, the sequence *ying1gai1 bu4 ying1gai1* in the following example is not this type of construction, but is instead a repair due to the resumed pitch height (with a pause before "bu4 ying1gai1"). Normally, the pitch contour of the **V bu4** (not) **V** construction follows the baseline declination without prosodic emphasis over "bu4". "Ying1gai1" and "bu4 ying1gai1" are two expressions of thought in which "bu4 ying1gai1" substitutes for "ying1gai1".

(5) 他 應該(Rep) 不 應該(Alt) 當 建築(Rep) 建築師(Alt) 的
Ta1ying1gai1(Rep) bu4 ying1gai1(Alt) dang1 jian4zhu2(Rep) jian4zhu2shi1(Alt) de5
He should(Rep) should not(Alt) be a architecture(Rep) architect(Alt) structural-PARTICLE
He should should not be an architecture architect.

Repairs like (5) were not identified as a repair by applying our identification principles (Section 4.2), because our identification is based on structural changes of

word sequences on the surface level. This also illustrates the need that we have to consider the prosody of repairs additionally.

3.3 Morphology and Inflection

Chinese lacks inflectional morphology, and no agreement or concord is expressed among different syntactic elements. However, particular functions are expressed by particles, as illustrated in (6), where the possessive morphology in Chinese has the form “nouns/pronouns + the structural particle *de5*”. So “his” would be 他(he)“ta1” 的(structural-PARTICLE)”de5” in Chinese. And there is no verb congruence between the subject “his teacher” and the verb “drive”.

(6) 他 的 老師 開 車 上班
Ta1 de5 lao3shi1 kai1 che1 shang4ban1
he structural-PARTICLE teacher drive car go-to-work
His teacher goes to work by car.

The components of compounds are at the same time morphemes, syllables and characters. Hence, a Chinese speaker has more possibilities to interrupt and to repair an inappropriate word sequence. For instance, if a Chinese speaker wants to say “father” (fu4qin1), instead of “parents” (fu4mu3), s/he may simply interrupt after “fu4” and then continue with “qin1” or “fu4qin1”. The former case leads to a paused word sequence (with no overt repairing). The latter one is then a repetition repair.

3.4 Compounding and Homophones

In addition, word formation in Mandarin Chinese is often accomplished by combining morphemes, where each morpheme has its own lexical content and orthographic character. Calculating all combinations of possible Mandarin Chinese syllables (C+V and C+V+C) plus lexical tones, there are about 400 different segmental syllables and 1277 distinct tonal syllables (Duanmu 2000: 57). So there are many homophones in Mandarin Chinese. However, the proportion of monosyllabic words in modern Chinese is decreasing and new polysyllabic words are being invented at a rapid pace. Compounding in Chinese offers a wide range of different combinations of characters for describing the same object. For instance, “notebook” in English can be translated into Chinese differently, as illustrated in (7) and (8).

(7)	筆	記	本
	bi3	ji4	ben3
	pen	record	book

(8)	記	事	本
	ji4	shi4	ben3
	record	things	book

3.5 Particles and Filled Pauses

Particles in Chinese are defined differently from ones in English. There are two types of particles in Chinese: grammatical particles and discourse particles. Grammatical particles are those such as the structural particle *de5*, and the aspect particle *le5* as mentioned earlier in this paper. Grammatical particles are always written in standard characters. However, for discourse particles the number of the choices of characters varies. Our transcription system (Tseng & Liu 2001) transcribes all discourse particles produced in our data in capital letters whether the discourse particle is "lexicalized" or not. What are "non-lexicalized" discourse particles"? Chinese speakers often identify all uttered syllables by suitable characters. For instance, filled pauses such as "uhn" in English may be mapped onto the discourse particle 嗯"EN" in Chinese. But for some discourse particles one may not easily find suitable characters, such as those borrowed from dialects or those filled pause-like discourse particles such as "uh" in English. There are discourse particles in Chinese, for which more than one choice of character is available and the choice may be different from one Chinese speaker to the other. Furthermore, it is difficult to clearly separate filled pauses from discourse particles in Chinese. So we include both filled pauses and discourse particles in the classification of disfluency.

3.6 Syllables and Prosody

As there is no inflection and no verb congruence in Chinese, to determine syntactic units from the surface level of word sequences is not as obvious as it is in English or in German. Syllables in Chinese play an especially important role, as syntactic, morphological and lexical units all intersect at the syllable via the connection through the character transliteration. Even for polysyllabic words, once a syllable is

uttered, an association between meaning and character will be set up immediately for literate Chinese speakers. Syllables pronounced with inappropriate lexical tones may lead to false connections with other syllables and the associated words.

4. WORKING HYPOTHESES ON CHINESE REPAIRS

Based on the linguistic features of the Chinese language discussed above, this section is concerned with hypotheses on what Chinese repairs look like in spontaneous Mandarin.

4.1 Phrasal Boundaries do not Play a Central Role in Chinese Repairs

As noted previously, Chinese lacks inflection and word order can vary to a great extent. This implies that for Chinese speakers, a wider range of varieties is available to continue a “not-yet-erroneous” word sequence than in other languages. To illustrate this, in German, inflection at the phrasal level is strict. Therefore, after a masculine determiner, only a masculine noun is allowed. After having detected an error after a wrong determiner for the target noun, a German speaker has to go back to the phrasal beginning to restart and to repair the noun phrase. But it is not necessary for Chinese speakers, because there are no inflectional categories. Instead, positions such as after a structural particle may be relevant for re-initiating a Chinese repair. For instance, in repairs within a possessive construction, the repeated pronoun may be shorter than the previous one, but the repeated structural particle is contrastively longer due to the fact that the upcoming noun after the structural particle is the head of the noun phrase.

4.2 Deletion Repairs are Seldom Produced

Because of the large number of homophones and the flexible compounding method in Chinese, additions and substitutions of syllables are more often produced than deletions of syllables. When something inappropriate has been uttered, the speaker has a number of possibilities to make the sentence sound correct such as by using homophones to build a new compound or by using the possessive construction to continue the sentence.

4.3 Immediate Interruption and Re-Initiation after Inappropriateness is Detected

To continue the discussion of the possessive constructions in Chinese from

another point of view, an error after a structural particle can be corrected immediately. In addition, there are no syntactic constraints restricting the position of re-initiation of the repair to return to the phrasal beginning. For languages such as English or German, it is often necessary to go back to the phrasal beginning to re-initiate a repair. Omission of subjects in sentences and lack of inflection and verb congruence also lead to the consequence that Chinese repairs can be initiated immediately without syntactic restrictions such as the necessary repetitions of the subject of the sentence. This also implies that long Chinese repairs seldom occur, for the reason that one would stop immediately at the morphological boundary where restarting a new compounding process is possible.

The position for re-initiating Chinese repairs may also depend on how spontaneous speech is segmented in language processing and planning. We would thus expect that the re-initiation of repairs may correspond to some kind of segmentation of units for spontaneous Mandarin. In later analysis of prosody, we will look into the relationship of repairs and intonation units to see if we can find correlations between them. Moreover, Levelt & Cutler proved error repairs (e.g. the blue the green one) are more prosodically marked than appropriateness repairs (e.g. that one that blue one) in respect of perception. But this prosodic marking was not supported by Nakatani & Hirschberg (1994) in their F0 and amplitude measurement of the reparandum offset and the repair onset. In later analyses, we will investigate the prosodic features of Chinese repairs to see if we can find acoustic cues marking the immediate re-initiation of Chinese repairs. But we will focus our measurements on comparable locations, that is, the onset of the reparandum syllable and the onset of their repair counterpart.

4.4 Articulation Rate of Chinese Repairs May Not Drop

A reduced articulation rate in the case of disfluency has been reported in Oviatt et al (1998). Fowler & Housum (1987) also mentioned that repeated words should require less processing time and therefore are uttered faster. But we would expect a weaker influence in respect of articulation rate of Chinese repairs, that is, the speaking tempo of the repaired parts will not drop as clearly as for instance English, German and Dutch ones do. There are two reasons. The first is that particles and filled pauses are differently categorized and used in Mandarin. They constitute independent syllables, sometimes even independent characters. They are more than a simple “uh” as in

English. Thus, when they are imbedded in repairs, they would require a similar processing time as other ordinary syllables. The second, grammatical particles preceding the head of a phrase may be produced more slowly to give speakers more time to process the head of phrase, as already stated in Section 4.1.

5. REPAIR SYNTAX

Given the term “repair syntax”, one may immediately refer to the grammatical properties of repairs. However, this study adopts a more general interpretation of repair syntax, namely we will focus on how repairs are organized within the Chinese language. The analyses are concerned with the combination types, the syntactic characteristics, and the morpho-lexical lengths of Chinese repairs. What we aim to obtain are systematic characterisations of the structure of the Chinese repairs.

5.1 Data

The Taiwanese Putonghua Corpus (TWPTH) was recorded in Taiwan and was made available through the Linguistic Data Consortium (LDC98S72, Taiwanese Putonghua Speech and Transcripts). Putonghua refers to Mandarin Chinese. The speakers were given the instructions in advance to speak in usual conversation style and that they could speak on any topic they wanted to, or even on no fixed topic at all. In this way, the obtained conversations are to a high degree spontaneous. A total of 40 speakers were recorded including five dialogues and 30 monologues (Duanmu et al 1998). Three dialogues were analyzed for the study presented in this paper. Each dialogue is about 20 minutes long. In total, 325 immediate speech repairs were identified.

Chinese words are not separated by blanks in writing as for instance in English, therefore, the definition of “word” varies greatly in Mandarin, depending on which morpho-syntactic framework one chooses for his/her analysis (Li & Thompson 1981). Thus, in order to apply consistent identification principles throughout the data, we adopted the automatic word segmentation and tagging system developed for the Academia Sinica Balanced Corpus (CKIP 1995) for segmenting words and tagging grammatical categories for our data. The criteria for identifying word boundaries and developing the set of part of speech tags for the Academia Sinica Balanced Corpus were based on a lexicon containing eight million Chinese words (CKIP 1995). Dialogue data are illustrated in Table 1.

Table 1: Dialogue Data

DIALOGUES	SUBJECT: SEX	TURNS	WORDS	SYLLABLES	SYLLABLES PER WORD
Dialogue-01	D1-A: F	189	1,937	2,989	1.54
	D1-B: F	183	1,688	2,765	1.64
Dialogue-02	D2-A: F	163	1,247	2,040	1.64
	D2-B: M	168	1,375	2,253	1.64
Dialogue-03	D3-A: M	144	1,782	2,993	1.68
	D3-B: M	142	1,096	1,803	1.65
Total		989	9,125	14,843	

Often, it is taken for granted that Chinese is a monosyllabic language due to the one-to-one mapping between character, syllable and morpheme. This interpretation was not supported in a corpus-based study on the Academia Sinica Balanced Corpus containing mainly WRITTEN Mandarin texts (Huang et al 2001). Neither is it supported by our spoken data. The total numbers of syllables produced by all six subjects who have talked on various topics are different. But the average word length is 1.6 syllables, approximately the same for each individual subject, as shown in Table 1. By looking at the word frequency list of our spoken data, we found that disyllabic words are the majority in the spoken dialogue data, as also reported for written Chinese data in Huang et al (Huang et al 2001).

5.2 Classification of Chinese Speech Repairs

This section is concerned with precise criteria for determining each repair type. Repairs of simple structure such as direct repetition or substitution are easy to identify. But especially for repairs of complex structures, we need a clear definition of repair structure and boundary. Four types of repairs are first taken into consideration: substitution, repetition, addition and deletion repairs. Once simple repair types are defined, they can be applied to identify complex speech repairs by combining simple structures.

5.2.1 Substitution Repair

If within a syntactic pattern, one (or more than one) word/morpheme is substituted, i.e. the target for substitution and the substituting word have the same syntactic categories, then the whole syntactic sequence including the target for substitution and the substituting word is called a substitution repair.

Example: 可能 有 一陣(Rep) 一段(Alt) 時間
ke3neng2 you3 yi2zhen4(Rep) yi2duan4(Alt) shi2jian1
possibly there is a period(Rep) a piece(Alt) time
Possibly there is a period a certain time.

5.2.2 Repetition Repair

If there is one (or more than one) word/morpheme within a syntactic pattern immediately repeated without any lexicalised elements in between (except discourse particles and filled pauses), then the syntactic pattern including the repeated elements is called a repetition repair.

Example: 想 說 明天(Rep) 明天(Alt) 去
xiang3 shuo1 ming2tian1(Rep) ming2tian1(Alt) qu4
want say tomorrow(Rep) tomorrow(Alt) go
I'm planning to go tomorrow tomorrow.

5.2.3 Addition Repair

In two adjacent syntactic patterns of similar contents, if one (or more than one) word/morpheme is inserted into the second pattern in comparison to the first pattern, then the sequence including these two adjacent patterns is called an addition repair. It is to be noted that direct repetition does not count as an addition repair.

Example: 那 子女(Rep) 其他 子女(Alt) 都 外出 了
na4 zi3nü3(Rep) qi1ta1 zi3nü3(Alt) dou1 wai4chu1 le5
then children(Rep) other children(Alt) all away aspect-PARTICLE
Then the children the other children all left home.

5.2.4 Deletion Repair

In two adjacent syntactic patterns of similar contents, if one (or more than one) word/morpheme is deleted in the second pattern in comparison to the first pattern, then the sequence including these two adjacent patterns is called a deletion repair.

Example: 好像 是 建造(Rep) 建(Alt) 合法 以後 (TWPTH)
hao3xiang4 shi4 jian4zao4(Rep) jian4(Alt) he2fa3 yi3hou4
seems BE construct(Rep) construct(Alt) legal afterwards
It seems that it was after the legal construction construct-.

5.3 Repair Types

Applying the principles above, we have classified all identified repairs. As shown in Table 2, more than 60% of repairs are simple repetitions. And almost all complex repairs (24/25) were produced in combination with repetitions.

Table 2: Chinese Repair Types

SIMPLE REPAIR TYPES		COMPLEX REPAIR TYPES	
Type	Occurrence	Type	Occurrence
Repetition	202	Addition/Substitution	1
Substitution	46	Addition/Repetition	5
Addition	43	Deletion/Repetition	1
Deletion	9	Repetition/Addition	10
		Repetition/Addition/Substitution	1
		Repetition/Deletion	1
		Repetition/Substitution	3
		Substitution/Repetition	3
Total (Simple Repairs)	300	Total (Complex Repairs)	25

According to results illustrated in Table 2, people are more likely to add (totally 60/325 repairs involve addition, i.e. 43 simple and 17 complex repairs) or to substitute (54/325 repairs, i.e. 46 simple and 8 complex repairs) something than to delete (11/325 repairs, i.e. 9 simple and 2 complex repairs) something in Mandarin conversation. Results on German repairs obtained by Tseng (1999) suggested that merely 10% of the overall repairs found in the BAUFIX Corpus are simple direct

repetitions. The corpus setting of these two corpora is different and it is not fully justified to claim that repair production is language dependent. However, we cannot overlook the clear differences. Comparison of appropriate corpora may further clarify the relationship of repair production and language typology.

5.4 Part of Speech in Repair

As repair types alone cannot directly tell us about their relations to Chinese syntax, all 325 repairs have been syntactically tagged using the part of speech (POS) system for the Academia Sinica Balanced Corpus consisting of mainly written Chinese data. Despite differences between spoken and written corpora, we are still able to gather useful insights into the distribution of POS among Chinese repairs. Results are represented in Table 3.

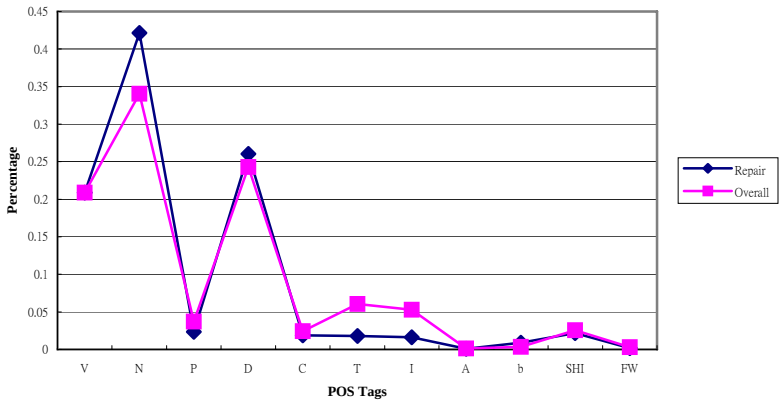
Table 3: Parts of Speech Involved in Chinese Repairs

PART OF SPEECH (POS)	ABBREVIATION IN CKIP TAGGING SYSTEM	OCCURRENCES
Verb	V	258
Verb: be	SHI	27
Noun	N	521
Preposition	P	29
Adverbial	D	322
Conjunction	C	23
Particle	T	22
Interjection	I	20
Non-predicate Adj.	A	1
Foreign Word	FW	2
Words, not allowed to be used alone	b	11
Total		1236

The most frequently repaired syntactic categories are nouns, adverbials and verbs. But to claim that people can more often find repairs in these positions than in others, we need to undertake further normalized analyses (cf. Figure 1 & 2).

Interestingly, discourse particles and interjections were extremely seldom found in Chinese repairs. This makes the edit signal hypothesis proposed by Labov (1966) and Hindle (1983) less relevant in the case of spoken Mandarin, which says that disfluencies are mostly marked by editing terms signalling the editing phase. Only a few particles and interjections have been found in our data, so it is possible that Chinese repairs could be marked by other linguistic or paralinguistic means such as prolongation (Fox Tree & Clark 1997). Given the fact that nouns, adverbials and verbs were most frequently found in the dialogues, we would like to know if the probability to find repairs in these three categories RELATIVE to their use in overall dialogues is STATISTICALLY also higher than the other categories. In order to answer this question, we compared the POS distribution in repairs with that in the overall data.

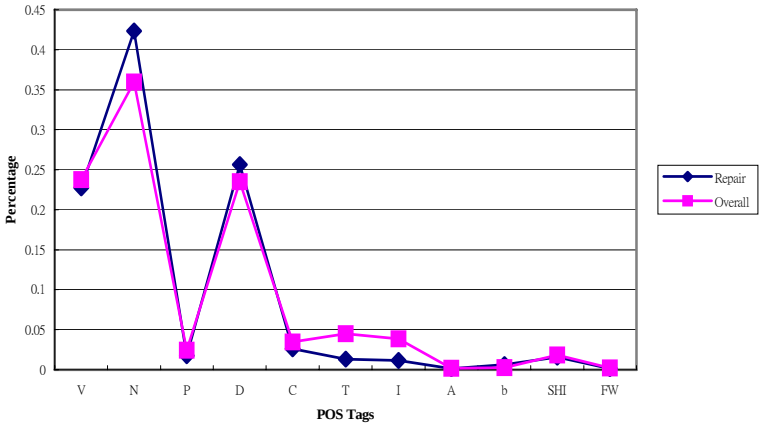
Figure 1: Comparative Distribution of POS in Repairs and in Overall Data
(in terms of number of tokens)



As illustrated in Figure 1 and 2, the POS distribution is similar across all tagged syntactic categories. Verbs, prepositions, adverbials, the verb BE, foreign words and words which are not allowed to appear alone all have approximately the same percentages both in repairs and in the overall use. Nouns are most likely to be repaired. Unlike other syntactic categories, the proportion of nouns in repairs is higher than their proportion in the overall data. Our data provide clear evidence on this issue

in terms of both normalized analyses on the number of tokens as shown in Figure 1 and on the number of syllables in tokens in Figure 2. In other words, while building a probability-oriented repair detection model in terms of syntactic categories, nouns should be assigned the highest priority. In addition, particles and interjections were less often used in repairs than in conversation as compared with nouns. This analysis is in accordance with the results reported in Tseng (2001) that Chinese editing terms appear only in 7% of the total number of repairs, relatively seldom in comparison to other languages. 30% use of “er” in the data of Dutch repairs was mentioned in Levelt (1989:483).

Figure 2: Comparative Distribution of POS in Repairs and in Overall Data
(in terms of number of syllables in tokens)



5.5 Length of Repair

In order to take a further look at the syntactic properties of Chinese repairs, we analyzed the length of repairs. Because it is difficult and ambiguous to measure syntactic length in Chinese, we chose “syllable” as our measurement unit.

5.5.1 Syllables Involved in Repair

The sum of syllables produced in our dialogues is 14843 and the number of

syllables involved in repairs is 1719. We obtain an average of 11.6% of syllables involved in repairs. This means that in every ten syllables produced in spoken dialogue at least one syllable is possibly problematic for parsing algorithms or speech recognition systems. Considering this aspect we obtained similar results across all three dialogues. As shown in Table 4, 11% of the overall syllables on average are involved in repairs. This high percentage once again justifies the importance of investigations into repairs in spontaneous speech.

Table 4: Syllabic Characterization

DIALOGUES	TOTAL SYLLABLES	SYLLABLES IN REPAIR	% OF REPAIR SYLLABLES
D 1	5,754	666	11.5%
D 2	4,293	523	12.2%
D 3	4,796	530	11.1%

5.5.2 Retraced Syllables Involved in Repeats

When a speaker goes back to their previous speech and restarts their speech, it is called retracing. Retracing occurs quite frequently in the production of repairs; and it shows both syntactic and lexical influences of the language on determining locations for re-initiating speech. Because simple repetitions and complex repetitions account for 70% of the overall repairs, we focus on the retraced syllables within repeats.

Table 5: Retraced Syllables in Repairs

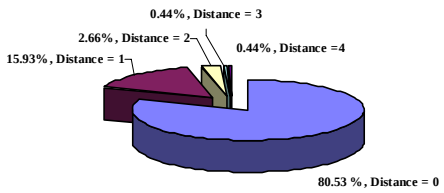
# OF RETRACED SYLLABLES	IN SIMPLE REPETITIONS	IN COMPLEX REPETITIONS	TOTAL
1	143	11	154
2	41	6	47
3	15	3	18
4	2	1	3
5	1	3	4
Total	202	24	226

Results are illustrated in Table 5. As the statistics show, the number of retraced syllables is not large, mainly ranging from 1 to 3. In order to further explore the interaction of the retraced syllables and the syllabic structure of target words in the alteration part, we defined and calculated the syllabic distance for retracing.

5.5.3 Retracing Distance to the Target Word

Syllabic distance is defined as the absolute value of the difference between the number of retraced syllables in the reparandum and the number of syllables of target words in the alteration containing the repeated syllables. In other words, the absolute value for NEGATIVE retracing difference is used. For instance, in the repair "jian4zhu2 jian4zhu2shi1" (architecture architecture-scholar (architect)) the number of retraced syllables in the reparandum part is 2 and the corresponding target word has 3 syllables. Thus, the retracing distance to the target word is 1. Moreover, for deletion repair such as "jian4zao4 jian4" (construct construct), the retracing difference is –1, but the syllabic distance is 1.

Figure 3: Syllabic Retracing Distance to Target Word



After calculating the syllabic distance of retracing in repeats, it is now possible to examine to what extent the number of syllables in the alteration influences the realization of retracing. Detailed data are given in Appendix A. The number of retraced syllables and the number of syllables of the target words are positively correlated (r=0.821). That also means that the number of retraced morphemes correlates with the number of syllables of target words, i.e. the alteration. As shown in Figure 3, syllabic

distance is 0 in most cases. Longer than 2 is only found in about 3% of the overall repeated sequences. This result supports the notion that the number of characters involved in retracing is restricted, and not arbitrary. Retracing in most repairs found in our data was located at the beginning of the problem word, but not the problem "phrase". That is also one of the main reasons why the syllabic retracing distance to the target word is 0 in more than 80% of the repairs.

6. THE PROSODY OF CHINESE REPAIRS

Essential to spoken dialogues, prosody is a useful means for emphasising and stressing special intentions and communicative functions. Speech repairs are produced partly because the correctness of the delivered information is required and partly because the speaker changes his/her language planning. Thus, prosody could be an immediate tool to point out problematic speech sequences and to put further emphasis on the corrected sequences. In this section, I aim to determine whether Chinese speech repairs are prosodically marked or not and furthermore to determine how they are presented.

6.1 Articulation Rate

Articulation rate is represented by calculating the duration of each syllable (msec/syll.). We regard filled pauses as valid syllables, as long as they can be explicitly mapped to certain Chinese characters. Silent pauses are excluded. For all six subjects, the results of their respective articulation rates are shown in Table 6. Considering these six pairs of values, we found no significance of tempo difference in the overall and the repaired syllables, $p=.285>.05$ based on the paired t-test.

Table 6 shows a tendency of a lower articulation rate in repairs, i.e. slower speech production. Part of the reason may be our repair identification principles. Repeated identical word sequences are counted as direct repeats as well, so they contain discourse particles, too. Discourse particles used for hesitations are usually lengthened. This may contribute to the lower articulation rate in repairs produced by some subjects. But because speech rate may be influenced by various factors in spontaneous speech, in the next section we focus on words repeated in high-frequency repetitions only and compare the durations of the occurrences in the reparandum and the alteration with those in the overall data.

Table 6: Articulation Rate in Overall and Repair Syllables

SUBJECT	OVERALL/ REPAIR	SAMPLE (N)	MEAN (MSEC/SYLL.)
D1-A	Overall Syllables	3,095	188.15
D1-A	Repair Syllables	575	200.78
D1-B	Overall Syllables	631	227.56
D1-B	Repair Syllables	115	215.24
D2-A	Overall Syllables	1,580	227.88
D2-A	Repair Syllables	140	221.71
D2-B	Overall Syllables	1,610	231.09
D2-B	Repair Syllables	225	234.57
D3-A	Overall Syllables	2,034	186.82
D3-A	Repair Syllables	366	205.93
D3-B	Overall Syllables	896	197.57
D3-B	Repair Syllables	114	267.11
Total	Overall Syllables	9,846	204.66
Total	Repair Syllables	1,535	214.88

6.2 Temporal Properties of Top Frequency Words Involved in Repetitions

6.2.1 Core Vocabulary in Chinese Conversation

For the reason that some repairs are only produced once or twice and they may not be representative for the repetition analysis, we based our data selection on the top frequency words in conversation as reported in Tseng (2001). The core vocabulary consists of 36 words and is listed below. Their frequency can be found in Appendix B.

The word segmentation was done automatically using the CKIP word segmentation system. Therefore, a number of the following words may appear as a word combined with other words in the CKIP system, for instance, *hen3hao3* (very good) is a word in the CKIP system. The list shown in Appendix B includes only results of the automatic segmentation which appear as independent items. Tokens consisting of a combination with the core vocabulary are not included in Appendix B.

7 verbs: *zai4* (is located), *shi4* (is), *jiu4shi4* (that is), *shuo1* (say), *qu4* (go), *yao4* (want), *you3* (have),
5 adverbials: *ye3* (too), *jiu4* (then), *dou1* (all), *hen3* (very), *dui4* (right),
4 grammatical particles: *ne5* (question), *ma1* (question), *le5* (aspect), *de5* (structure),
4 nouns: *hua4* (words), *shi2hou4* (time point), *ren2* (man), *xiao3hai2zi5* (kids),
3 na and zhe words: *zhe4yang4* (this way), *na4ge5* (that one), *na4* (then),
3 pronouns: *ta1* (he), *wo3* (I), *ni3* (you),
2 negations: *bu4* (not), *mei2you3* (have not),
1 adjective: *hao3* (good),
1 connective: *suo3yi3* (so) and
6 discourse particles: O, EN, AI, LA, A, MA.

A number of words in the core vocabulary such as *jiu4shi4* (that is), *shi4* (yeah/is), *dui4* (right, correct) have reactive pragmatic functions (Clancy et al 1996) and are often used to demonstrate the speaker's intention to begin his/her turn. In our listing, they are grouped into the category *verb* to keep the conformity to the CKIP word segmentation rules. Another reason not to put them into the category *particles* is that, conventionally, discourse particles in Chinese include only words which are originally particles written in standard Chinese characters and words which stem from the original particles but have a multiple choice of Chinese characters in the writing. Discourse particles O, EN, AI, LA, A, MA in the core vocabulary may express different discourse attitudes in different discourse situations such as surprise, hesitation, agreeing, or pleading etc. Determiners/adverbials *na4*, *na4ge5*, *na4me5*, *na4yang4*, *zhe4*, *zhe4ge5*, *zhe4me5* and *zhe4yang4* serve similar pragmatic purposes as discourse particles. When used in conversation, these words function more like connectives such as *so*, *therefore*, or *then*, and so they are used as discourse markers. Therefore, they form a separate group in spoken Mandarin.

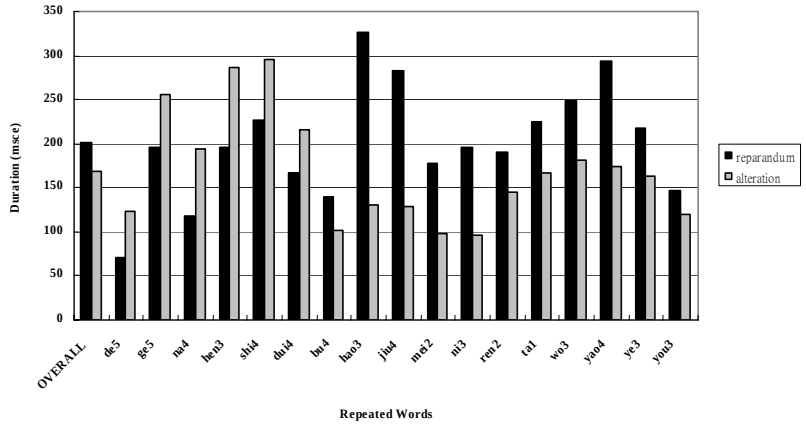
6.2.2 Duration of Core Vocabulary Involved in Repetitions

We can only analyze the temporal features for direct repetitions. For repairs, because the words are distinct, we are not able to compare their durations one by one. Therefore, out of the core vocabulary, words involved in direct repetitions which were found more than twice in our data were chosen and the temporal measurement of these tokens was done and analyzed. The list of these words can be found in Appendix C. Discourse particles are not likely to be repeated in repetitions, thus this list does not contain discourse particles. We compared the duration of their reparandum part to that of their alteration part. The average duration of the to-be-repeated words is 200.86 msec and the average duration of the repeated words in the alteration is 169.19 msec ($p=.148>.05$ based on the paired t-test of duration of to-be-repeated and repeated words). Although no statistically significant difference was found between the repeated words in the reparandum and in the alteration, the details of the distribution, as illustrated in Figure 4, shows the tendency that the repeated words in the alteration are shorter than those in the reparandum part. This may be due to the fact that the time required for processing words in the alteration is included in the reparandum phase or in the editing terms. This effect should be more obvious in the case of direct repetitions, whereby the repetition itself provides no new information and therefore possibly demands less processing time.

6.2.3 Grammatical Words Preceding Phrasal Head are Sometimes Lengthened

In Figure 4, some words have a longer average duration in the alteration than in the reparandum, namely *de5* (structural-PARTICLE), *dui4* (correct), *ge5* (CLASSIFIER), *hen3* (very), *na4* (that) and *shi4* (BE). These words are used to precede the head of a noun phrase (*de5*, *ge5*, *na4*), an adverbial (*hen3*), or a sentence (*shi4*, *dui4*). For instance, in the repair *ta1de5 ta1de5 hai2zi5* (his his child) the second *de5* was measured 141 msec and the first *de5* was only 78 msec. In other words, in repairs involving complex syntactic structure, repeated content words may be shorter, but the repeated grammatical words preceding the head of the syntactic structure may be longer. This tendency is clearly shown in our analysis.

Figure 4: Duration in the Reparandum and the Alteration of Frequent Words



6.3 Duration, Intensity and Pitch at Initiating and Re-Initiating Positions

While discussing the resetting in repairs, mostly only pitch is mentioned. In this section, analyses on the beginning part of the reparandum and the alteration are discussed in terms of the following three parameters: (1) pitch value of the beginning point of the reparandum and the comparable part of the alteration, (2) intensity of the beginning point of the reparandum and the comparable part of the alteration, and (3) the duration of the comparable words in the reparandum and the alteration of repeated and corrected repairs. We will only focus on the onset points of the to-be-repeated/to-be-corrected words and the onset points of their counterpart words in the alteration, i.e. the comparable repeated/corrected words. All other words involved in the whole repair sequences are excluded. That is to say, we investigate prosodic marking of the identically repeated/corrected locations. This differs from the approach of Nakatani & Hirschberg (1994). Within our analysis, we differentiated two classes of repairs: repairs containing overtly repaired words and repairs containing only repeated words. Table 7 summarizes the results done on all six subjects.

Table 7: Initial Positions of the Reparandum and the Alteration in Repeated and Corrected Repairs

	MEAN	PAIRED DIFFERENCES				
Repeated Repairs		Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)	Sample (N)
F0 (Hz): to-be-repeated	182.06	10.94	37.57	5.31	.05	50
repeated	171.12					
Intensity (dB): to-be-repeated	25.21	2.18	11.24	.59	.00	367
repeated	23.03					
Duration (msec): to-be-repeated	209.81	39.23	124.30	6.49	.00	367
repeated	170.58					
Corrected Repairs		Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)	Sample (N)
F0 (Hz): to-be-corrected	197.4	33	48.88	15.46	.06	10
corrected	164.4					
Intensity (dB): to-be- corrected	23.99	4.56	11.47	.72	.00	254
corrected	19.43					
Duration (msec): to-be- corrected	203.02	22.33	135.46	8.5	.01	254
corrected	180.7					

Table 7 shows clear acoustic cues of prosodic marking on the repeated/corrected positions, except the pitch values. Differences of intensity and duration were clearly observed. These results clearly confirm the location where the re-initiation process of repairs occurs from the prosodic point of view. The intensity is weakened on initiating the repeated and the corrected elements and the duration of the repeated as well as the corrected elements is shorter than for their preceding counterparts. Because of the quality of recording, we were only able to measure the F0 values of a small number of to-be-repeated/to-be-corrected and repeated/corrected pairs. However, despite the scarcity of a useful acoustic sample, this indirectly supports the existence of a pitch reset in restarting Mandarin repairs. We use the following repairs to illustrate the results. *Ke3 ke3neng2* (po- possibly) is a repeated repair, whereas *ying3 guan1xi1* (in- sake) is a corrected repair.

可 (Rep)	可能 (Alt)	是	大人	的	影 (Rep)	關係 (Alt)
ke3(Rep)	ke3neng2(Alt)	shi4	da4ren2	de5	ying3(Rep)	guan1xi1(Alt)
po-(ssibly)	possibly	is	adults	structural-PA.	in-(fluence)	sake

It is po- possibly because of the in- because of the adults.

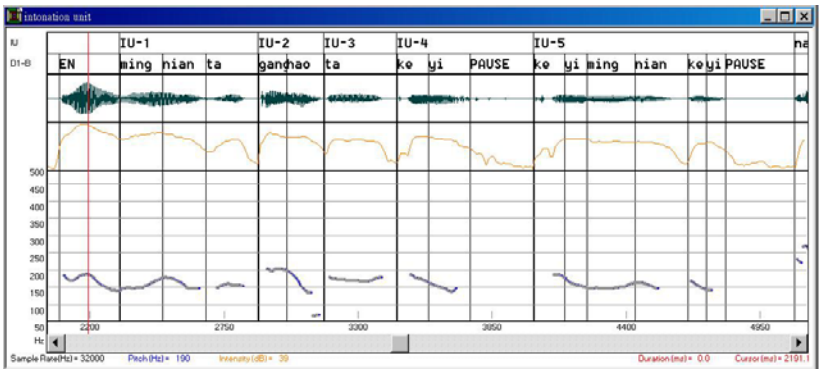
I was not able to measure the initial F0 values for the first *ke3* in the repetition of *ke3-ke3*. The initial F0 values for the second *ke3* in the repetition *ke3-ke3* and in the repair *ying3-guan1* are 178Hz and 149Hz-169Hz, respectively. The initial intensities of *ke3-ke3* and *ying3-guan1* are 49dB-33dB and 76dB-60dB and the temporal durations are 96.3msec-83msec and 129.4msec-177.6msec (*guan1* is longer than *ying3*, because only a fragment of *ying3* was actually produced).

6.4 Repairs and Intonation Units (IU)

We identified 753 intonation units. The alterations/corrections occur mostly at the beginning of an intonation unit. In other words, the reparandum and the alteration form two separate intonation units. Tao (1996) has defined and analyzed intonation units in Mandarin conversation as follows: (1) a new intonation unit may begin with a higher pitch value than the ending pitch value of the previous intonation unit, (2) after an intonation unit, there may be a clear pause, and (3) the content of an intonation unit contains a minimum of one coherent meaning unit. Adopting his criteria, we have employed both auditory and acoustical judgements (Schuetze-Coburn et al 1991) to

identify the intonation unit involved in repairs. An annotator first identified intonation unit boundaries. The second speech annotator then labelled the intonation units boundaries anew. After comparing the results, the inter-annotator consistency is about 85%. This is to say that 85% of the final intonation units we used for the analysis were identical according to the judgements of both annotators. Most of the deviations in the identification of boundaries are due to different understandings of a meaningful unit in the case of an absent pause. We made the final decisions by discussing the differences and achieved consensus among the annotators.

Figure 5: Intonation Units in Spoken Mandarin



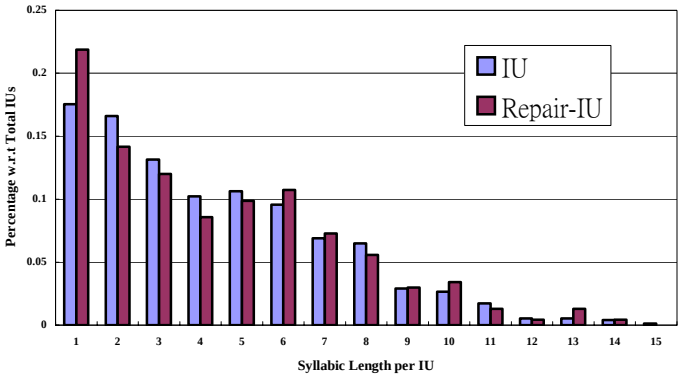
Our data shows that one-phrase repairs often independently form single intonation units, whereas multi-phrase repairs may stretch across several intonation units. In the latter case, the alteration often starts as a new intonation unit. According to the results presented in Section 5.3, the reset hypothesis may only hold when the reparandum and the alteration form two separate and identical intonation units. This is similar to the proposal made in Tao (1996) that the pitch may rise at the beginning of an intonation unit compared with the end of the preceding intonation unit, thereby resetting the baseline. Figure 5, processed by using PitchWorks developed by SCICON R & D, gives an example for the interaction of intonation units and repairs in the following utterance fragment

明年	他	剛好	他	可以	可以	明年	可以
ming2nian2	ta1	gang1hao3	ta1	ke3yi3	ke3yi3	ming2nian2	ke3yi3
next-year	he	coincidently	he	can	can	next-year	can

Next year he will just he can next year he can

Figure 5 demonstrates a labelled utterance with word boundaries, accompanied by waveform and F0 pitch level illustrations. The complex repair in this very disfluent utterance segment is divided into five intonation units: 1. *ming2nian2* (next year) *ta1* (he), 2. *gang1hao3* (coincidently), 3. *ta1* (he), 4. *ke3yi3* (can) and 5. *ke3yi3* (can) *ming2nian2* (next year) *ke3yi3* (can). Pitch resets at the beginning of the third, fourth and fifth intonation units are clearly observable, all about 190 Hz. The place where a pitch reset occurs does not necessarily represent the beginning of a phrase with the same syntactic category, since for instance, *ta1* (he) is a pronoun, whereas *ke3yi3* (can) is a verb. This may further indicate the possibility that re-initiation within repairs has more directly to do with prosodic phrasing such as pitch or breath groups than with syntactic phrasal structures.

Figure 6: Syllabic Distribution of IUs and Repair-IUs



Intuitively, a repair may be equally long or longer than an IU. IUs that contain part of a repair are called repair-IU in our terminology. Thus, Figure 6 shows the

comparison of the overall IUs and the repair-IUs with respect to the syllabic length per IU. First of all, the data shows that both general IUs and repair-IUs are of a limited length with respect to syllables. Intonation units longer than ten syllables are in the minority. As illustrated in Figure 6, the distribution of IUs and repair-IUs is positively correlated (r=0.95). Figure 6 also shows that a one-syllable IU is more likely to be a repair-IU than IUs with a length of more than two syllables. A possible explanation for this result is that one repair may involve more than one IU and often it involves pausing after a word length of one syllable, as the majority of repairs are simple repetitions. After a pause, a new intonation unit usually begins.

7. DISCUSSION AND CONCLUSION

Our data shows that neither phrasal boundaries nor word categories directly and significantly correlate with the formation of Chinese repairs. In conversation, there is no preference for repairs to restart far away from the location of the reparandum. Instead they occur in the nearest and most necessary position such as in positions after a structural particle. Communication efficacy contributes largely to this way of producing repairs, because the head of the phrase usually comes after a structural particle. The beginning of a phrase is not a privileged position for restarting an erroneous utterance fragment. Thus, phrase-initial positions in complex phrases may not be as relevant as head-preceding positions to the production of speech repairs, as most of the repeated words are shorter than their former counterparts, while the repeated head-preceding function words are longer. More than 80% of the collected repairs, mostly simple repetitions, involve only one phrase and a large number of instances are located within simple phrases containing monosyllabic and disyllabic words. The majority of repetitions are not compound words. Their semantic content is unambiguous and they are frequently used in spoken Mandarin. This might indicate that the function of repetitions tends to be pragmatic. When problems occur, the easiest way to keep the turn is simply to repeat the currently uttered words.

Usually, words of simple morphological structure such as pronouns are more likely to be repeated than words of complex syllabic structure, even though they may immediately come after the repeated words. As proposed in Fowler & Housum (1987), repeated words provide “given” information. Unlike words coming for the first time in the context, which contain “new” information, repeated words are usually produced in

a reduced form such as in a shorter duration or with a weaker amplitude. Both shorter duration and weaker amplitude were observed in our data involving repetitions as shown in Table 7. Furthermore, Chinese repairs can solely repeat a part of a word consisting of a sequence of fully meaningful characters or morphemes. So the linguistic level of Chinese repetitions may, in fact, involve the syllable level. Our results on repairs also showed that a syllable in Chinese plays a rather different role from other languages. It is something in between a morpheme and a word in English. Regarding the complexity principle mentioned by Clark & Wasow (1998) discussing repetitions in English, they proposed that the more complex a phrase is, the more likely a restart will be produced to continue the phrase. We did not find clear supports for this proposal in our data. Based on results of syllabic retracing distance, the number of syllables of interrupted words is in most cases equal to the number of syllables of the intended target words. In case of restarts in complex phrases, restart is usually located at the morphological component preceding the problematic constituent. It is well-known that one interrupts his/her problematic speech immediately after inappropriateness is detected. In Chinese repairs, the “immediateness” can mean the morpheme-boundary. Within a compound word, a repair can be re-initiated for any morphological components of the word. This explains why we mainly found short repairs in Chinese, but not repairs involving a long word sequence or a long distance retracing.

As illustrated in Table 7, the re-initiation of repairs in Chinese is marked by a fast speaking tempo and a weaker intensity in comparison to the comparable position in the reparandum. The fact that the F0 values at the beginning of the reparandum and the alteration are not significantly different indirectly indicates a pitch reset. These acoustic cues support a prosodic marking at the onset of the to-be-repeated/to-be-corrected words and the onset of their counterparts, the repeated/corrected words. Furthermore, almost all reparandum parts are themselves intonation units. The features of the re-initiation process of speech repairs are similar to those of a new intonation unit relative to the preceding one. The range of an intonation unit can vary from one single word to several phrases from the grammatical point of view. But for Chinese, regarding the number of syllables, the length of an intonation unit often falls in a limited range. This fact is also observed within speech repairs. Shorter duration and weaker amplitude of the repeated words all clearly indicated that

the reparandum and the alteration should be regarded as two independent units. As shown in the data, they are not syntactic units. Our data on intonation units and repairs give us a primitive picture of how intonation units may interact with the re-initiation processes of speech repairs. Additional research on comparisons of the prosody of intonation units and speech repairs is needed to better shape the features of prosodic units in speech production.

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APPENDIX

Appendix A: Retraced Syllables vs. Syllables of Target Words

(# of retraced syllables, # of syllables of the target word)	Syllabic Distance	Occurrences
(1, 1)	**0**	**128**
(1,2)	1	32
(1,3)	2	4
(2,1)	1	2
(2, 2)	**0**	**35**
(2, 3)	1	12
(2, 4)	2	6
(2, 6)	4	1
(3, 1)	2	1
(3, 3)	**0**	**17**
(3, 4)	1	1
(4, 3)	1	1
(4, 4)	**0**	**2**
(4, 7)	3	1
(5, 2)	3	1
(5, 5)	**0**	**2**
(5, 6)	1	1
(5, 7)	2	1
	Distance ≥ 2	15
	Distance < 2	233
	Total	248

Appendix B: Frequency of the Core Vocabulary Produced by Six Speakers

Words	D1-A	D1-B	D2-A	D2-B	D3-A	D3-B
在 *zai4* (is located)	23	8	6	14	9	15
是 *shi4* (is)	44	21	19	21	23	11
就是 *jiu4shi4* (that is)	12	12	6	11	13	5
說 *shuo1* (say)	14	25	24	21	14	4
去 *qu4* (go)	13	17	2	7	16	4
要 *yao4* (want)	11	12	21	7	20	5
有 *you3* (have)	23	12	5	9	21	15
也 *ye3* (too)	20	14	3	14	1	1
就 *jiu4* (then)	17	36	20	7	26	17
都 *dou1* (all)	14	8	4	7	14	5
很 *hen3* (very)	9	35	15	4	3	1
對 *dui4* (right)	12	33	15	21	6	3
呢 *ne5* (question)	7	10	4	17	4	1
嗎 *ma1* (question)	2	4	2	3	11	1
了 *le5* (aspect)	22	23	23	32	24	15
的 *de5* (structure)	73	81	69	52	93	56
話 *hua4* (words)	6	12	15	12	22	6
時候 *shi2hou4* (time point)	7	6	9	2	12	9
人 *ren2* (man)	19	11	5	12	9	3
小孩子 *xiao3hai2zi5* (kids)	2	4	14	9	2	1
這樣 *zhe4yang4* (this way)	3	11	11	3	9	6
那個 *na4ge5* (that one)	22	32	11	17	27	11

那 *na4* (then)	10	26	34	25	62	42
他/她/它 *ta1* (he)	121	111	44	25	58	15
我 *wo3* (I)	34	99	36	23	39	32
你/妳 *ni3* (you)	12	42	25	28	74	29
不 *bu4* (not)	52	63	56	53	92	35
沒有 *mei2you3* (have not)	18	17	9	7	14	12
好 *hao3* (good)	32	34	35	9	40	14
所以 *suo3yi3* (so)	1	5	4	2	6	6
喔/哦 O	2	15	18	16	8	6
嗯 EN	68	68	41	15	5	28
唉/哎 AI	27	26	26	15	8	7
啦 LA	19	32	22	49	13	6
啊 A	27	41	26	38	76	52
嘛 MA	8	4	2	6	5	15

Appendix C: Average Duration of Repeated Elements in Selected Words

Words	Average Duration of the Repeated Elements in the Reparandum Part (msec)	Average Duration of the Repeated Elements in the Alteration Part (msec)	Average Duration of the Repeated Elements in The Overall Data (msec)
不 *bu4*	139.3	101.3	113.9
的 *de5*	70.0	124.0	164.7
對 *dui4*	166.0	215.2	202.5
個 *ge5*	195.5	255.3	148.1
好 *hao3*	326.0	130.0	201.9
很 *hen3*	195.7	286.5	207.8
就 *jiu4*	283.0	129.0	164.7
沒 *mei2*	177.3	97.6	137.6
那 *na4*	118.3	193.6	164.0
你/妳 *ni3*	196.5	97.0	135.4
人 *ren2*	191.0	145.0	162.7
是 *shi4*	226.3	295.8	204.3
他/她/它 *ta1*	225.6	166.5	166.4
我 *wo3*	247.7	181.7	152.3
要 *yao4*	293.0	174.0	165.7
也 *ye3*	217.5	163.6	159.6
有 *you3*	146.0	120.2	141.4

現代漢語中的詞語更正

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本文以語法與聲韻特徵分析探討現代漢語口語層次裡語誤與其更正的使用是否具語言學上的規律性。由語法角度進行漢語詞語更正類型分析、詞類分佈以及回溯距離分析。聲韻分析則主要是基頻、強度與音長三項聲學特徵在所有詞語更正序列中的字與語誤與更正個別字上的測量。分析結果顯示現代漢語口語詞語更正是具有特定形式，而非任意隨機現象。但並不直接與語法或詞類相關，反而與詞組的音節數較為相關。特別的是在更正的起動點上，可以明顯觀察到聲韻標示。多數的聲韻標示又與語調單位特性相符。

關鍵詞： 詞語更正，現代漢語，口語語料庫