RESEARCH ARTICLE

SELF-REPAIR PATTERNS IN CONVERSATIONAL SPEECH OF MANDARIN APHASICS

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Abstract

The purpose of this study is to investigate same-turn self-repair performance in Mandarin aphasics. Results indicated that the overall self-repair performance of Wernicke's and Broca's aphasics is in general similar. However, there are some substantial differences between the two patient groups. The relative higher distribution of the completion pattern in Wernicke's group could be due to their rather fluent production ability. Broca's better error-detecting ability could be attributed to the less impaired comprehension ability. Evidence from the distribution frequency of each self-repair pattern in Mandarin aphasics supports the claim that repetition is the most common type in self-repair pattern found in English aphasic speakers (e.g., Lebrun, 1987; Levelt, 1983; Maher et al., 1994) as well as in Mandarin normal speakers (Chui, 1996; Tseng, 2006). This similarity might indicate a universal tendency of the self-repair use. In sum, three possible factors involved in the choice of self-repair methods are the processing difficulty, the linguistic deficits of different patients, and the value of the repair pattern affecting the self-repair performance of aphasics.

Keywords: self-repair, Broca's aphasics, Wernicke's aphasics, Mandarin

1. INTRODUCTION

A repair is a behavior signaling interlocutors' attempt to fix troubles during conversation (Ferguson, 1994; Fox & Jasperson, 1995). In spontaneous speech, speech revisions made by the speakers themselves are called same-turn self-repair (Schegloff, 1979; Schegloff et al., 1977).

Blackmer and Mitton (1991) on the timing of self-repairs in conversation have defined them as a changing term of prior material, and/or a repetition of prior material[1] and/or an editing term. An editing term was defined as a filler without semantic value in relation to the sentence under construction, and without function as a discourse marker other than possibly indicating that the speaker wished to continue speaking (see Schiffrin 1987). While troubles may result from errors, perceptible errors do not necessarily need to be repaired (Schegloff et al., 1977). Errors can sometimes be ignored when they do not interfere with listeners' understanding or impede the progress of speech turns. On the other hand, the speaker may alter his/her own utterances when there are no speech errors. Therefore, trouble repair is not restricted to error correction.

The main purpose of self-repair is to make sure speakers' speech is expressed in correct ways and understood by listeners, and the ability to monitoring troubles is therefore important in the repair performance. Previous studies have suggested that the monitoring device is one of a number of components included in the speech production process and helps speakers detect troubles in their speech (Laver 1973; Levelt, 1983, 1989; Postma & Kolk, 1993; Van Wijk & Kempen, 1987).

The repair behavior has been studied by conversation analysts and psycholinguists (e.g., Blackmer & Mitton, 1991; Brinton et al., 1986; De Smedt & Kempen, 1987; Fox & Jasperson, 1995; Fox, Maschler & Uhmann, 2010; Gallagher, 1977; Laakso & Sorjonen, 2010; Laver, 1973, 1980; Levelt, 1983, 1989; Nooteboom, 1980; Oomen & Postma, 2001; Postma & Kolk, 1993; Schegloff, 1992; Schegloff et al., 1977; Tye-Murray, 1991; Van Wilk & Kempen, 1987). From the perspective of conversation analysis, the observation of repair organization has been focused on the interaction between interlocutors. Schegloff et al. (1977) made two important distinctions based on the person who initiates and/or completes the repair. The first distinction involves self-initiated versus other-initiated repair. The former refers to the repair without prompting and the latter refers to the repair with prompting. Prompting is manifested by the listener's request for clarification of the speaker's message. The second distinction includes self-repair versus other-repair, which refers to the repair done by the speaker him/herself versus by another participant. From the perspective of psychology, repair is regarded as the product of the self-monitoring mechanism involved in the speech production process (e.g., Laver, 1973; Levelt, 1983, 1989; Postma & Kolk, 1993; Van Wijk & Kempen, 1987). When speakers detect troubles in their own speech, they interrupt the speech and then try to

[1] They excluded repetition for emphasis.

correct themselves.

In addition to studying repair behaviors of normal adult speakers, researchers pay attention to aphasics' repair performance as well. The researchers focused on the whole-scale interactive pattern between aphasic and normal speakers (e.g., Ferguson, 1992; Goodwin, 1995; Klippi, 1991; Laakso, 2003; Milroy & Perkins, 1992; Oelschlaeger, 1999; Oelschlaeger & Damico, 2003; Perkins, 2003). These studies have shown that aphasics maintain repair abilities involving self-monitoring and repair behaviors of aphasics (e.g., Liss, 1998; Maher et al., 1994; Marshall & Tompkins, 1982; Marshall et al., 1980; Marshall et al., 1985; Marshall et al., 1998; Oomen et al., 2001; Schlenk et al., 1987).

For normal speakers, to repair their own trouble sources in speech is common and simple. However, brain lesions limit aphasics' linguistic competence and performance so the patients might not be equipped with the kinds of self-repair abilities that normal speakers have. First of all, they might ignore trouble sources because of their inability to recognize their troubles. Secondly, they might spend quite a long time completing a repair. Thirdly, they might have difficulties when other interlocutors request them to do self-repair. Last, they might need some help from other interlocutors.

In English, a number of researchers suggested that aphasics' self-monitoring ability is related to comprehension ability; if there is a problem with the monitoring system, the language comprehension ability might be impaired (Lebrun, 1987; Maher et al., 1994). In their studies, it was found that aphasics with good comprehension could perform better in monitoring their own speech than those with worse comprehension ability. However, some researchers disagreed with this view due to finding no correlation between self-monitoring and comprehension abilities (e.g., Marshall et al., 1985, 1994; Nickels & Howard, 1995; Schlenck et al., 1987).

Few studies have discussed the types of self-repair patterns in Mandarin conversation (Chui, 1996, 2001; Tseng, 2006). Since repair studies involving Mandarin aphasics have never been discussed, the purpose of this study is thus to investigate same-turn self-repair performance in Mandarin aphasics. This paper, which is mainly a descriptive study of Mandarin Chinese speech self-repairs from four aphasic patients (two Broca, two Wernicke), following Chui's (2001) and Tseng's (2006) classification based on their own Mandarin spoken corpora, will look at the types of repair patterns involving the self-repair performance of aphasics in Mandarin. The paper will then look at the distribution of each repair pattern and further discuss mechanisms underlying the aphasic self-repair performance. It will be interesting to find out whether or not the Mandarin aphasic patient data will yield

similar repair patterns to normal speakers. Next, self-repair behavior between Wernicke's and Broca's aphasics will be compared as to see whether they have similarities or differences in performance[2]. Finally, the issue regarding whether or not aphasic patients with good comprehension ability will perform self-repair better in production will also be addressed.

This study will be organized in five sections. In Section Two, we will review some related studies of self-repair sequence and aphasics' repair performance. In Section Three, the methodology and details of data collection will be introduced. The analysis and discussion of the data will be presented in Section Four. Section Five presents our concluding remarks and possible future work.

2. LITERATURE REVIEW

Although more studies need to be done to find out the exact way that people monitor their own speech production process, the monitoring function exists in trouble detection as to whether it is for inner speech monitoring or covert errors. After the detection of the trouble, self-repair is then performed. Troubles could exist in any linguistic forms, and there are corresponding repair ways.

The majority of repair studies in conversation have been done in English conversation, and few reports in the literature bear on the issue of self-repairs in Mandarin. Chui (1996, 2001) and Tseng (2006) used on their own spoken corpora to provide evidence on self-repair behavior in Mandarin speakers. Chui (1996), adopting a quantitative method, classified six basic repair types in spontaneous dialogues in Taiwan Mandarin that included repetition, completion, replacement, addition, reordering and abandonment (N=458). She concluded that repetition occurs way more often than the rest of the types (42.6%), completion is the next most common type (21.4%), followed by abandonment (16.2%), and reordering as the least common one (0.4%). In general, Chui (1996) also suggested that self-repair patterns vary from language to language. Tseng (2006) collected another spoken corpus and classified five basic repair types for Taiwan Mandarin (N=325), which included repetition, substitution, addition, deletion and complex repairs. Tseng found that repetition repair way outnumbered the other four types (62.1%), substitution and addition repairs were next (14.1% and 13.2% respectively), and complex repair types were more common than deletion (7.6% vs. 2.7%). After comparing the spoken corpora of German and Mandarin, Tseng also claimed that the self-repair method is language dependent. Based on the repair patterns, Chui (1996) and Tseng

[2] Note that the repair behaviors of the aphasic subjects under this study will include the data involving error corrections only when we presented the substitution type in self-repair patterns.

(2006) might have different views in the classification system, but they both found that the repetition seems to be the most common type of self-repairs in Mandarin, and they also confirmed the cross-linguistic studies that support differences in the organization of self-repairs (Fox et al., 1996; Hayashi, 1994). In addition, they agreed that the self-repair in Mandarin is not necessarily conditioned by syntactic factors. Since the aphasic patients who participated in the study all had major problems with syntax, and they had difficulties producing complicated sentences with complete syntactic structure, the issue of a self-repair boundary will not be the focus in the study; however, we will follow a similar classification system to that of Chui (1996, 2001) and Tseng (2006), and see whether similar self-repair patterns are displayed by Mandarin aphasics.

The second issue in the current paper is whether aphasics with good comprehension ability would perform significantly better than those with worse comprehension ability. In addition to studying language mechanisms of normal speakers, psycholinguists pay attention to aphasics' linguistic ability by examining aphasics' self-repair performance from their self-monitoring ability. Levelt's perceptual loop theory indicates that monitoring only proceeds through the speech comprehension system (Levelt, 1983, 1989). In line with Levelt, some researchers have proposed that aphasics' self-monitoring ability is based on comprehension ability, and they proposed that monitoring deficits in aphasics could be caused by impaired language comprehension (Lebrun, 1987; Maher et al., 1994). This observation, found in the data of an aphasic patient, lead Lebrun (1987) to suggest that the impaired lexical-semantic representations are associated with impaired speech comprehension. Similarly, Maher, Rothi and Heilman (1994) found that, in certain aphasic patients, lack of awareness of their speech-language failures has been reflected in an absence of notable self-correction of speech production errors. They further studied self-repair behaviors of patients with different aphasic syndromes, and found that patients with good comprehension ability produce the highest percentage of self-repairs, suggesting that aphasics with good comprehension can perform better in monitoring their own speech than those with worse comprehension ability. However, when Schlenck, Huber, and Willmes (1987) conducted a picture description experiment to examine aphasic self-repair performance, their study showed that there was no significant difference in repair performance between patients with Broca's and Wernicke's aphasia. Nickels and Howard (1995) also found that there was no correlation between self-monitoring and comprehension ability. In addition, Marshall et al. (1985) and Marshall et al. (1998) found that some aphasics detected errors in speech and frequently made

self-corrections regardless of their poor comprehension skills. Furthermore, some studies even suggested that good comprehension ability might not positively help aphasics make repair or recognize their own speech errors (Marshall et al., 1998; Shuren et al., 1995).

Therefore, the main purpose of this paper is to look at self-repair patterns in Mandarin aphasic patients in general, and then to find out whether in Mandarin the comprehension ability has anything to do with the self-repair performance. Specifically, issues involving whether or not Broca's and Wernicke's aphasic patients perform differently in the self-repair behavior will be addressed. Finally, there is a need to look at whether Mandarin aphasic patients perform similar self-repair patterns as normal speakers do.

3. DATA AND CODING

The data for the present study come from the corpus collected by the authors, which consists of 15-hours of video-taped face-to-face conversations between aphasic patients and speech therapists. It is generally accepted that Broca patients exhibit typical speech patterns characterized by slow and halting speech, and they are often unable to initiate a fluent production of words. Their disfluent speech includes many filled pauses and discourse markers, and their syntactic outputs are relatively poor. Their utterances mostly consist of content words rather than function words. Sentences with complete syntactic structures are not common in their speech. The Wernicke patients, on the other hand, show prototypical speech patterns which are relatively fluent but sometimes do not convey the right message; their message usually include occasional nonsense words (neologistic jargon) and phonemic paraphasia (substitutions of individual phonemes). Furthermore, elaborate descriptions are frequently used, but these so-called circumlocutions are often off the topic or hard to understand. In general, the number of words within a Broca patient's single speech turn is basically not as much as that of a Wernicke's aphasic. Although most of their symptoms are different from Wernicke's aphasics, both groups share the problems of word-finding difficulties and mispronunciations.

In this study, the aphasic speech data has been drawn from interview questions with speech therapists. Most of the contexts are responses to questions produced during the course of open-ended conversations regarding the patients' illness, work, hobbies, family, friends, the weather, etc. The spontaneous speech of each patient individually given the interview in a moderately quiet room lasted about 30 minutes. For each self-repair, we recorded and transcribed the complete utterance including self-corrections, pauses and gestures, comments by the speaker or by listeners, the direct questioning of the

speaker and the unaided intuition of the listeners, and relevant contextual information for the whole discourse; some portions were written in phonetic transcription, when appropriate. Two experienced assistants, who had been employed a year prior to the initiation of this study to conduct acoustic and speech-error analyses, and the first author, who has his own, or her own corpora of naturally-occurring speech errors and aphasic speech in Mandarin collected over decades, transcribed and coded the transcripts in their entirety. We then compared notes; phonetic inconsistencies were either resolved by negotiation or by using spectrographic analysis, whenever needed.

All of these aphasic patients suffer from unilateral damage to the left hemisphere caused by cerebral vascular disease, brain trauma, brain tumor, or stroke. Table 1 shows a summary of the significant features of each patient's case.

Table 1. Summary of aphasic subjects

Patient	***Fluency***	***Age (years)***	***Gender***	***Education***	***Time post onset (years)***	**Neurological information**
XCX	Fluent (Wernicke's)	49	M	College	3	Cerebrovascular accident (CVA); Temporal-parietal lobe hemorrhage; craniotomy
YMQ	Fluent (Wernicke's)	50	F	College	2	CVA; Temporal-parietal lobe hemorrhage; s/p section meningioma
WZY	Non-fluent (Broca's)	68	F	College	3	Trauma; Frontal-temporal lobe
CCH	Non-fluent (Broca's)	44	M	MA	3.5	CVA Frontal-temporal lobe (basal ganglia) MCA infarction

The diagnoses of the four aphasia subjects who contributed the data to this study have been substantiated by CT scans as part of their standard clinical care. Arrangements to interview the group were made by their therapists, and conversational recordings were collected in the counseling rooms of the Department of Physical Medicine and Rehabilitation at National Taiwan University Hospital. These individuals were distinguished by clinical characteristics and accompanying pathology. Based on clinical observation of speech therapists and subjects' performance on the Boston

Diagnostic Aphasia Examination (BDAE), two subjects were classified as Wernicke's aphasics and two as Broca's aphasics. In the study, only moderately impaired aphasics were chosen, since some studies have indicated that the severity of aphasia might affect their self-correction ability (Farmer, 1977; Farmer et al., 1978; Joanette et al., 1980; Marshall & Tomkins, 1982; Marshall et al., 1980; Marshall et al., 1994). Individuals that were diagnosed with a non-fluent form of aphasia or a motor speech impairment (e.g., dysarthria or apraxia) were excluded from this study to avoid attributing phonetic or articulatory distortions to a phonological origin.

Topics of aphasic-therapist conversations were mostly recent media reports and events of the life of the person with aphasia. Sometimes there were semi-structured tasks such as describing a sequence of events illustrated in a picture card and highly structured tasks such as the confrontation naming task or evaluation. Some researchers suggested that the frequency of repair might be affected by tasks and genres (Chui, 2001; Ferguson, 1994; Marshall & Tompkins, 1982; Marshall et al., 1985). When an ambiguous situation occurred, it would be difficult to determine whether the repair was due to linguistic difficulties, and in this case, we did not include the data in the study. According to a study by Kowall, Wiese, and O'Connell (1983), given normal rate of speech, pauses below two seconds are usually taken to reflect ongoing planning of linguistic structure, while longer pauses can safely be assumed to reflect trouble in language production. This analysis has been confirmed by Schlenck, Huber and Willmes (1987), and we thus considered filled or unfilled pauses as editing elements only when their duration was at least two seconds.

In the conversation of four therapist-aphasic dyads, there were 207 self-repairs made by Wernicke's aphasics collected from 17 pieces of recording transcriptions (8.5 hours), and 347 made by Broca's patients from 13 pieces of recording transcriptions (6.5 hours). According to Schlenck, Huber and Willmes (1987), repairs may include one or more of the following editing elements: (1) pauses of at least two seconds, (2) interjections of filled pauses of at least two seconds such as *uh…uh...*, (3) repeats of immediately preceding utterances, (4) one or several phonemic approximations, (5) circumlocutions or semantic approximations, and (6) comments, e.g., *what is it called again?* Those interactive repair behaviors between therapists and aphasics are not the concern of this study; it is the repair utterances which aphasic patients used in their own speech turn that will be the major goal in the study.

4. FINDINGS AND DISCUSSION

Previous studies have set up various systems in categorizing repair types. Fox and Jasperson (1995) used a seven-pattern

system to analyze English repair. Chui (1996, 2001) adapted their system and used a six-pattern system to classify 458 Mandarin self-repairs whereas Tseng (2006) divided 325 Mandarin self-repairs into simple types and complex types. The simple types included four single repair patterns and the complex types involved the combination of two or more single patterns. This study has adopted the classification system found in Chui (1996, 2001) and Tseng (2006). Since the aphasic patients who participated in the study may not be able to produce sentences that are as long or as complicated as those normal speakers generate in conversation, five major categories have so far been classified.

Each self-repair pattern of aphasic patients is listed below with its definition, and one example of each pattern is provided. Speaker *T* represents the therapist, and speaker *P* represents the patient. Underlined utterances indicate the presence of using the specific self-repair pattern.

(1) Repetition: All or part of the trouble utterance is repeated without change to the structure or the information that is given, and there is no lexicalized element in between (except filled pauses and particles).

song…song…. song…laopo ba? hai shi shenme?
send send send wife QST or COP what
'send…send…send… to (his) wife? Or what?'

Type one shows a repetition repair in which the verb *song* 'send' is repeated.

(2) Replacement

a. Substitution: Replacements requiring the change of content belong to this category.

huaduo…e… shumu…e… huaduo hen piaoliang
flowers PRT trees PRT flowers very beautiful
'Flowers…uh…trees…uh…flowers…are beautiful.'

Type Two shows a substitution repair in which the lexical item *shu mu* 'trees' is replaced by *hua duo* 'flowers'. Examples like this would also be considered as self-correction errors since the patient replaced one lexical item with another new one, and corrected his own speech.

b. Reformulation: The original structure of utterances is abandoned and a new structure is provided.

wo nüer... jiao wo… qingchunbang… jiu shi…

1.SG daughter teach 1.SG pimple stick EMP COP
ji… qingchundou… de dongxi
remove pimple ASSC things
'My daughter…taught me…pimple stick…that is…remove… pimples… thing.'

The second type of substitution repair, reformulation, is the case where the structure of original utterance is changed. The aphasic patient paraphrased the repair item. In this type of example, the structure change does not result in difference in meaning.

c. Negation: The trouble source is disapproved by negation markers and the new candidate is further supplied.

e… you… e… wo… meiyou…meiyou hui qu…xuexiao le
PRT yes PRT 1.SG NEG NEG back go school PRT
'uh…yes…uh…I…no…didn't go back… to college.'

The final type of substitution is negation in which a negation marker *meiyou* 'no' is inserted in the utterance.

The next type is addition, which includes the completion and elaboration repair patterns.

(3) Addition

a. Completion: An unfinished lexical item or expression is fulfilled by the repair outcome.

P(atient): …houlai… jiu tiao dao…5… 5 kuai… yi ge
afterwards EMP jump to five five dollars one CL
'…later…go up to…5…5 dollars…one'
T(herapist): ...bu shi 5 ge?
NEG COP five CL
'…not (for) five?'
P: ...bu shi… shi… shi 5 kuai
NEG COP COP COP five dollars
'…no, (it) is…is five dollars.'
T: ...o... shi yi ge yao 5 kuai
PRT COP one CL want five dollars
'…oh, (it) is five dollars for one.'

In completion repair, the aphasic speaker added the dollar value *kuai* and the classifier *ge* to complete the information and he tried to make sure the therapist wouldn't get confused.

b. Elaboration: The second structure is enriched in meaning by increasing some elements in two adjacent structures with similar content.

P:…e… zhe yang…jiu gou le… zhe yang…jiu shi…
PRT this way EMP enough PRT this way EMP COP
'…uh…this…is enough…this…is…'
jiu shi shuo… xiaohai…jiankang…
EMP COP COMPL children healthy
'that is…children…healthy…'
T: ni de yisi shi shuo xiaohai zhiyao jianjiankangkang
2.SG ASSC mean COP COMPL children only healthy-healthy
'Do you mean that the children are healthy?'
bu yong dou na diyiming shi ma?
NEG have to always get first rank COP QST
'and they don't have to get straight A's?'
P: …e… shi zhe yang…
PRT COP this way'
'Yes…that is right.'

In elaboration repair, the aphasic patient said that 'this' is enough, and he further extended what he meant by 'this'. He added more information about 'children's health'. The patient at first intended to use a determiner to cover the new information, and then she repaired and added the extra phrases by elaborating with new information.

(4) Deletion: Something is erased in the second structure of two adjacent structures having similar content.

P: …xianzai…o… e... bu hao zhao…
now PRT PRT NEG easy find
'…now…oh…uh…not easy to find.'
shiye renkou… shiye… hen duo
unemployment population unemployment very much
unemployment population…unemployment much'
T: jingji bu hao suoyi gongzuo bu hao zhao
economics NEG good so work NEG easy find
'The economy is bad…so it's not easy to find work.'
P: …o… e... shi... shiye ren duo
PRT PRT unemployment people many

…oh…uh…yes…many unemployed people'

Contrary to the elaboration repair, the deletion type shows the speaker deleted some lexical items in the utterance. In this example, the patient deleted the noun 'population'.

(5) Multiple: Two or more repair patterns are used to deal with the trouble source.

P: …baohan xiang riben…bu shi…na ge deguoren…deguoren de hua
including like Japan NEG COP that CL German German ASSC COMPL
'such as Japan…no... well, German…German'

The final type is a multiple repair in which the speaker used two patterns to deal with a trouble. At first, the lexical item *riben* 'Japan' is negated and replaced by *deguoren* 'German', and then the speaker repeated the intended item *deguoren* 'German'.

The following tables show how the repair patterns were used in the four aphasic patients' conversation. The distribution of each self-repair pattern in Wernicke's group is provided in Table 2.

Table 2. Self-repair in Wernicke's group (N=207)

Self-repair patterns		Number	Percentage	Total
1. Repetition		94	45.4%	45.4%
2. Replacement	a. Substitution	25	12.1%	22.7%
	b. Reformulation	5	2.4%	
	c. Negation	17	8.2%	
3. Addition	a. Completion	37	17.9%	21.8%
	b. Elaboration	8	3.9%	
4. Deletion		6	2.9%	2.9%
5. Multiple		15	7.2%	7.2%
Total		207	100%	100%

In Table 3 , it can be seen that the most frequently used self-repair pattern for Wernicke's patients is repetition (45.4%), followed by replacement (22.7%), addition (21.8%), multiple (7.2%), and deletion (2.9%). The following presents the distribution of self-repair patterns in five major categories in Broca's group.

Table 3. Self-repair in Broca's group (N=347)

Self-repair patterns		Number	Percentage	Total
1. Repetition		157	45.2%	45.2%
2. Replacement	a. Substitution	76	21.6%	26.8%
	b. Reformulation	1	0.3%	
	c. Negation	17	4.9%	
3. Addition	a. Completion	47	13.8%	15.9%
	b. Elaboration	7	2.1%	
4. Deletion		9	2.6%	2.6%
5. Multiple		33	9.5%	9.5%
Total		347	100%	100%

In this table, it can be seen that the most frequent self-repair pattern for Broca's patients is repetition (45.2%), which outnumbers replacement (26.8%). Deletion (2.6%) is the least common one.

Next, we wanted to find out whether there were different performance patterns when the patients suffered from different lesion sites in their brains. The distribution of each subtype pattern in the five main categories for Wernicke's and Broca's groups is provided below.

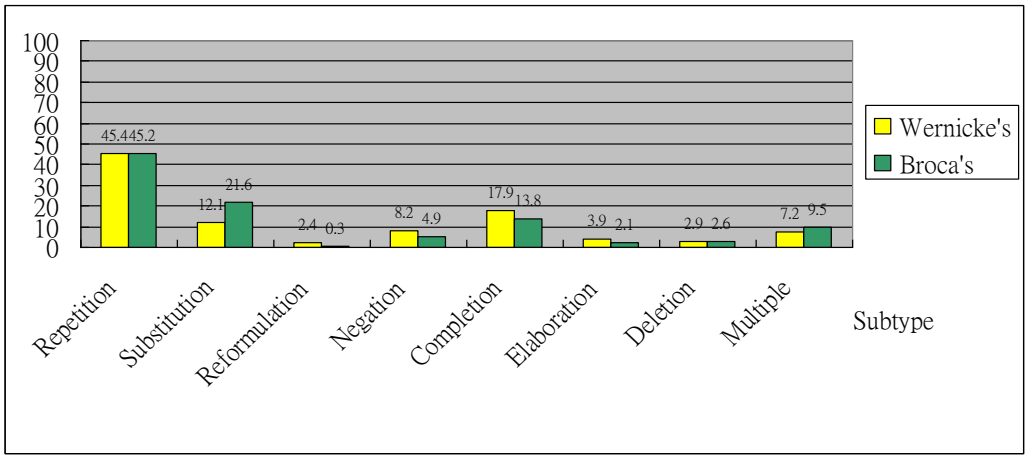

Figure 1. Distribution of self-repair patterns between Wernicke's and Broca's groups

It can be seen that the most frequently used pattern in both Wernicke's and Broca's groups was repetition, reaching 45.4% for Wernicke's and 45.2% for Broca's. The replacement category took second place and it reached to 22.7% in Wernicke's group and 26.8% in Broca's group. The third place was taken by the addition category, and it reached 21.8% in Wernicke's and 15.9% in Broca's group. The deletion and multiple categories were rarely used, making up less than 10% in each patient group.

Chi-square tests were performed to compare the distribution of the five main categories in the two patient groups. The results indicated that the overall distributional frequency was similar in Wernicke's and Broca's group and there is no significant difference ($\chi^2(4)=4.560$, $P>.01$). The overall distribution of the five categories was similar in each patient group, but there were some differences in the subtypes.

It has been shown that repetition is the major self-repair pattern in both Wernicke's group (45.4%) and Broca's group (45.2%). This finding is not surprising since the repair requires neither an increase nor a decrease in the information of the original utterance in the conversation. Without changing semantic content or linguistic forms, this pattern costs aphasics less effort. Since the language ability is impaired to a certain degree, this pattern might provide an efficient and uncomplicated way for aphasics to do repair.

As Jou and Harris (1992) suggested, repetitions can be regarded as a means of keeping track of what has been produced without costing too much attention. In order to maintain their speech turn while thinking about what they want to say next, patients might use repetition as a buffer. The present study also confirms the findings in normal speakers of Mandarin since more than 60% of Mandarin speakers in Tseng's (2006) and 42.6% in Chui's (1996) study showed that repetition was the most frequently adopted pattern. These findings suggest that the unaltered characteristic of the repetition pattern make it the simplest way for Mandarin speakers to prolong their time to think, and that this strategy would work for both normal speakers and aphasic patients.

As for the replacement category, it took the second position and made up about 25% of the repairs in each patient group. There are three subtypes within this category. The first one is the substitution pattern, which was used more often than the other two in both patient groups. In fact, the Broca's patients seemed to use substitution more frequently than the Wernicke's patients (21.6% vs. 12.1%), and there is a significant difference (χ^2 (1) = 8.395, $p < .01$). This might show that Broca's patients are more likely to correct errors than Wernicke's patients are, and the difference between these two patient groups

could be related to their self-monitoring and error-detecting ability (Levelt, 1983; Marshall et al., 1985). Broca's patients, who have better comprehension ability, may be aware of their own errors. Once they have detected that some lexical item or phonological form has gone wrong in their utterance, they may have a preference to go back to the point where the error was made to edit it; Wernicke's patients, on the other hand, are often unaware of their own errors. Some researchers have proposed that better self-monitoring could be attributed to better comprehension (Lebrun, 1987; Levelt, 1983, 1989; Maher et al., 1994). The results in our study showed a similar pattern; Broca's patients detected and fixed their errors more often than Wernicke's patients.

The second subtype under replacement is the negation pattern. It is similar to the substitution pattern in that they both replace the unintended speech with the intended phrase, and the only difference lies in that negation repair requiring the insertion of extra negation markers such as *meiyou* 'no', *bushi* 'no' and *budui* 'wrong'. In Wernicke's group, the distribution of the negation pattern was similar to that of the substitution pattern (12.1% vs. 8.2%); the result achieved a z-score of 0.041 (z.025=-1.96; z.975=1.96), and there was no significant difference between the negation and substitution sub-types in Wernicke's patients. However, in Broca's group, the distribution of the negation pattern was far less than that of the substitution pattern (21.6% vs. 4.9%); the results achieved a z-score of 6.423 (z.025=-1.96; z.975=1.96), and there was a significant difference between the negation and substitution sub-types in Broca's patients. We speculate that Broca's patients prefer not adding an extra burden to the repair process since they already have difficulties in speaking. They may use negation markers only when they consider that the trouble utterance has caused more serious problems. For them, negation markers only carry the function of emphasizing. As for Wernicke's patients, their production is more fluent, and therefore, the production of negation markers is not that difficult. In this case, they may choose to use them freely.

The third subtype under the replacement category is the reformulation pattern. This pattern focuses the repair work on the syntactic level. The distributions in each patient group were both low. They made up 2.4% in Wernicke's group and only 0.3% in Broca's group. In general, the two patient groups in the study did not produce complicated sentences and therefore it is not surprising that they have problems making self-repairs at the syntactic level. Broca's patients especially have more serious syntactic deficits than Wernicke's patients. Their speech is mostly filled with fragmentary words and phrases but not sentences with complete construction. Therefore, it is reasonable that they adopt this pattern less often than Wernicke's

aphasics as it presents more processing difficulties. In speech production models, language is processed through different stages (Levelt, 1989). First of all, concepts are formed, and then they will be sent to form the semantic and syntactic structures. Later, lexical items and phonetic segments are selected. Finally, the motor commands are conveyed to the muscles and the utterances are produced. Syntactic processing is somewhat in the initial stage of the whole process, and the repair work involved at this stage may require more reaction time. That is, the reorganization of syntactic structures would take more effort than lexical or phonetic selection.

The addition category took third place in the overall distribution in both patient groups. This category took 21.8% in Wernicke's group and 15.9% in Broca's group. Two subtypes are included in this category. One is completion and the other is elaboration. In both patient groups, completion made up a higher percentage than did elaboration. In addition, the distribution frequency of the two subtypes was respectively higher in Werincke's than in Broca's group. In our study, the distribution of the completion pattern reached 17.9% in Wernicke's group, and it took second place among the overall eight subtypes. This result is similar to the finding in Chui's (1996) study. She found that completion self-repair placed second among the overall six patterns (21.4%). As for Broca's patients, the completion repair made up 13.8%, which is less than it is for both Wernicke's group and for normal speakers. The difference may be due to the disfluency of Broca's aphasics. Although Broca's patients can still access items stored in the mental lexicon and they often try to repair those unfinished items previously produced, their retrieval process and speech may not go smoothly enough, and that may hinder their self-repair ability in completing an unfinished word. As for the elaboration pattern, its distribution was fairly low. This pattern made up 3.9% in Wernicke's group and 2.1% in Broca's group. As mentioned earlier, the difficulty of repair could be related to the language processing stages. There are several steps in the process of language production, and we consider elaboration being more related to the concept-formation stage. To elaborate our speech means to give more new information to the ongoing conversation. The new information starts from the concept-formation stage without a clear shape, and the speaker therefore needs to decide its semantic, syntactic, and phonetic structures from the beginning. Compared with other repair patterns, if the repair is a lexical completion, the retrieving time would be shorter. However, the elaboration pattern requires speakers to process a new concept, the cost of which is much more effort. As a result of the difficulty of processing, the elaboration pattern was not frequently used.

As for the deletion category, the use of this

pattern was rather limited in both patient groups (Wernicke's group: 2.9%; Broca's group: 2.6%). This result is in line with the findings of Tseng (2006) who indicated that only about 2.7% of repairs made by normal speakers of Mandarin were deletions. We consider the low percentage of use of this pattern due neither to the linguistic deficits of aphasics nor its higher processing demands but rather to its less effective nature. Repair work should be done to make speech more understandable, but this type of repair seems ill equipped with the function. Therefore, normal speakers and aphasics seldom adopt this repair pattern.

The final category is that of multiple self-repair. There were 7.2% and 9.5% in Wernicke's and Broca's groups respectively. The use of multiple patterns could be a sign of speakers having processing difficulties. They might not find the correct way to deal with the trouble right away, and hence they need to try many times. A similar result indicated to Tseng's study (2006) in which normal speakers used the multiple pattern in only 7.6% of repairs, suggesting that normal speakers do not use this pattern at a high frequency; this is what we found for Mandarin aphasics as well. The distribution rate of this pattern in aphasic and normal groups might suggest that both normal and aphasic speakers prefer to fix their trouble with one repair pattern in a simple fashion.

5. CONCLUSION

This paper presents the results of a quantitative analysis of self-repair patterns in Mandarin aphasics. The analysis reveals patterns of similarities and differences between two aphasic groups. We first looked at the self-repair patterns in aphasic patients' conversation. We discussed the use of self-repair patterns of Wernicke's and Broca's patients. The overall distributions of the five repair categories were similar in the two patient groups although there were still subtle differences in some subtypes. As for the five major categories, the repetition pattern occurs the most often in self-repair patterns in Mandarin aphasic patients, and deletion was the least common pattern. The replacement category took second place and the addition category took third place in overall distribution, but there were differences of distribution in subtypes between patient groups. Under the replacement category, Broca's patients used substitution more than Wernicke's patients did, but Wernicke's patients used the substitution and the negation patterns at a similar percentage, while the reformulation pattern was rarely used by either patient group. Under the addition category, the completion pattern was used more often than the elaboration pattern, with Wernicke's patients using the addition category more often than Broca's patients did.

We speculate that there are three possible

factors affecting the distribution frequency of self-repair patterns. First of all, patterns requiring more processing effort may decrease in their rate of use. It is not surprising that repetition is the major self-repair pattern in both Wernicke's (fluent) and Broca (non-fluent) groups since this type of repair requires neither increasing nor decreasing elements of the original utterance in the conversation. Without changing semantic content or linguistic forms, this pattern costs aphasics less effort or attention to the process of repair. Since their language ability is impaired to a certain degree, this pattern provides an efficient and uncomplicated way for aphasics to do repair. Reformulation and elaboration, on the other hand, made up a very low percentage in both patient groups. This can be attributed to the heavier processing burden they cause. Second, the linguistic deficits inherent in the different types of aphasia might also be an important factor in determining a patient's repair performance. For example, Broca's patients used more substitution patterns than did Wernicke's patients. This could be due to their better self-monitoring and error-detection ability, and this ability might come from their less impaired comprehension. Moreover, the higher percentage of the addition category in Wernicke's group might also indicate that their production is better than Broca's patients. Therefore, the finding confirms the studies found in English where Broca's patients detected and replaced their errors more often than did Wernicke's patients. Finally, the third possible factor is the value of those repair patterns. The deletion pattern was the least used; this might be ascribed to it being less effective in repair work. Repair work should promote clarity in speech, but the deletion pattern might not help a lot.

In addition, we also discussed the similarities between Mandarin aphasic patients and normal speakers. In the two patient groups, repetition (45%) took first place and deletion (3%) was the least common pattern. The figures and results are in substantial agreement with the repair studies found in Chui (1996) and Tseng (2006) for normal speakers of Mandarin, indicating that there might be a universal tendency in the choice of repair patterns.

In the studies involving self-repair by normal speakers of Mandarin, Chui (1996) suggested that Mandarin speech repair is subject to the complexity of lexical items and the size of words, and thus the constituent boundaries are not the major factors influencing Mandarin speakers' repair preference. This reveals that Mandarin repair is not mainly conditioned by syntactic constraints as English is. Tseng (2006) also discussed self-repair patterns of Mandarin at the syntactic level. The results show that phrasal boundaries do not significantly correlate with the Mandarin repair formation. In addition, semantic

categories do not determine the repair formation, and short-distance repairs such as re-initiation from the previous syllable are more common than repairs involving long distance retracing. These two studies speculated that repair in Mandarin is not necessarily conditioned by syntactic factors. Since the present self-repair data collected from the aphasic patients is not able to give any supporting evidence as to whether or not the repair behavior in aphasic patients is conditioned by the syntactic environment, in the future we will try to administer our interviews at approximately 12 months post onset to those patients who suffer from mild left-hemisphere damage and who are able to convey longer chunks of phrasal structures to see whether we can find any evidence to prove that Chui's (1996) and Tseng's (2006) repair boundary issue in Mandarin is accurate.

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