

2014

Development of the Taiwanese Mandarin Main Concept Analysis and Linguistic Communication Measure: Normative and Preliminary Aphasic Data

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DEVELOPMENT OF THE TAIWANESE MANDARIN MAIN CONCEPT ANALYSIS
AND LINGUISTIC COMMUNICATION MEASURE: NORMATIVE AND
PRELIMINARY APHASIC DATA

by

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B.S. Chung Shan Medical University, 2006

A thesis submitted in partial fulfillment of the requirements
for the degree of Master of Arts
in the Department of Communication Sciences and Disorders
in the College of Health and Public Affairs
at the University of Central Florida
Orlando, Florida

Spring Term
2014

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ABSTRACT

Aphasia is a language disorder resulting from damage to brain areas that control language expression and reception. Clinically, the narrative production of Persons with Aphasia (PWA) provides valuable information for diagnosis of aphasia. There are several types of assessment procedures for analysis of aphasic's narrative production. One of them is to use quantification systems, such as the Cantonese Linguistic Communication Measure (CLCM; Kong & Law, 2004) or the Main Concept Analysis (MCA; Kong, 2009), for objective quantification of aphasic's discourse. The purposes of this study are (1) to translate the MCA and CLCM to a Taiwanese Mandarin Main Concept Analysis (TM-MCA) and a Taiwanese Mandarin Linguistic Communication Measure (TM-LCM), respectively, and (2) to validate them based on normal speakers and PWA in Taiwan. In the pilot study, a total of sixteen participants, eight certified speech-language pathologists (SLPs) and eight normal speakers, were invited to establish the Taiwanese Mandarin main concepts related to the four sets of sequential pictures created by Kong in 2009. The language samples from eight normal speakers were then used to determine the informative words (i-words) in the picture sets. In the main study, thirty-six normal speakers and ten PWA were recruited to perform the same picture description tasks. The elicited language samples were analyzed using both the TM-MCA and TM-LCM. The results suggested that both age and education affected the oral discourse performance. Significant differences on the measures in TM-MCA and indices in TM-LCM were noted between the normal and aphasic groups. It was also found that overall aphasia severity affected the picture description performances of PWA. Finally, significant correlations between some of the TM-MCA measures and TM-LCM indices were noted. In conclusion, both the TM-MCA and TM-LCM are culturally appropriate to the Taiwanese Mandarin population. They can be used to supplement standardized aphasia tests to help

clinicians make more informative decisions not only on diagnosis but also on a treatment plan of aphasia.

ACKNOWLEDGMENTS

This study can not be completed without the support from a great number of people. First, I would like to acknowledge Dr. Anthony Pak Hin Kong for providing me an opportunity to work on a research project in the field of Chinese aphasia. Throughout the study, he provided me with numerous resources, ideas, suggestions, and comments which were very essential for this study. I would also like to express my appreciation to my thesis co-chairs, Dr. Jack Ryalls and Dr. Janet Whiteside. I was so blessed to have both of them in my thesis committee. I appreciated their precious time to review my thesis and insightful suggestions and comments.

I also want to extend my thanks to the Taiwanese speech-language pathologists: Ms. Yiwen Tsai, Ms. Chin-Wei Tien, Ms. Michelle Hui-Hsin Lee, Ms. Ming-Chun Li, Mr. Pei-hung Lin, Mr. Chun-Ying Chen, Ms. Yi-Wei Lin, Mr. Chien Chou Chen, and Ms. Tzu Yun Chen. In addition, I am so grateful for having all of the normal speakers and individuals with aphasia as well as their families in my study. Without their help, this study definitely could not be finished. Last, a lot of thanks to my family and Dr. Charlotte Harvey as well as Mr. Todd Fix for their emotional support and encouragement.

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CHAPTER ONE: INTRODUCTION

Aphasia, a language disorder resulting from damage to brain areas that control language expression and reception, has been a long-standing concern among aphasiologists. In the past, aphasiologists devised various classification methods to differentiate aphasia syndromes. One of them was to classify aphasia into motor types, that presented disturbed verbal output with relatively good comprehension ability, and sensory types, that demonstrated poor comprehension ability with relatively intact verbal production (Wagenaar, Snow, & Prins, 1975). Several studies, however, showed that language comprehension deficits occur in all aphasia, casting doubt on the basis for classification (Wagenaar et al., 1975). Another method, namely the Boston classification system, was the most widely used in clinical settings and research reports (Helm-Estabrooks, Albert, & Nicholas, 2013). This system emphasized analysis of oral production as a key component to evaluate aphasia; therefore, it translated motor-sensory types into non-fluent and fluent types mainly based on oral production (Wagenaar et al., 1975). Specifically, non-fluent types were characterized by slow speech rate, short utterances with simple grammatical structure, fewer function words and lack of melody when compared to normal speech. In contrast, fluent types presented utterances as a whole conveying less effective information, but with paraphasias and neologisms noted (Wagenaar et al., 1975).

Since oral narrative production analysis is vital for evaluation of Persons with Aphasia (PWA) (Wagenaar et al., 1975), several methods have been published in English for this purpose. For example, Benson (1967) analyzed aphasic language samples with ten measures, including speech rate, prosody, articulation, utterance length, effort, pause, press of speech, perseverations, word choice, and paraphasia. Each of these measures was judged by using a 3-point rating scale (1 being low, abnormal, marked, frequent, absent, or substantive and 3

being high, normal, minimal, rare, present, or relational, depend on which measure was examined). The scoring system, however, was considered to be too simple to detect the subtle changes in performances over time. Goodglass and Kaplan (1972) proposed a 7-point scale to evaluate aphasic oral language on six measures, including articulation, phrase length, grammatical variety, and paraphasia, as well as word finding. The scoring procedure of 1 being severe and 7 being normal, nevertheless, was limited by its involvement of subjective rating, yielding a low inter-rater reliability (Wagenaar et al., 1975). Saffran, Berndt, & Schwartz (1989) also devised the Quantitative Production Analysis (QPA), focusing on the analysis of morphological (e.g., the ratio of nouns to verb) and syntactic characteristics (e.g., proportion of well-formed sentences) of the PWA. One of the advantages of this system was that it objectively compared language production deficits across PWA. Another was its capability to evaluate performances that occurred in the single PWA over time (Saffran et al., 1989).

In the Taiwanese Mandarin literature, there is a great paucity of studies about analysis of aphasic language production by using quantitative methods. Most studies that investigated the deficits of aphasic discourse were based on Cantonese speakers (Kong, 2009; Kong, 2011; Kong & Law, 2004; Law, 2001). However, Taiwanese Mandarin and Cantonese are not mutually intelligible largely because of phonological, semantic, and grammatical differences. It is problematic for Taiwanese speech-language pathologists (SLPs) to directly apply these studies to their clinical practice. In light of this, this study aimed to translate two quantitative systems well validated in Cantonese, namely the Main Concept Analysis (MCA) and Cantonese Linguistic Communication Measure (CLCM), and then to validate them based on normal speakers and PWA in Taiwan.

CHAPTER TWO: REVIEW OF LITERATURE

1. Quantification Systems of Aphasic Connected Speech in English

Yorkson and Beukelman's studies in 1977 and 1980 provided an important basis for several investigations that emerged in the years followed. In the Yorkson and Beukelman (1977) study, thirty-one normal speakers and thirty-three fluent and non-fluent PWA whose verbal scores on the Porch Index of Communicative Ability (PICA; Porch, 1967) ranged from the 41st to the 99th percentile (means severity of verbal output) were invited to describe the Cookie Theft picture from the Boston Diagnostic Aphasia Examination (BDAE; Goodglass & Kaplan, 1993). Three measures, including syllables per minute, concepts per minute, and syllables per concept, were examined to differentiate the performances of high level PWA from their normal counterparts. The study provided the following criteria and procedures for defining concepts. First, concepts mentioned by at least one normal speaker were listed. Second, concepts not related to the task and assumptions that speakers made beyond what was evident in the picture were all excluded from the list. Third, each concept was only counted one time. Finally, after listing all of the potential concepts from the normal language samples, the authors calculated the numbers of concepts in each aphasic language sample by comparing the listed concepts. It was found that the measures of syllables per minute and concepts per minute had inverse correlation with severity of verbal output in the PICA; that is, the more severe the aphasia as measured in the PICA, the smaller the number of these two measures. Second, these two measures could be used to differentiate aphasic from normal language samples. Third, the performance on syllables per minute (speaking rate) was significantly different between fluent and non-fluent high-level PWA. Finally, high-level fluent PWA tended to use more syllables to convey one concept when compared to normal

speakers and high level non-fluent PWA.

In 1980, Yorkston and Beukelman replicated their previous study's procedures (1977), but this time they invited fifty speakers with mild and moderate aphasia and seventy-eight normal speakers to complete the same picture description task. In this study, they replaced the 'concept' by 'content unit' and did not calculate syllables per concept; in other words, three measures, which were content units, syllables per minute and content units per minute, were used for discourse quantification. Content units referred to the amount of information conveyed; a content unit was defined as a grouping of information always expressed as a unit by normal speakers. This criterion for defining content units was the same as the 'concepts' in the previous study (Yorkston & Beukelman, 1977). Findings were similar to the previous study (1977). All of these three measures were inversely related to severity of aphasia; and two of the measures, syllables per minute and content units per minute, could be used to differentiate aphasic from normal samples. However, the measure of content units, which was a new measure in the current study, could only be used to distinguish low-moderate aphasia from the mild, but not for discriminating mild PWA from normal speakers.

In the same year, Golper, Thorpe, Tompkins, Marshall, and Rau invited ten high-level PWA (five fluent and five non-fluent), ten right hemisphere-damaged speakers, and ten normal speakers to describe the Cookie Theft picture from the BDAE. After the language samples were orthographically transcribed, they applied eight measures, including the three from the Yorkston and Beukelman study (1980) and five new ones, for further analysis. The new measures included mean length of grammatical strings, number of sequence interrupters (such as using "I mean" and "uh's" in non-initial position within a phrase or word), number of phrases interrupted and incomplete as well as revised, number of phonemic errors (such as phonemic substitution, omission or unintelligible phoneme), and number of errors in grammar, syntax or morphology. It was found that all of the measures, except for the total

content, yielded significant differences between speakers with mild aphasia and normal/right hemisphere damaged speakers. In other words, most of these measures were useful for diagnosing mild aphasia.

Similar to the Yorkston and Buekelman studies in 1977 and 1980 that focused on the informativeness and efficiency of the connected speech produced by PWA, Nicholas and Brookshire (1993) devised a system that used five measures (word count, correct information units (CIUs), words per minute, percent of CIUs and CIU per minute) and ten stimuli (four single pictures, two picture sequences, two requests for personal information and two requests for procedural information) for quantifying the connected speech samples of twenty normal speakers and twenty speakers with non-fluent and fluent aphasia. A CIU was defined as a word that was intelligible, accurate, and informative about the content of the pictures. The results showed that the performances of the normal speakers on these five measures, especially CIUs per minute, were significantly better than that of the PWA. Some overlaps (the greatest overlap for number of words and the least for CIUs per minute) in scores between individuals in these two groups for all measures were also presented, suggesting that the performances of the PWA might fall into the range of the normal speakers' performances.

Shewan (1988) presented another quantitative system called the Shewan Spontaneous Language Analysis (SSLA) system for investigation of oral narrative abilities in subjects with and without aphasia. Participants were asked to describe the picture from the Western Aphasia Battery (WAB; Shewan & Kertesz, 1980). This system contained twelve measures similar to the previous studies (Golper et al., 1980; Wagenaar et al., 1975; Yorkston & Beukelman, 1980) that examined the phonological (e.g., melody and articulation), syntactic (e.g., length of utterances, complex sentences) and semantic (e.g., content units and paraphasias) domains of language. The results suggested that ten of the measures, except for repetitions and length, could reveal significant differences between the PWA and their age-

matched controls.

Saffran (1989) devised the Quantitative Production Analysis (QPA) that clearly described procedures for measuring the connected speech of speakers with aphasia, focusing on the analysis of characteristics of morphological and structural disruptions. Ten chronic PWA, including five non-fluent agrammatic and non-fluent non-agrammatic speakers, and five normal speakers were asked to orally produce a familiar story of Cinderella. All orthographically transcribed language samples were analyzed using eleven measures including one speech rate index, six morphological measures (the ratio of close-class words to narrative words, noun to pronoun, determiner to noun, and noun to verb, frequency of verb inflection, and elaboration of auxiliary) and four structural measures (proportion of words in sentences, proportion of well-formed sentences, structural elaboration, and embedding index). With its comprehensive and detailed analytic procedures, the system was able to differentiate the non-fluent agrammatic from the non-fluent non-agrammatic speakers, and the normal speakers from both non-fluent groups. However, given the long time needed for analysis, speech-language pathologists may have difficulties applying this system in clinical practices, especially if they do not have a fair amount of linguistic background and/or if they have a large caseload (Kong, 2004).

A linguistic communication measure (LCM) was presented by Menn, Ramsberger and Helm-Estabrooks (1994). Forty-two speakers with various types of aphasia and fourteen age and education matched controls were invited to describe the Cookie Theft picture from the BDAE. This was followed by using three indices: number of information conveyed, lexical efficiency (the ratio of the total number of words to the number of content units), and grammatical support (the ration between the sum of correct words in content units plus the number of correct endings attached to these words over the number of content units) to evaluate their language samples. The analytic results allowed one to compare the

performances among the PWA and within a PWA over time. Clinically, the system was claimed by the authors to be used to supplement standardized aphasic tests for further understanding one's oral language deficits.

One major limitation of the above-mentioned measures, such as CIUs and content units per minute, was that they failed to provide information about whether a person conveyed what was the most evident in the pictures, even if these measures were able to reveal how much of what a person said was correct, related, and informative (Nicholas & Brookshire, 1995). In other words, "a speaker might be very efficient, in that almost all the words he or she produced were accurate, relevant, and informative, but the speaker might fail to convey the main units of information that gave connected speech its overall structure" (Nicholas & Brookshire, 1995, p. 152). Nicholas and Brookshire (1995) therefore devised a standard system looking at the presence, accuracy, and completeness of main concepts to re-analyze their 1993 study's language samples. The language samples were first evaluated on whether all the possible main concepts existed or not. If so, further evaluation in the information in the main concepts was conducted to decide if it was accurate and complete. After the main concepts were identified, each of the main concepts was assigned one of these four measures: Accurate/complete (AC), Accurate/incomplete (AI), Inaccurate (IN), and Absent (AB). The result showed that the aphasic group produced more AB, IN and AI main concepts, but fewer AC main concepts, when compared to the normal group. Additionally, the relationship between the estimated aphasia severity and the main concept performance was noted. The estimated severity of aphasia had a strong relation to AC and AB.

2. Brief Introduction of Chinese and Its Grammar

Chinese is a language or language family containing various dialects that are mutually intelligible with varying degrees. Approximately one-fifth of the world's population speaks Chinese as their native language. Standard Chinese is a standardized form of spoken Chinese based on the Beijing dialect of Mandarin Chinese. It is the official language in both Mainland China and Taiwan. Taiwanese Mandarin is a variant of standard Chinese spoken in Taiwan. It is largely similar to the standard Chinese spoken in Mainland China with a few different aspects. For example, traditional Chinese characters are used for writing in Taiwan; however, simplified Chinese characters are used in Mainland China. Moreover, different sentence structures, such as 你有沒有鉛筆? nǐ¹ yǒu méi yǒu qiān bǐ in Taiwan verse 你有鉛筆沒有? nǐ yǒu qiān bǐ méi yǒu in China refer to the question of “Do you have a pencil?”, may be used in the two regions to express the same meaning. Finally, there is a variation of semantics, i.e., using different lexical items to refer to the same thing. An example will be the use of 腳踏車 jiǎo tà chē and 自行車 zì xíng chē for “bicycle” in Taiwan and Mainland China, respectively. Alternatively, different meanings can also be represented by the same lexical item, such as 土豆 tǔ dòu in Taiwan meaning peanut but potato in Mainland China.

Compared with English, there are few formal morphological markers in Chinese (Wong, Li, Xu, & Zhang, 2009). For example, a verb has the same form for all the different time references in Chinese and does not have different inflectional endings depending on the person and the number of subjects in Chinese. The singular and plural distinction for nouns is also absent in Chinese. Unlike English, Chinese does not have case endings for nouns (Wong et al., 2009). However, a classifier is very common in Chinese but the counterpart for English

¹ Phonemic transcriptions in this study are given in pinyin, the official system to transcribe Chinese characters into roman letters. The tone of a syllable is represented by a tone marker: ^ˉ, ^ˊ, ^ˇ, and ^ˋ for tone 1 to 4, respectively.

is absent. A noun is matched to a specific classifier when the noun phrase contains a numeral, such as 三本書 sān běn shū “three books” (三 is a numeral, 本 is a classifier, and 書 is a noun) (Kong, 2006). Sentence-final particles are also widely used in Chinese. They serve various pragmatic functions, such as “expression of speech act types or the source of knowledge of the speaker, and expression of the attitude of the speaker toward what they are saying” (Kong, 2006, p 19). In addition, reduplication is easily found in Chinese but not in English. Both monosyllabic and disyllabic root morphemes can be reduplicated (Wong et al., 2009). Finally, Chinese permits the omission of subjects and objects in some contexts, but this is not permitted in English (Kong, 2009). The typical Subject-Verb-Object (SVO) word order can be changed in Chinese. Therefore, depending on the discourse content and pragmatic status of a speaker, an order of VOS can be grammatically correct for use as a right dislocation of nouns or pronouns in a sentence. Similarly, the order of OSV, where the word or phrase in the object position is moved to the initial position of the sentence, is also appropriate for the purpose of topicalization (Kong, 2009).

3. Quantification Systems of Aphasic Connected Speech in Chinese

In the Chinese literature of aphasia, there are only a few studies that investigated aphasic production at the connected speech level. Law (2001) was among the first who adapted a Cantonese version of the QPA for analyzing Cantonese aphasic discourse samples elicited from describing fairy stories. The modifications involved new procedures in extracting narrative words, classifying words into parts-of-speech, structurally analyzing compound words and new criteria for embeddedness. These procedures were necessary due to the major differences between English’ and Cantonese’ grammar (Kong, 2004; Law, 2001). This modified system included 33 indices that could be used to further understand the participants’

abilities of three domains: fluency, morphology and syntax. Two PWA (one Broca's and one anomic aphasia) and their age-matched controls were invited to participate in a story-telling task. It was found that the speaker with Broca's aphasia used a slower speaking rate, a lower ratio of the propositional speech to the total words, a simpler sentence structure, and a higher proportion of elliptical sentences than his age-matched counterpart. However, the individual with anomic aphasia presented within normal range on most measures except for post-verbal modification, such as 我跑得快 wǒ pǎo de kuài "I run fast."

A more clinically oriented method called the Cantonese Linguistic Communication Measure (CLCM), primarily based on the LCM, was developed by Kong and Law (2004). Language samples were elicited and audio-recorded through four picture description tasks, including revised pictures from the BDAE (Goodglass & Kaplan, 1993), the WAB (Kertesz, 1982), the Cantonese version of the WAB (Yiu, 1992), and a picture of a Chinese restaurant. The orthographic transcriptions were further analyzed using eight indices, including the total number of words (N), the number of informative words (i-word) that was similar to the content units mentioned in the Menn et al. (1994) study, the index of Lexical Efficiency (ILE), the Index of Communication Efficiency (ICE), the Index of Grammatical Support (IGS), the Index of Elaboration (IEI), the Index of Error (IEr), and the Index of Lexical Richness (ILR). The results showed there were significant differences on all of the indices, except for the N, between the PWA and the normal speakers. In addition, the predictive validity suggested that i-word, ICE, IGS, and IEr as well as ILR, generally, could reach 75% accuracy in differentiating the PWA and the controls.

Kong (2009) more recently used the Main Concept Analysis (MCA) adapted from the Nicholas and Brookshire study (1995) to measure Cantonese aphasic connected speech from twenty speakers. The modification was needed in order to develop a culturally appropriate

measurement. Specifically, four sets of sequential pictures appropriate for the Cantonese community were developed because the author's previous study (Kong & Law, 2003) found that employing the Cookie Theft picture from the BDAE as a speech elicitation stimulus did not gather appropriate language samples. In addition, due to linguistic differences between Cantonese and English, the computation procedures were altered. In particular, use of elliptical utterances (e.g. omissions of subjects or objects) in a sentence, use of the right dislocation of nouns or pronouns in a sentence (VOS), and use of a word or phrase in the object position placed in the sentence beginning (OSV) were not correct in English (the main concept might be scored AI) but may be accepted in Cantonese (the main concept could be scored AC). Lastly, two other measurements, the main concept (MC) score and AC per minute, were added to calculate the summary of the first four measures and to decide how efficiently the subjects conveyed their information, respectively. The study included ten fluent and ten non-fluent PWA as well as ten normal speakers (control group). Language samples were analyzed by using the six above-mentioned main concept measures. It was found that the results of all the measures in the control group were better than the two types of PWA and that the fluent aphasic group performed better than the non-fluent aphasic group. Moreover, aphasia severity correlated significantly with all the measures, except for AI and IN.

Two years later, Kong (2011) established the external validation of the MCA. It was found the main concept measures were highly correlated to the Cantonese version of the WAB and CLCM indices. More specifically, both AC and MC measures had positive relations with i-word index, scores of spontaneous speech (SS)-Information and Fluency, score of naming subtest, and overall AQ (Aphasia Quotient) of the Cantonese version of the WAB. In contrast, AB measure was inversely related to these. AC measure had a positive relation with ILR but negative related to IER. Finally, there was a positive correlation between

AC per minute and ICE, between MC and SS-subtest, and between AC per minute and SS-Fluency.

CHAPTER THREE: RESEARCH AIMS

The primary aim of the study was to translate and adapt two published quantitative systems for Cantonese aphasic discourse production, namely the Main Concept Analysis (MCA; Kong, 2009) and Cantonese Linguistic Communication Measure (CLCM; Kong & Law, 2004), to be used for native speakers of Taiwanese Mandarin. Though the MCA and CLCM had been developed and modified for the Cantonese community, the Cantonese versions might not be able to be used directly to the Taiwanese population without modification when considering various differences between Taiwanese Mandarin and Cantonese. It is pivotal that these two systems are applicable for the Taiwanese population. In light of this, it was necessary to develop the Taiwanese Mandarin main concepts and informative words (i-words) for this purpose.

The second goal was to investigate whether different age groups and/or educational levels affected the performances of the picture description tasks as measured by these two systems. In the literature, age was proven to influence the number of main concepts and i-words; that is, younger speakers tended to convey more main concepts and to produce more i-words than the elders. However, the effect of educational levels on production of the i-words, studied by Kong and Law (2004), was not remarkable. The third aim was to explore whether there were significant differences between the performances of the PWA and the controls. Based on the English and Cantonese studies mentioned in the literature section, it was expected the normal speakers could generally perform better than the PWA. In addition, the relationships between aphasia severity and the main concept measures, and between aphasia severity and the linguistic communication indices were examined. This was motivated because several research studies have shown the more severe the aphasia, the poorer the performances on these measure/indices. In the current study, the correlations

between the overall aphasia score in the Concise Chinese Aphasia Test² (CCAT; Chung, Li, & Chang, 2003) and the measures/indices would be investigated.

The last objective of the current study was to explore the relation between each main concept measure and each linguistic communication index. It was expected measures and/or indices measuring similar aspects of discourse production would be correlated. This would provide additional validity evidence for these adapted tools for use by the Taiwanese Mandarin population.

2 Concise Chinese Aphasia Test (CCAT) is the most commonly used standardized aphasic test among the SLPs in Taiwan. The test has two formats for alternative use. Each format consists of nine subtests, including Conversational Question, Picture Description, Picture-Object Matching, Auditory Comprehension, Object and Action Naming, Reading Comprehension, Repetition, Symbol and Word Copy, and Spontaneous Writing. Each subtest includes 10 items/questions with each item/question scored possibly from the highest of 12 to the lowest of 1 depend on each individual responses (accuracy, completeness, response rapidity/delay and efficiency). After each item is scored, an average score for each subtest can be calculated by a sum of ten items' scores being divided by ten. Each subtest is also timed. An overall average score can be then obtained by a sum of the nine subtests' average scores being divided by nine. Once an overall average score is obtained, it can be used to reflect the aphasia severity, ranging from near to normal (score 11 or above) to profound (score 3 or below).

CHAPTER FOUR: METHODOLOGY

1. Pilot Study

1.1. Subjects

A total of sixteen Taiwanese, including eight SLPs and eight normal speakers, was invited to participate in this pilot study. The SLPs had completed a bachelor and/or master degree in speech-language pathology and audiology and held the certificate of speech-language pathology in Taiwan. The normal speakers reported no history of neurologically based deficits and/or other medical conditions that might affect their speech-language performances. In addition, they demonstrated adequate hearing abilities bilaterally and visuospatial skills, and normal expressive and receptive language abilities.

1.2. Stimulus Materials

There are a total of four sets of sequential pictures developed by Kong in 2009. Each picture set consists of four black-and-white line drawing pictures with dimensions of 5.51 in by 8.46 in. Each picture set has its own theme. There is only one central character in picture sets 1 and 2, while picture sets 3 and 4 contain three characters. In picture set 1, which is cooking in a kitchen, there is an old lady cutting the carrots in a kitchen. She accidentally cuts her right index finger; therefore, she accesses a first-aid kit, taking out a bandage to cover her wound. In picture set 2, which is waking up late for work, there is a man waking up too late. He then starts to brush his teeth and comb his hair followed by changing his clothes. He finally finds out that he is wearing a pair of socks different in color. In picture set 3, which is

buying ice-cream, there are a mother and her daughter buying some ice-cream in an ice-cream shop. The mother is paying while the salesman is preparing an ice-cream. The daughter then accidentally drops the ice-cream and cries. The salesman sees this incident and gives her another ice-cream. In picture set 4, which is helping an old man, there is an old man carrying a plastic bag walking in an opposite direction of a father and his son who are taking a walk on the street. The oranges fall from the old man's plastic bag. The son sees this incident and helps to pick up the oranges. The old man finally praises him. A copy of the four picture sets can be obtained from Kong.

1.3. Procedures

The eight clinically certified SLPs were instructed to write the main concepts related to the four picture sets in order to determine all of the possible main concepts depicted in the pictures. The other eight normal speakers were prompted to orally describe the same four picture sets for further confirmation whether the main concepts that the SLPs orthographically provided were appropriate and for determination of all of the potential i-words. The following step-by-step procedures were used.

Step 1: The SLP was provided with the written instructions regarding the definition of a main concept: a statement consisting of only one main verb or action but composed of two or more essential pieces/words that are accurately related to the picture(s) and informative about the content of the concept (Kong, 2009; Kong, 2011; Nicholas & Brookshire, 1995). After thoroughly understanding the meaning of the main concept, he or she participated in a training task using the picture (theme: Picnic) in the CCAT. Following feedback on the performance in the training task, he or she was provided with the four picture sets, one at a time, and then wrote down each potential main concept related to the pictures. After all of the

SLPs completed this task, their responses were tallied. Only main concepts that had been mentioned by six out of eight SLPs were included in the preliminary list.

Step 2: The normal speaker and the investigator sat side-by-side at a table with a recording system in a quiet room. The interview and the screening tests were conducted in order to rule out the possible effects of medical history, impaired hearing, visuospatial, and language abilities on the performance of picture description tasks. The normal speaker was asked some personal questions, such as medical history that might affect his or her language-speech performances. Then, his or her hearing abilities bilaterally were screened at 25 dB HTL at frequencies of 500, 1000, 2000, and 4000 Hz by using an audiometer. After passing the hearing screening, he or she was presented with the Symbol Cancellation task from the Cognitive Linguistic Quick Test (CLQT; Helm-Estabrooks, 2001). The procedure followed the rules of the test's manual. However, the English instructions were translated to Taiwanese Mandarin in order for thorough understanding of the test. The subject was then prompted to perform the CCAT to ensure the absence of any language impairment. Each subject was presented with the four picture sets, one at a time in random order, in front of him or her. He or she was given a standard instruction 請看這四張圖片，由左至右。告訴我每張圖片發生了什麼事情。 qǐng kàn zhè sì zhāng tú piàn yóu zuǒ zhì yòu gào sù wǒ měi zhāng tú piàn fā shēng le shén me shì qíng "Please look at these four pictures from the left to the right. Tell me what's happening in the pictures." At the same time, the investigator pointed to each essential character, object, and/or incident in the pictures to confirm that the subject had looked at everything in the pictures. A general prompt 這裡呢? zhè lǐ ne "what about here?" might be given depend on the subject's responses. When the subject had stopped talking for at least 5 seconds, the general prompt 還有任何其它你要說的嗎? hái yǒu rèn hé qí tā nǐ yào shuō de ma "anything else that you want to say?" was provided. The investigator only provided head nods and/or general verbal response of "uh-huh" to respond to the subject's

participation. Each spoken response to the picture stimuli, together with any prompts from the investigator, was recorded. The investigator then orthographically transcribed each subject's language sample.

Step 3: In order to validate the main concepts listed in the preliminary list, the investigator used this preliminary list along with the scoring steps and rules (in Appendix D) to examine the transcripts of the eight normal speakers. The study had adopted the criterion from the Kong (2012) that only those scored as AC (accurate and complete) or AI (accurate but incomplete) by at least five normal speakers were put in the final list.

Step 4: After the above procedures completed, the investigator proceeded to select the potential i-words for these four picture sets. A word mentioned by three out of eight normal speakers was listed in the i-word sheet.

1.4. Data analysis for step 3

In order to examine the main concepts in the eight transcripts, four measures, including Accurate and Complete (AC), Accurate but Incomplete (AI), Inaccurate (IN), and Absent (AB), were used. These four measures were adopted from the previous studies' (Kong, 2009; Nicholas & Brookshire, 1995). When all of the essential items (underlined words) in a main concept were correct and provided, this main concept was considered as AC. If the essential items in a main concept were correct but one (or more) item was missing, AI was given to this main concept. IN was counted when any of the essential items in a main concept were provided incorrectly. If there were no essential items provided in a main concept or this main concept was not provided, AB was counted. The detailed scoring steps and rules for determination of each score are provided in Appendix D.

2. Main Study

2.1. Subjects

There was a total of forty-six right-handed native Taiwanese Mandarin speakers, thirty-six normals and ten PWA, recruited to perform picture description tasks in this main study. The normal speakers, fourteen living in Taipei (north of Taiwan) and twenty-two living in Kaohsiung (south of Taiwan), were equally divided into three age groups: 20 to 39 years of age, 40 to 59 years of age, and 60 years or above, and two educational levels: secondary or below (low) and post-secondary (high). Each sub-group consisted of three males and three females. The background information is provided in Table 1. They reported no history of neurological diseases, head injuries, and/or other medical conditions that might influence their speech and/or language performances and no history of language therapy. In addition, they demonstrated adequate hearing abilities bilaterally, visuospatial skills and language abilities as determined by the investigator prior to the tasks of picture description.

Table 1 A summary of background information on normal speakers

Age group	Education			
	Secondary or below (low)		Post-secondary (high)	
	Average age (years)	Average years of education	Average age (years)	Average years of education
20-39 y/o	31.83	11.83	30.67	16.67
40-59 y/o	51.17	9.67	48.17	16.33
60 y/o or above	61.50	7.50	61.33	17.00

The PWA were recruited from local support groups in both north and south of Taiwan. Table 2 shows the PWA's detailed background information. Each of the PWA had suffered a single stroke on the left side of the brain at least six months post-onset at the time of the interview. They were diagnosed with aphasia and recommended to receive language therapy

by their clinicians. All of them also demonstrated adequate hearing abilities bilaterally and visuospatial skills. This group comprised of a range of aphasia severity, from within normal to moderately severe, based on the CCAT.

Table 2 Background information on PWA

Subject (initials)	Gender	Age	Education (years of education)	Etiology	Post-onset (months)	Aphasia severity
YQL	M	41	Secondary 5 (11)	CVA	10	WNL
MCG	F	49	Secondary 6 (12)	CVA	8	WNL
YHZ	F	41	Secondary 6 (12)	CVA	7	Mild
QLL	M	51	Secondary 6 (12)	CVA	61	Mild
YQT	M	54	Secondary 3 (9)	CVA	31	Mild
CLT	F	32	Secondary 6 (12)	CVA	16	Mild
AYX	F	63	Primary 6 (6)	CVA	42	Mild to Mod
XTL	F	58	Primary 6 (6)	CVA	49	Mod
MQW	M	59	Secondary 6 (12)	CVA	7	Mod
JHC	M	53	Post-secondary 4 (16)	CVA	8	Mod to Severe

Note: CVA = cerebrovascular accident, WNL = within normal limits, Mod = moderate

2.2. Procedures

The procedures were the same as step 2 in the pilot study, except for the interview portion. Each subject was asked more detailed personal information, such as name, date of birth, age, hand dominance, educational level, medical history (such as neurological diseases, traumatic brain injuries, other medical conditions, onset of the event, etc.), and history of language therapy.

Two PWA were asked to perform the picture description tasks two weeks after the first interview for establishing the test-retest reliability. Each recorded language sample was transcribed orthographically for further analysis.

2.3. Data analysis

2.3.1. *Taiwanese Mandarin main concept analysis (TM-MCA)*

2.3.1.1. *Taiwanese Mandarin main concept measures*

Six main concept measures, including AC, AI, IN, and AB, as well as the other two, Main Concept score (MC) and AC per minute, created by Kong in 2009, were utilized to analyze the main concepts in the transcripts. More detailed information about AC, AI, IN, and AB can be referred to the data analysis for step 3 in the pilot study. Appendix D also provides the steps and the rules for determination of each score. According to Kong (2009), MC is a summarized score and is calculated by the formula $(3*AC+2*AI+1*IN)$, The AC per minute, a ratio of AC to the total recording time in minutes, is an efficiency measure.

2.3.1.2. *Introduction to the TM-MCA Scoring Form*

The TM-MCA Scoring Form (Appendix E) was used in order to analyze the Taiwanese Mandarin main concepts. This scoring form was adapted from Kong (2009) with the following two changes. First, the title of the scoring form was changed (Taiwanese Mandarin Main Concept Analysis TM-MCA Scoring Form) to match the current study. Second, the main concepts used in the previous study were replaced by the main concepts determined in the pilot study. Two examples, one from a normal speaker and another from a PWA, are provided in Appendix F.

2.3.2. *Taiwanese Mandarin linguistic communication measure (TM-LCM)*

2.3.2.1. *Taiwanese Mandarin linguistic communication indices*

Each oral language sample was analyzed by using seven indices adopted from the previous mentioned study (Kong & Law, 2004). Indices of quantification included the number of words (NW), the number of informative words (I-word), the index of lexical efficiency (ILE), the index of communication efficiency (ICE), the index of grammatical support (IGS), and the index of elaboration (IEI), as well as the index of error (IEr). A word was defined as one or multiple characters that were intelligible but not necessary to be accurate, relevant, or informative to the picture in the oral language sample. In contrast, an i-word must be accurate, relevant, and informative relative to the picture. ILE, a ratio of the NW to the I-word, was an index that indicated how efficient a speaker could transmit the information. ICE, a ratio of the I-word to the total recording time in minutes, was an index that suggested how efficient a speaker could convey the informative messages. IGS, a ratio of the number of closed-class functors to the I-word, estimated the amount of grammatical morphemes around an informative word. IEI, a ratio of the number of open-class morphemes to the I-word, indicated the amount of extra information around an informative word. Finally, IEr, a ratio of the number of errors to the I-word, estimated the amount of errors in a language sample. The detailed rules for identification of words, i-words, i-word units, closed-class functors, open-class morphemes, and errors are provided in Appendix G.

2.3.2.2. *Introduction to the TM-LCM Scoring Form*

A TM-LCM Scoring Form (Appendix H) was created in this study for analysis of Taiwanese Mandarin linguistic communication measure. Two examples, one from a normal

speaker and another from a PWA, are provided in Appendix I.

2.4. Statistical analysis

A one-way between-groups ANOVA was administered for each picture set to evaluate whether the age groups of the normal speakers have effects on each main concept measure and linguistic communication index. An independent-samples t-test was carried out for each picture set to examine the effects of the educational level.

In order to determine whether the PWA were significantly different from the normal speakers on the measures and the indices, each of the PWA was paired with one of the normal speakers based on gender, ± 3 years, and ± 4 years of educational. A paired-samples t-test was carried out to examine the differences of these two groups on the six main concept measures and seven linguistic communication indices. The Bonferroni method was used (Silva & Stam, 1995) to control for Type I errors; in other words, the p-value was adjusted to 0.0083 (0.05/6) and 0.0071 (0.05/7) for the main concept measures and the linguistic communication indices, respectively.

In order to examine the correlations between the overall aphasia severity and the overall performance of each main concept measure and linguistic communication index, Pearson's correlation coefficients were administered between the PWA's overall aphasia score of the CCAT and the overall value of each measure and index. Based on the results of the previous studies (Kong, 2009; Kong, 2011; Nicholas & Brookshire, 1995; Yorkson & Beukelman, 1977; Yorkson & Beukelman, 1980), the I-word, ICE, AC, MC, and AC/min were estimated to be significantly positively related to the overall aphasia score. In contrast, AB was expected to correlate significantly negatively relative to the overall aphasia score. In addition, the Pearson's correlation coefficients were carried out between the overall score of

each main concept measure and that of each linguistic communication index in order to explore whether the main concept measures were related to the linguistic communication indices. It was expected that, according to Kong (2011), AC and MC would be significantly positively correlated to I-word, but AB would be negatively related to I-word. AC per minute and ICE were estimated to be positively related, but AC and IEr would be negatively correlated.

Three reliability measures, including inter-rater, intra-rater and test-retest reliability, for the aphasic group were conducted. Four out of ten orthographically transcribed language samples (40%) were randomly selected and analyzed by the investigator and another certified Taiwanese SLP to obtain inter-rater reliability. These four selected language samples were re-analyzed by the investigator to reach intra-rater reliability. For test-retest reliability, the quantitative analysis was not feasible at this time, due to only two PWA being contacted within two weeks after the first test. Therefore, the figures were alternatively utilized to demonstrate the relation between the test and the re-test. All of the scores of the main concept measures and linguistic communication indices were normalized to a standardized scale ranging from 0 to 10 by the formula $[0+(X-A)(10-0)/(B-A)]^3$, and then plotted in the figures for qualitative analysis.

³ In the Formula $[0+(X-A)(10-0)/(B-A)]$, X is the original score of the main concept measure or linguistic communication index. A is the minimal original value of the main concept measure or linguistic communication index, and B is the maximal original one.

Table 3 Performance of normal speakers of three age groups

Age group	Measure	Picture set 1	Picture set 2	Picture set 3	Picture set 4	Overall
20-39 y/o	AC	4.17 (0.39)	4.67 (0.89)	5.25 (1.29)	4.25 (1.54)	18.33 (2.64)
		4.00-5.00	3.00-6.00	3.00-7.00	2.00-7.00	16.00-24.00
	AI	0.17 (0.39)	0.42 (0.51)	0.67 (0.65)	1.92 (1.56)	3.17 (2.04)
		0.00-1.00	0.00-1.00	0.00-2.00	0.00-4.00	0.00-7.00
	IN	0.00 (0.00)	0.58 (0.67)	0.08 (0.29)	0.17 (0.39)	0.83 (0.84)
		0.00-0.00	0.00-2.00	0.00-1.00	0.00-1.00	0.00-2.00
	AB	0.67 (0.49)	0.33 (0.49)	2.00 (1.21)	0.67 (0.78)	3.67 (2.06)
		0.00-1.00	0.00-1.00	1.00-5.00	0.00-2.00	1.00-8.00
	MC	12.83 (1.27)	15.42 (2.07)	17.17 (3.59)	16.75 (2.63)	62.17 (6.73)
		12.00-15.00	13.00-18.00	9.00-21.00	12.00-21.00	52.00-74.00
	AC/min	12.76 (2.71)	11.45 (5.01)	11.03 (3.00)	8.69 (3.29)	10.51 (1.98)
		8.77-18.18	5.19-21.74	5.56-16.67	3.45-13.51	6.67-13.93
40-59 y/o	AC	3.42 (0.90)	3.92 (0.90)	4.25 (1.29)	3.50 (1.38)	15.08 (2.88)
		2.00-5.00	3.00-6.00	2.00-6.00	2.00-5.00	9.00-20.00
	AI	0.83 (0.83)	0.58 (0.51)	1.00 (0.60)	2.50 (1.31)	4.92 (2.15)
		0.00-2.00	0.00-1.00	0.00-2.00	1.00-5.00	3.00-8.00
	IN	0.08 (0.29)	0.58 (0.51)	0.17 (0.39)	0.08 (0.29)	0.92 (0.79)
		0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-2.00
	AB	0.67 (0.49)	0.92 (0.51)	2.58 (1.08)	0.92 (0.90)	5.08 (1.88)
		0.00-1.00	0.00-2.00	1.00-5.00	0.00-2.00	2.00-8.00
	MC	12.00 (1.71)	13.50 (1.93)	14.92 (3.63)	15.58 (2.71)	56.00 (6.38)
		10.00-15.00	11.00-18.00	7.00-19.00	12.00-19.00	44.00-67.00
	AC/min	8.31 (2.99)	8.11 (2.41)	9.47 (3.44)	7.17 (2.43)	8.05 (1.96)
		5.00-14.81	4.62-12.50	4.00-13.95	2.44-11.11	5.45-11.59
60 y/o or above	AC	4.00 (0.43)	4.25 (1.29)	3.92 (1.31)	3.83 (1.11)	16.00 (2.73)
		3.00-5.00	2.00-6.00	2.00-6.00	2.00-6.00	12.00-21.00
	AI	0.25 (0.45)	0.08 (0.29)	1.42 (1.08)	1.83 (1.19)	3.58 (1.68)
		0.00-1.00	0.00-1.00	0.00-3.00	0.00-4.00	1.00-7.00
	IN	0.00 (0.00)	0.83 (0.94)	0.25 (0.62)	0.25 (0.62)	1.33 (1.16)
		0.00-0.00	0.00-3.00	0.00-2.00	0.00-2.00	0.00-3.00

Age group	Measure	Picture set 1	Picture set 2	Picture set 3	Picture set 4	Overall
	AB	0.75 (0.45)	0.83 (0.72)	2.42 (1.00)	1.08 (0.79)	5.08 (2.02)
		0.00-1.00	0.00-2.00	1.00-4.00	0.00-3.00	2.00-8.00
	MC	12.50 (1.17)	13.75 (3.14)	14.83 (3.07)	15.42 (2.81)	56.50 (7.15)
		11.00-15.00	9.00-18.00	9.00-19.00	8.00-19.00	46.00-68.00
	AC/min	10.33 (3.41)	8.87 (4.33)	8.06 (4.06)	7.27 (2.53)	8.27 (2.80)
		7.02-17.39	2.50-20.00	2.06-16.67	4.17-11.32	4.45-13.87

Note: The values at the top in each column represent ‘mean (standard deviation)’. The values at the bottom in each column represent ‘range’

Table 4 Performance of normal speakers of two educational levels

Education	Measure	Picture set 1	Picture set 2	Picture set 3	Picture set 4	Overall
Low	AC	3.83 (0.71)	4.17 (1.15)	4.00 (1.53)	3.44 (1.38)	15.44 (3.20)
		2.00-5.00	2.00-6.00	2.00-7.00	2.00-7.00	9.00-24.00
	AI	0.39 (0.70)	0.33 (0.49)	1.11 (0.90)	2.22 (1.40)	4.06 (2.18)
		0.00-2.00	0.00-1.00	0.00-3.00	0.00-5.00	1.00-8.00
	IN	0.06 (0.24)	0.67 (0.84)	0.33 (0.59)	0.22 (0.55)	1.28 (1.13)
		0.00-1.00	0.00-3.00	0.00-2.00	0.00-2.00	0.00-3.00
	AB	0.72 (0.46)	0.83 (0.51)	2.56 (1.20)	1.11 (0.83)	5.22 (1.99)
		0.00-1.00	0.00-2.00	1.00-5.00	0.00-3.00	1.00-8.00
	MC	12.33 (1.41)	13.83 (4.09)	14.56 (3.91)	15.00 (2.95)	55.72 (7.52)
		10.00-15.00	9.00-18.00	7.00-21.00	8.00-21.00	46.00-74.00
High	AC/min	10.46 (3.79)	9.21 (5.01)	8.73 (4.28)	6.96 (2.31)	8.40 (2.21)
		5.66-18.18	2.50-21.74	2.06-16.67	3.45-13.46	4.45-11.41
	AC	3.89 (0.68)	4.39 (0.98)	4.94 (1.06)	4.28 (1.23)	17.50 (2.48)
		3.00-5.00	0.00-1.00	3.00-7.00	2.00-6.00	13.00-22.00
	AI	0.44 (0.62)	0.39 (0.50)	0.94 (0.80)	1.94 (1.35)	3.72 (1.97)
		0.00-2.00	0.00-1.00	0.00-3.00	0.00-5.00	0.00-8.00
	IN	0.00 (0.00)	0.67 (0.59)	0.00 (0.00)	0.11 (0.32)	0.78 (0.65)
		0.00-0.00	0.00-2.00	0.00-0.00	0.00-1.00	0.00-2.00
	AB	0.67 (0.49)	0.56 (0.70)	2.11 (0.96)	0.67 (0.77)	4.00 (1.97)

Education	Measure	Picture set 1	Picture set 2	Picture set 3	Picture set 4	Overall
		0.00-2.00	0.00-2.00	1.00-5.00	0.00-2.00	1.00-8.00
	MC	12.56 (1.42)	14.61 (2.38)	16.72 (2.76)	16.83 (2.15)	60.72 (5.96)
		10.00-18.00	11.00-18.00	9.00-21.00	13.00-20.00	51.00-70.00
	AC/min	10.47 (3.27)	9.74 (4.42)	10.32 (2.76)	8.46 (3.08)	9.48 (2.69)
		4.62-20.00	4.62-12.50	3.54-13.95	2.44-13.51	4.71-13.93

Note: The values at the top in each column represent ‘mean (standard deviation)’. The values at the bottom in each column represent ‘range’

Table 5 Performance of aphasic and normal groups

		Picture set 1		Picture set 2		Picture set 3		Picture set 4		Overall	
Measure		Aphasic group	Normal group	Aphasic group	Normal group	Aphasic group	Normal group	Aphasic group	Normal group	Aphasic group	Normal group
AC	Mean	1.20	3.70	2.60	4.30	2.20	4.10	1.70	4.10	7.70	16.2
	SD	1.03	1.06	1.65	1.16	2.20	1.37	1.42	1.60	5.33	3.99
AI	Mean	0.80	0.60	1.00	0.50	1.90	1.30	2.00	2.00	5.70	4.40
	SD	0.63	0.84	0.82	0.53	1.52	0.82	1.63	1.33	3.23	2.32
IN	Mean	1.50	0.10	1.30	0.50	0.80	0.10	1.30	0.10	4.90	0.80
	SD	0.97	0.32	1.06	0.53	1.23	0.32	1.64	0.32	3.18	0.79
AB	Mean	1.50	0.60	1.10	0.70	3.10	2.50	2.00	0.80	7.70	4.60
	SD	1.51	0.52	1.45	0.48	2.47	1.27	1.05	0.79	5.08	2.27
MC	Mean	6.70	12.4	11.1	14.4	11.2	15.0	10.4	16.4	39.4	58.2
	SD	3.77	2.01	4.56	2.32	6.75	4.00	3.63	2.84	16.11	8.61
AC/min	Mean	1.18	8.84	1.96	8.44	1.22	9.49	1.10	7.82	1.33	8.40
	SD	1.58	3.68	1.54	2.78	1.36	3.07	1.50	2.58	1.27	2.01

Note: SD = standard deviation

CHAPTER FIVE: RESULTS

1. Pilot Study

A total of 26 main concepts was decided in the preliminary list for these four picture sets with five, six, eight, and seven main concepts in the picture set 1, 2, 3 and 4, respectively.

Four of the main concepts had alternatives that had similar meaning or acceptable concepts related to the pictures. For instance, in picture set 2, the sixth could be either “The man is wearing a pair of socks that are wrong/different in color.” or “The man found the pair of socks are different in color.” In picture set 4, the sixth could be “The boy is picking up the fruits/oranges.” or “The boy is helping (the old man) to pick up the fruits/oranges.”

Additionally, an essential item in a main concept could be substituted by another as long as it was acceptable. For example, in the second main concept of the picture set 1, the essential item 手指頭 shǒu zhǐ tóu “finger” could be replaced by 手 shǒu “hand.” Similarly, in the fifth main concept of the picture set 2, the essential item 穿 chuān “put on” could be substituted by 換 huàn “change.” A total of nineteen essential items, three for picture set 1, six for picture set 2, six for picture set 3 and four for picture set 4, had alternatives.

The examination of the eight transcripts of the normal speakers suggested that none of the 26 main concepts needed to be removed. The list was finalized for used in the main study. The detailed main concepts can be seen in Appendix B.

Concerning the i-words of these picture sets, there were 19, 24, 29 and 27 (totaling 99) for the picture set 1, 2, 3 and 4, respectively. The detailed i-words for each picture set are provided in Appendix C. Similar to the Taiwanese Mandarin main concepts mentioned above, an i-word might have alternative characters as long as the meaning was the same in Chinese. For instance, in the picture set 1, alternatives for 蘿蔔 luó bo “carrot” might include 胡蘿蔔

hú luó bo or 紅蘿蔔 hóng luó bo. Moreover, an i-word might have alternative as long as they were acceptable. For example, in the picture set 3, alternatives for 店員 diàn yuán “salesman” might be 老闆 lǎo bǎn “boss”, 先生 xiān shēng “sir” and 男子 nán zǐ “man.”

2. TM-MCA

The performances of normal speakers on each main concept measure for each picture set, as well as the overall performance for each measure, based on age and education level, are provided in Table 3 and 4, respectively. A one-way between groups ANOVA was conducted to explore the impact of three different age groups (20 to 39 y/o; 40 to 59 y/o; 60 y/o or above) on the main concept measures. Overall, a statistically significant main effect at the $p < 0.05$ level was present for AC [$F(2, 33) = 4.455, p = 0.019$], and AC/min [$F(2, 33) = 4.288, p = 0.022$] for the three age groups. Post-hoc comparisons using the Tukey HSD test indicated that each mean score (overall AC and overall AC/min) for 20-39 y/o was significantly different from 40-59 y/o, indicating that the 20-39 year-old normal speakers tended to convey more accurate and complete main concepts, and to be more efficient to transmit those main concepts, when compared to the 40-59 year-old normal speakers. An independent-samples t-test was conducted to compare each main concept measure for the two educational levels. Overall, significant differences were found in AC and MC. That is, the speakers in the high education group seemed to produce more accurate and complete main concepts than the speakers in the low education group.

The performances of the aphasic and normal groups are presented in Table 5. A paired-sample t-test was administered to evaluate the differences on each main concept measure between the aphasic and normal groups. Overall, there were statistically significant

differences between these two groups in AC, IN, and AC/min. When compared to their matched counterparts, the PWA had a tendency to convey less accurate and complete main concepts, and to deliver those main concepts inefficiently. They, instead, produced more inaccurate main concepts. It was also noted that AC/min yielded significant differences between these two groups on each picture set, suggesting that AC/min could consistently differentiate the PWA from the controls throughout all the picture sets.

The relation between the overall aphasia score in the CCAT and the overall score of each main concept measure was investigated using the Pearson product-moment correlation coefficient. The results of the correlations are displayed in Table 6. The overall aphasia score was strong and positively related to AC, MC, and AC/min, but was strong and negatively correlated to AB.

The relationship between each main concept measure and linguistic communication index was investigated using the Pearson product-moment correlation coefficient. Overall, AC, MC, AC/min were strong and positively related to the I-word, but AB was strong and negatively correlated to the I-word. AI and MC had strong and negative relations with ILE; however, AB was strong and positively related to ILE. AC/min and ICE were strong and positively related. In addition, AB had a strong and positive relation with IEr, but AC, AI and MC were strong and negatively correlated to IEr.

The results of Kendall's tau and Pearson's r coefficients for intra-rater and inter-rater reliabilities are showed in Table 8. Generally, the coefficients of intra-rater reliability were higher than those of inter-rater reliability. The values of the correlation scores yielded at least 0.91 and 0.67 for intra-rater and inter-rater reliabilities, respectively, indicating that intra-rater reliability had a stronger correlation than inter-rater reliability.

Given the small sample size of establishing the test-retest reliability, the results of these measures were described qualitatively. The results of standardization for two PWA's original

scores are shown in Figure 1. These two PWA tended to convey more complete main concepts in the first test session than the retest. On the other hand, they tended to transmit more incomplete and incorrect main concepts in the retest session than the first. PWA 1 missed the same amount of main concepts for the two tests, but PWA 2 missed more main concepts in the retest. Both of them conveyed complete main concepts with similar efficiency for the two tests. All in all, for both PWA, the profiles were similar for the test and retest sessions, which reflected the consistency across time as reflected by the main concept measures.

Table 6 Correlation between overall aphasia score and overall performance of each main concept measure

CCAT	Pearson's r					
	AC	AI	IN	AB	MC	AC/min
Overall aphasia score	0.92**	0.26	- 0.40	- 0.88**	0.94**	0.69*

Note: *: $p \leq 0.05$, **: $p \leq 0.01$

Table 7 Correlations between main concept measures and linguistic communication indices

Index	Pearson's r					
	Measure					
	AC	AI	IN	AB	MC	AC/min
NW	0.09	- 0.57	0.36	0.05	- 0.07	- 0.33
I-word	0.96**	0.27	- 0.43	- 0.92**	0.98**	0.65*
ILE	- 0.57	- 0.70*	0.33	0.84**	- 0.78**	- 0.50
ICE	0.47	0.47	- 0.63	- 0.40	0.53	0.92**
IGS	0.37	0.47	- 0.39	- 0.44	0.48	0.42
IEI	0.32	- 0.20	0.07	- 0.25	0.25	0.20
IEr	- 0.64*	- 0.67*	0.32	0.90**	- 0.85**	- 0.49

Note: *: $p \leq 0.05$, **: $p \leq 0.01$

Table 8 Intra-rater and inter-rater reliability measures of aphasic data

Measure	Intra-rater reliability		Inter-rater reliability	
	Kendall tau coefficient	Pearson's r	Kendall tau coefficient	Pearson's r
AC	0.91		1.00	
AI	1.00*		0.91	
IN	1.00*		0.67	
AB	0.91		0.78	

Measure	Intra-rater reliability		Inter-rater reliability	
	Kendall tau coefficient	Pearson's r	Kendall tau coefficient	Pearson's r
MC	1.00*		1.00*	
AC/min		1.00**		1.00**

Note: *: $p \leq 0.05$, **: $p \leq 0.01$

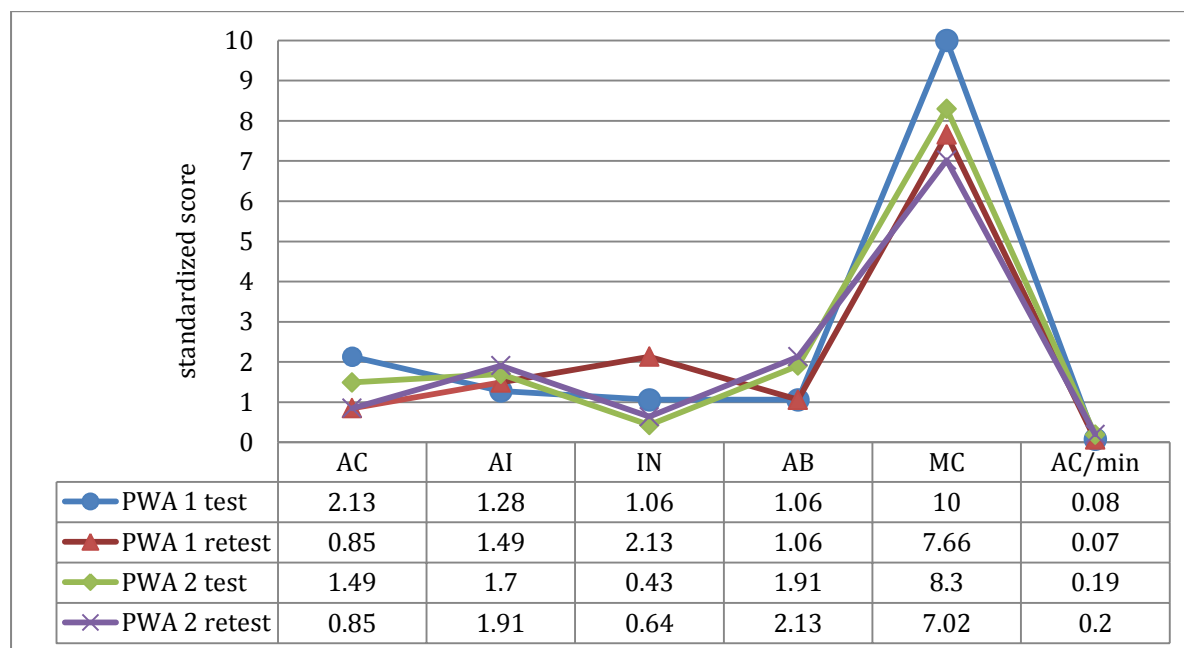


Figure 1 Test-retest reliability measure on main concept measures for two PWA

3. TM-LCM

The performances of the normal speakers on all of the linguistic communication indices for each picture set and overall performance, based on age and educational level, are provided in Table 9 and 10, respectively. A one-way between groups ANOVA was carried out to explore the impact of the three age groups (20 to 39 y/o; 40 to 59 y/o; 60 y/o or above) on linguistic communication indices. Overall, a statistically significant difference at the $p < 0.05$ level was present for I-word [$F(2, 33) = 4.021$, $p = 0.027$] for the three age groups. Post-hoc comparisons using the Tukey HSD test indicated that overall I-word for 20-39 y/o was significantly different from 40-59y/o, but 60 y/o or above did not differ significantly from the other groups. This suggested that the group of 20-39 y/o tended to produce more i-words than

the group of 40-59 y/o. An independent-samples t-test was administered to compare each linguistic communication index for the two educational levels. Overall, there were significant differences in IGS. In other words, the speakers in the high education group had a tendency to produce more grammatical words than the speakers in the low education group.

The performances of the aphasic and normal groups are presented in Table 11. A paired-sample t-test was conducted to examine the differences on each linguistic communication index between the aphasic and normal groups. Overall, statistically significant differences between these two groups were presented in I-word, ICE, and IEL. The PWA tended to produce less i-words depicted in the picture(s) and additional information, when compared to their matched controls. In addition, ICE was found to be able to differentiate these two groups on each picture set.

The relation between the overall aphasia score in the CCAT and each linguistic communication index was investigated using Pearson product-moment correlation coefficient. The results of their correlations are displayed in Table 12. A strong and positive correlation between the overall aphasia score and I-word was found. Moreover, both ILE and IEr were strong and negatively correlated to the overall aphasia score.

Table 13 shows the results of Pearson's r coefficients for the intra-rater and inter-rater reliabilities. The coefficients of the intrarater reliability were relatively better than those of the inter-rater reliability. The values of the correlation scores yielded at least 0.91 and 0.44 for intra-rater and inter-rater reliabilities, respectively, indicating that intra-rater reliability, generally, had a stronger correlation than inter-rater reliability.

Test-retest reliability measure was alternatively described by qualitative judgment. The results of standardization for two PWA's original scores are shown in Figure 2. Both of the PWA had a tendency to produce more words and i-words in the first test session. They demonstrated more efficiently to transmit i-words in the retest session. They produced a fairly

similar amount of grammatical words and additional morphemes around an i-word. PWA 1 said more errors in the retest session, but PWA 2 produced the same amount of errors during test and retest sessions. Generally, both PWA demonstrated similar profiles between the test and retest sessions, reflecting the consistency across time as reflected by the linguistic communication indices. When compared to the test-retest reliability of the main concept analysis, the consistency across time in the linguistic communication measure was better.

Table 9 Performance of normal speakers of three age groups

Age group	Index	Picture set 1	Picture set 2	Picture set 3	Picture set 4	Overall
20-39 y/o	NW	43.08 (16.14)	53.92 (16.62)	62.42 (14.42)	62.42 (14.98)	221.83 (52.35)
		25.00-79.00	32.00-80.00	40.00-85.00	34.00-86.00	142.00-327.00
	I-word	13.92 (1.98)	13.25 (2.05)	20.08 (3.06)	18.67 (1.78)	65.92 (5.98)
		11.00-17.00	10.00-17.00	15.00-25.00	15.00-21.00	52.00-73.00
	ILE	3.09 (1.06)	4.01 (0.83)	3.14 (0.70)	3.35 (0.79)	3.35 (0.64)
		1.79-5.64	2.67-5.71	2.28-4.47	1.89-4.59	2.25-4.48
	ICE	42.58 (9.76)	31.24 (8.53)	42.36 (9.16)	38.69 (9.27)	37.83 (6.39)
		28.00-56.00	18.18-44.00	26.92-59.52	25.64-52.63	25.35-45.89
	IGS	1.31 (0.45)	1.21 (0.29)	1.31 (0.34)	1.46 (0.49)	1.33 (0.26)
		0.50-1.86	0.75-1.71	0.84-2.00	0.78-2.29	0.90-1.74
	IEI	0.68 (0.19)	0.83 (0.40)	0.49 (0.13)	0.81 (0.36)	0.69 (0.20)
		0.43-1.07	0.17-1.41	0.30-0.68	0.19-1.35	0.33-1.03
	IEr	0.00 (0.00)	0.13 (0.13)	0.00 (0.00)	0.01 (0.02)	0.03 (0.03)
		0.00-0.00	0.00-0.38	0.00-0.00	0.00-0.06	0.00-0.07
40-59 y/o	NW	55.25 (20.22)	68.25 (32.63)	62.33 (18.08)	73.08 (29.20)	258.92 (87.81)
		19.00-96.00	30.00-146.00	39.00-104.00	39.00-122.00	128.00-434.00
	I-word	12.25 (1.91)	12.42 (1.73)	18.17 (2.37)	15.92 (3.45)	58.75 (4.98)
		9.00-16.00	10.00-15.00	13.00-22.00	10.00-21.00	50.00-64.00
	ILE	4.52 (1.62)	5.51 (2.38)	3.46 (1.06)	4.81 (2.39)	4.41 (1.53)
		1.73-8.00	2.58-9.73	2.23-6.12	2.44-10.60	2.56-7.75
	ICE	30.39 (10.69)	26.20 (8.30)	41.59 (14.02)	34.40 (11.43)	31.83 (7.68)
		17.91-51.85	14.29-45.45	24.68-72.00	12.20-46.88	19.84-44.93
	IGS	1.27 (0.44)	1.24 (0.42)	1.14 (0.45)	1.47 (0.64)	1.26 (0.44)
		0.70-2.00	0.50-2.00	0.42-1.78	0.63-2.70	0.60-1.96
	IEI	0.88 (0.28)	0.72 (0.36)	0.45 (0.19)	0.91 (0.29)	0.72 (0.19)
		0.25-1.33	0.08-1.36	0.13-0.88	0.52-1.53	0.43-1.06
	IEr	0.05 (0.09)	0.12 (0.12)	0.06 (0.14)	0.04 (0.06)	0.06 (0.06)
		0.00-0.23	0.00-0.40	0.00-0.46	0.00-0.13	0.00-0.20
60 y/o or above	NW	12.25 (1.49)	61.58 (32.68)	67.08 (21.74)	71.58 (24.99)	247.08 (88.09)
		26.00-75.00	32.00-133.00	37.00-103.00	41.00-131.00	167.00-391.00

Age group	Index	Picture set 1	Picture set 2	Picture set 3	Picture set 4	Overall
	I-word	0.25 (0.45)	12.83 (2.48)	18.58 (3.80)	17.00 (3.28)	60.67 (7.92)
		10.00-15.00	10.00-18.00	11.00-23.00	9.00-21.00	44.00-70.00
	ILE	3.77 (1.29)	4.72 (2.08)	3.85 (1.79)	4.21 (1.09)	4.07 (1.36)
		2.17-6.17	2.80-8.83	1.90-8.09	2.73-6.24	2.64-7.09
	ICE	31.75 (10.88)	26.43 (9.81)	38.29 (17.44)	32.23 (8.49)	31.20 (9.65)
		18.18-52.17	12.50-50.00	12.37-68.75	18.75-48.65	18.64-48.91
	IGS	1.17 (0.58)	1.21 (0.48)	1.13 (0.53)	1.27 (0.46)	1.18 (0.45)
		0.42-2.25	0.27-2.17	0.25-2.00	0.63-2.00	0.48-1.83
	IEI	0.78 (0.33)	0.65 (0.42)	0.40 (0.25)	0.72 (0.33)	0.61 (0.26)
		0.08-1.21	0.00-1.30	0.00-0.79	0.27-1.22	0.14-1.00
	IEr	0.03 (0.06)	0.13 (0.11)	0.03 (0.07)	0.07 (0.16)	0.06 (0.07)
		0.00-0.17	0.00-0.31	0.00-0.19	0.00-0.56	0.00-0.23

Note: The values at the top in each column represent ‘mean (standard deviation)’. The values at the bottom in each column represent ‘range’

Table 10 Performance of normal speakers of two educational levels

Education	Index	Picture set 1	Picture set 2	Picture set 3	Picture set 4	Overall
Low	NW	46.28 (21.33)	56.33 (30.20)	62.83 (19.49)	64.78 (23.07)	230.22 (83.61)
		19.00-96.00	30.00-146.00	37.00-104.00	34.00-122.00	128.00-434.00
	I-word	12.39 (1.61)	12.56 (2.04)	18.72 (3.36)	16.72 (3.16)	60.39 (7.29)
		10.00-15.00	10.00-17.00	12.00-25.00	9.00-21.00	44.00-73.00
	ILE	3.71 (1.58)	4.39 (1.92)	3.46 (1.22)	3.92 (1.31)	3.81 (1.33)
		1.73-8.00	2.58-9.73	1.90-6.12	1.89-7.33	2.25-7.75
	ICE	33.95 (11.42)	26.98 (6.85)	41.16 (16.25)	34.95 (8.47)	32.98 (7.42)
		17.91-56.00	12.50-43.48	12.37-72.00	21.84-48.84	18.64-44.72
	IGS	1.03 (0.50)	1.13 (0.41)	1.01 (0.47)	1.26 (0.57)	1.10 (0.42)
		0.42-2.00	0.27-2.00	0.25-2.00	0.63-2.29	0.48-1.96
	IEI	0.72 (0.29)	0.67 (0.42)	0.41 (0.21)	0.75 (0.33)	0.62 (0.24)
		0.08-1.07	0.00-1.41	0.00-0.88	0.19-1.35	0.14-1.03
	IEr	0.04 (0.08)	0.13 (0.12)	0.06 (0.12)	0.05 (0.13)	0.06 (0.07)

Education	Index	Picture set 1	Picture set 2	Picture set 3	Picture set 4	Overall
		0.00-0.23	0.00-0.38	0.00-0.46	0.00-0.56	0.00-0.23
High	NW	50.50 (15.92)	66.17 (25.85)	65.06 (16.73)	73.28 (24.03)	255.00 (70.53)
		29.00-76.00	34.00-133.00	40.00-103.00	54.00-131.00	157.00-391.00
	I-word	13.22 (2.16)	13.11 (2.14)	19.17 (3.02)	17.67 (2.99)	63.17 (6.48)
		9.00-17.00	10.00-18.00	11.00-24.00	10.00-21.00	51.00-72.00
	ILE	3.89 (1.31)	5.50 (1.93)	3.51 (1.34)	4.32 (1.95)	4.08 (1.26)
		2.31-6.33	2.80-8.83	2.29-8.09	2.56-10.60	2.64-7.09
	ICE	35.87 (11.95)	28.93 (10.79)	40.34 (10.97)	35.27 (11.41)	34.25 (9.37)
		18.18-53.57	14.12-50.00	16.81-57.58	12.20-52.63	19.84-48.91
	IGS	1.47 (0.35)	1.31 (0.36)	1.37 (0.34)	1.55 (0.47)	1.42 (0.29)
		0.80-2.25	0.62-2.17	0.76-2.00	0.94-2.70	1.02-1.84
	IEI	0.85 (0.26)	0.80 (0.36)	0.49 (0.17)	0.88 (0.33)	0.73 (0.19)
		0.44-1.33	0.15-1.36	0.13-0.79	0.43-1.53	0.43-1.06
	IEr	0.01 (0.04)	0.12 (0.12)	0.00 (0.00)	0.03 (0.04)	0.03 (0.03)
		0.00-0.15	0.00-0.40	0.00-0.00	0.00-0.11	0.00-0.08

Note: The values at the top in each column represent ‘mean (standard deviation)’. The values at the bottom in each column represent ‘range’

Table 11 Performance of aphasic and normal groups

		Picture set 1		Picture set 2		Picture set 3		Picture set 4		Overall	
Index		Aphasic group	Normal group	Aphasic group	Normal group	Aphasic group	Normal group	Aphasic group	Normal group	Aphasic group	Normal group
NW	Mean	74.00	57.80	78.80	73.30	97.50	63.50	92.40	76.50	342.70	271.10
	SD	59.35	21.04	51.96	33.94	50.42	19.91	71.95	27.32	226.34	89.57
I-word	Mean	7.70	12.70	9.40	13.00	13.00	19.40	9.60	16.80	39.70	61.90
	SD	3.53	1.70	3.69	1.70	7.36	2.07	4.38	2.78	16.50	4.98
ILE	Mean	12.31	4.54	12.58	5.65	11.07	3.33	13.18	4.57	12.98	4.39
	SD	14.63	1.60	13.83	2.45	12.94	1.23	13.08	1.53	17.12	1.51
ICE	Mean	7.46	30.94	6.95	25.48	8.31	46.69	6.19	33.65	6.96	32.69
	SD	6.02	10.80	4.74	5.26	6.14	13.98	5.54	8.70	5.03	6.47

		Picture set 1		Picture set 2		Picture set 3		Picture set 4		Overall	
IGS	Mean	0.63	1.23	0.62	1.21	0.74	1.06	0.96	1.35	0.72	1.20
	SD	0.46	0.54	0.40	0.42	0.55	0.49	0.61	0.61	0.32	0.48
IEI	Mean	0.28	0.89	0.28	0.73	0.39	0.46	0.43	0.91	0.35	0.72
	SD	0.28	0.25	0.33	0.34	0.32	0.19	0.22	0.27	0.14	0.17
IEr	Mean	2.95	0.06	3.77	0.08	2.40	0.02	2.79	0.03	3.33	0.04
	SD	4.53	0.10	6.55	0.08	5.09	0.06	6.09	0.05	6.91	0.04

Note: SD = standard deviation

Table 12 Correlation between overall aphasia score and overall performance of each linguistic communication index

CCAT	Pearson's r						
	NW	I-word	ILE	ICE	IGS	IEI	IEr
Overall aphasia score	- 0.21	0.94**	- 0.77**	0.56	0.29	0.14	- 0.79**

Note: **: $p \leq 0.01$

Table 13 Intra-rater and inter-rater reliability measures of aphasic data

Index	Intra-rater reliability	Inter-rater reliability
	Pearson's r	Pearson's r
NW	0.99*	0.97*
I-word	1.00**	0.99**
ILE	1.00**	0.99**
ICE	1.00**	0.99*
IGS	0.92	0.93
IEI	0.91	0.44
IEr	0.99**	1.00**

Note: *: $p \leq 0.05$, **: $p \leq 0.01$

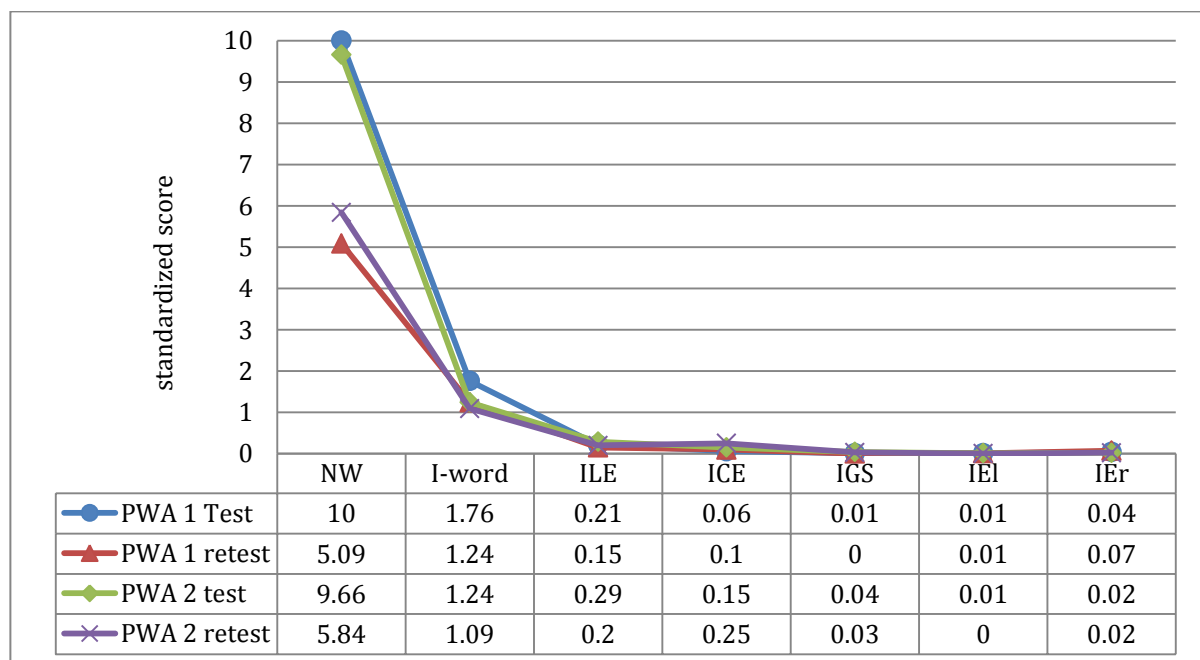


Figure 2 Test-retest reliability measure on linguistic communication indices for two PWA

CHAPTER SIX: DISCUSSION

The Taiwanese Mandarin main concepts related to the four picture sets were established in the present study. These main concepts were not the same as from the Kong study (2009), suggesting that culturally specific main concepts were necessary for the Taiwanese population. The current study created a total of 26 main concepts (five, six, eight, and seven for picture set 1, 2, 3, and 4, respectively) related to the picture sets. Although this total number was the same as in the Cantonese study investigated by Kong (2009), there were four main differences when compared. First, in the forth main concept of the picture set 1, one of the essential items was ok繃/急救物品/藥 ok bēng/jí jiù wù pǐn/yào “band-aid/first-aid object/medicine” in the current study, but 藥箱 yào xiāng “first-aid box” in the previous study. Second, in the picture set 3, the previous study had the “The girl asks for/wants an ice-cream.” main concept, but this did not exist in the current study. Third, the current study but not the previous had the “The grocery bag is broken.” main concept. Last, many of the essential items used in Cantonese (the previous study) had different lexical items from those in Taiwanese Mandarin, such as 膠布 jiāo bù “band-aid” in Cantonese verse ok繃 ok bēng “band-aid” in Taiwanese Mandarin, 雪糕 xuě gāo “ice-cream” in Cantonese verse冰淇淋/甜筒 bīng qí lín/tián tǒng “ice-cream” in Taiwanese Mandarin, etc. Due to discrepancy found in these two versions, it would be problematic to directly use the main concepts of the previous study to the Taiwanese population.

Based on the results regarding the effect of age and/or education on the main concept performance, it was recommended that both age and education should be taken into consideration when measuring a person’s oral narrative ability. The current study found that the young group conveyed more AC main concepts and demonstrated greater efficiency to transmit the main concepts than the middle-age group. However, the study did not report that

the elderly group presented a significant difference from the middle-age group, possibly because the study only recruited 60 to 65 year-old speakers with a mean age of 61.42 years in the elderly group, which was too close to the borderline of the middle-age group. Considering the results from the previous investigations (Kemper, 1987; Kemper, Kynette, Rash, O'Brien, & Sprott, 1989; Kynette & Kemper, 1986; Kemper, Thompson, & Marquis, 2001; Kong & Law, 2004; North, Ulatowska, Macaluso-Haynes, & Bell, 1986; Wright, Capilouto, Wagovich, Cranfill, & Davis, 2005) and the current study, age-related changes in a person's oral language production were noted. In addition, the present study indicated that the high education seemed to convey more AC main concepts than the low education. This finding was compatible with the Kemper et al. study (1989) showing that years of education might influence discourse skills. However, the Kong and Law study (2004) revealed the effect of education on oral language production was not remarkable. Differences in the type of picture and analytical method as well as sample size among the studies might account for the discrepancy. Taken all together, not only age but also education should be considered when assessing a person's discourse production.

The present study suggested that the TM-MCA can be used as a valid assessment tool to differentiate PWA from normal speakers. Current investigation found that AC, IN, and AC/min yielded significant differences between the two groups. However, the previous research (Kong, 2009) concluded that all of the main concept measures were able to differentiate the PWA from the normal speakers. The discrepancy of the findings might be due to different sample sizes, aphasia severity, and statistic analysis. The previous study recruited 20 PWA; however, the current study only included 10 PWA. In addition, the prior study had consisted of more individuals with more severe aphasia than the current study. Kong (2009) reported that the PWA's AQ in the Cantonese version of the WAB had a range between 30.5 and 97.8. In contrast, six out of ten PWA in the current study were relatively

milder with two PWA's overall aphasia severity being within normal range. The two PWA whose language abilities were scored as "within normal range" in the CCAT were included in the aphasic group because they demonstrated oral discourse deficits that were not reflected in the standardized test (CCAT). It should be noted that Kong (2009) conducted one-way between groups ANOVA to examine the performances between the aphasic and normal groups without considering the matched gender, age, and education level, however, the present study paired the PWA and their counterparts based on gender, age, and educational level prior to administer the paired-samples t-test. Though AI did not achieve a significant difference between the aphasic and normal groups, further review of the raw data suggested that the PWA tended to drop off one (or more) essential item in a main concept whereas the normal speakers tended to use non-specific words to replace the targets. Qualitative differences on AB were also noted between the two groups. Specifically, the normal speakers were scored as AB only when they did not convey a specific main concept; however, the PWA might also be scored as AB when they produced neologism that could not be recognized as a specific main concept. All in all, considering the findings from the previous and current studies, the main concept measures, especially AC and IN as well as AC/min, could be used to differentiate PWA from normal speakers.

Consistent with the previous research (Kong, 2009; Kong, 2011), AC, AB, MC, and AC/min were highly correlated to aphasia severity. When diagnosed with more severe aphasia, the patient was expected to have lower scores in AC, MC, and AC/min but higher score in AB, and vice versa. These findings were useful for SLPs working with PWA in clinical settings. For initial assessment, a SLP might conduct the sequential picture sets for supplementing the standardized aphasia test, in order to capture more detailed information about the patient's discourse ability. As a tool for subsequent follow-up, this discourse analysis can also act as a valid measure to monitor treatment progress.

It should be highlighted that this was the first study to establish the LCM in Taiwanese Mandarin. The culturally specific list of i-words related to the four picture sets allowed one to conduct this quantitative method to the Taiwanese Mandarin speakers. The criterion of selecting i-words in the present study was more stringent and objective than the previous (Yorkston & Bukelman, 1977). The criterion of selecting the concepts in the previous study was those mentioned by at least one normal speaker were written in the list. It also excluded concepts that were unrelated to the pictures and/or any comments beyond the pictures through the procedures of subjective judgement by the authors. In contrast, the current study only selected those being mentioned by at least three normal speakers as i-words. The current criterion can avoid subjective judgement for exclusion of unrelated words or assumptions.

The finding of the current study suggested the need for comparing age- and education-matched counterparts when investigating whether an individual's discourse ability was normal. The study revealed the young group generally produced more i-words than the middle-age group. There was no significant difference found between the middle-age and the elderly, possibly due to the fact that the mean age of the elderly group was too close to the borderline of the middle-age group. Combining the current finding with the previous (Kemper, 1987; Kemper et al., 1989; Kynette & Kemper, 1986; Kemper et al., 2001; Kong & Law, 2004; North et al., 1986; Wright et al., 2005), a person's connected speech might change with age. In regards to the effect of education, the present study found that the speakers with high education tended to use more grammatical words around an i-word than ones with low education. This finding was in agreement with the prior investigation (Kemper et al. study, 1989) showing that a person's oral language production might be affected by education. Kong and Law (2004), however, reported that the effect of education was unremarkable. Variations in the type of picture set, analytical method, and sample size among the studies might account for this discrepancy. Taken all together, age and education might potentially affect the

outcomes of the linguistic communication indices, especially I-word and IGS. It would be more appropriate to choose age- and education-matched counterparts to explain a person's oral production performance.

According to Kong and Law (2004), all of the linguistic communication indices were able to discriminate the PWA from the normal speakers; nevertheless, the current study only found I-word, ICE and IEL achieved significant differences between the two groups. There are three possible accounts for the disagreement. Firstly, the prior study used four theme pictures where the current study utilized four sequential picture sets as stimulus materials. Whether differences in stimulus materials contributed to different results should be further investigated. Secondly, the overall aphasia severity in Kong and Law (2004) was higher as compared to the current study. They reported that their PWA ranged in AQ in the Cantonese version of the WAB between 39.7 and 85.0 while the present study recruited six out of ten were milder PWA with two's aphasia severity being within normal limit. Finally, the process of subjective identification of an i-word unit may have also contributed to the different results. Although both studies provided guidelines regarding the segmentation of each i-word unit, subjective decisions on how many words should be included in an i-word unit might, in some extent, lead to discrepancy of index computation. This was especially the case if a subject's speech contained a large degree of irrelevant content and/or comfabulation. In this case, a rater might include all of the words (including open-class and/or closed-class) in an i-word unit as long as following the rule, leading to higher IGS and IEL values. More detailed rules and examples should be clearly provided to reduce the disagreement. Note that further examination of the raw data of the current study found that the PWA were able to produce amount of words similar to (or even more than) the normal speakers; however, their language samples also included repeated words/phrases, phonemic paraphasias, neologisms, and perservations, as well as the inaccurate/unacceptable lexical items, which also contributed

to their relatively higher IEr score with a mean of 3.33 when compared to the counterparts' mean score of 0.04. It was also noted that their closed-class functors mainly included pronoun, adverbials, and particles.

Regarding the correlation between the overall aphasia severity and the linguistic communication indices, the current study found I-word, ILE and IEr were highly related to the overall aphasia score. When diagnosed with more severe aphasia (low overall aphasia score), the patient produced relatively fewer i-words and more errors, including phonemic paraphasias, neologisms and/or perseverations. The patient also demonstrated poor efficiency to deliver the information. Same as the correlation between the overall aphasia severity and the main concept measures, these correlation findings provide SLPs with valuable information in clinical settings. SLPs might compare these indices prior- and post-treatment to detect the patients' progress on discourse over time.

The findings about the correlation between the TM-MCA and the TM-LCM suggested their clinical validity to examine the oral discourse of the PWA. The main purpose of the TM-MCA was to inspect how well a person was able to convey the most prominent parts depicted in the pictures, whereas the TM-LCM was used to detect how many words, i-words, errors, and additional messages related to the pictures a person could provide. Though these two methods looked at different aspects of discourse, they were correlated. For instance, in order to make an AC main concept, a person must produce all of the correct essential items. These essential items were considered accurate, relevant, and informative to the picture. In other words, these items corresponded to some of the i-words in the TM-LCM. Therefore, when one obtained a high score of AC, he or she was expected to have a relatively high score of I-word. On the other hand, if a person had a relatively high IN or AB score, one was not expected to have a high I-word score. In addition, both of the methods looked at the efficiency that a person conveyed accurate information. Their correlation was evidenced by

the Kong study (2011) and the current study. Kong (2011) measured the relations between the selected CLCM indices (such as i-word, ICE, and IEr) and the MCA measures and concluded that the i-word index was highly related to the AC, AB, and MC measures, that ICE had a strong correlation with AC/min, and that IEr was strongly correlated to AC. The present study also found the same results, but three new correlations that were not examined by Kong (2011) were also founded. Firstly, I-word was highly correlated to the AC/min measure. When the PWA produced more i-words, they tended to demonstrate greater efficiency to convey AC main concepts. Secondly, ILE was strongly related to AI, AB, and MC. When the PWA demonstrated low efficiency to deliver the i-words (high ILE score), they tended to omit one (or more) essential item in a main concept and/or miss the main concept(s) in the pictures. Finally, IEr was highly related to AI, AB, and MC. When the PWA produced more errors in their language samples, they conveyed less accurate main concepts and/or missed more main concepts. The relation between ICE and AC/min was not unexpected since both of them measured the oral discourse efficiency. Nevertheless, it seemed to be surprising that ICE did not achieve a significant relation with AC especially when AC/min's relations with I-word and ICE were reported. One possible explanation was even if a PWA demonstrated great efficiency to deliver the i-words, he or she might not convey the most salient information in the pictures. In addition, the study did not show that IEr yielded a significant correlation with IN or AC/min, suggesting that the most of the errors produced by the PWA were not the essential items in a main concept. It was expected that IGS and IEl did not have significant correlations with the main concept measures since IGS and IEl detected additional or more detail information around an i-word, while the main concept measures examined whether the main events in the pictures were mentioned. Though the evidence supported that both of the methods were highly correlated, it should not be interpreted as that one tool can be substituted by another. The TM-MCA should hypothically inform SLPs whether their

PWA were able to describe the most essential events in the pictures. It does not include quantitative measures on how many words, i-words, errors, closed-class functors, and open class morphemes their PWA produced, as reflected by the TM-LCM. That is, if SLPs want to quantitatively measure the linguistic ability of their PWA, they should use the TM-LCM. However, when both methods are used, SLPs can gain a more complete picture of their PWA's strengths and limitations in oral discourse.

The current finding suggested that the intra-rater reliability had significantly higher correlations than the inter-rater reliability on the TM-MCA measures and the TM-LCM indices. As expected, the author had more scoring experiences, such as scoring all of the normal and aphasic transcripts, than another SLP. It was believed that a longer training and repeated use of the systems should improve the rating accuracy (Kong, 2011). It was noted that the correlation between the author and another SLP in IEL was relatively low ($r = 0.44$). Further examination of the raw data noted that the author tended to exclude the unrelated words in an i-word unit while another SLP tended to calculate those words in an i-word unit.

Examination of the stimulus materials from the previous studies (Golper et al., 1980; Menn et al., 1994; Shewan, 1988; Yorkston & Bukelman, 1977; Yorkston & Bukelman, 1980), it was noted they were limited to the use of only one theme picture, such as Cookie Theft picture of the BDAE and Picnic picture of the WAB, to elicit the oral language samples. Using only one picture might not be able to detect a PWA's authentic oral language ability due to the fact that the verbal outputs that reflect the language performance might be influenced by a particular stimulus material (Cooper, 1990). Hence, it is possible to underestimate the PWA's oral ability. The current study used four picture sets with each set having four sequential pictures to elicit language samples. The sequential pictures might be beneficial because they were able to elicit longer language samples (Potechin, Nicholas, & Brookshire, 1987) as well as more main events (Wright et al., 2005). Moreover, using more than one

picture set could help to detect how well a PWA's oral narrative could generalize across different stimuli (Cooper, 1990). Therefore, SLPs should apply more than one picture to assess the patients' oral language ability, which could assist in the accurate decisions for diagnosis and treatment plans.

One of the limitations was that the current study was not able to determine whether the elderly speakers had a significantly different amount of verbal outputs than the young and middle-age ones. The mean ages of the three age groups in the present study were 31.25 years, 49.67 years, and 61.42 years, respectively. The first two groups had approximately 19 years gap; however, the last two groups only had about 11 years gap. Further studies should include older elderly with a mean age of about 70 years in the elderly group. This will help to determine whether the three age groups will have differences on oral language performance. In addition, the current study only recruited ten PWA to conduct the picture description tasks. The results from these ten PWA might not be able to generalize to the performances of all types of aphasia syndromes. Further investigations should recruit more PWA to see whether similar results can still be obtained, such as significant differences on all of the main concept measures and/or linguistic communication indices between the aphasic and normal groups. Lastly, the study did not recruit PWA on the basis of different types of aphasia. It was not able to tell whether different types of aphasia presented different or same performances on main concept measures and linguistic communication indices. Further studies should include non-fluent and fluent types of aphasia to explore if any group differences will be present in the main concept measures and/or linguistic communication indices.

APPENDIX A:
IRB HUMAN SUBJECTS PERMISSION LETTER



University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Chun-Chih Yeh and Co-PI: Pak Hin Kong**

Date: **November 08, 2012**

Dear Researcher:

On 11/8/2012, the IRB approved the following human participant research until 11/7/2013 inclusive:

Type of Review: UCF Initial Review Submission Form
Project Title: A Taiwanese Mandarin Quantification System for Analysis of
Aphasic Connected Speech: Normative and Aphasic Data
Investigator: Chun-Chih Yeh
IRB Number: SBE-12-08841
Funding Agency:
Grant Title:
Research ID: N/A

The Continuing Review Application must be submitted 30 days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form cannot be used to extend the approval period of a study. All forms may be completed and submitted online at <https://iris.research.ucf.edu>.

If continuing review approval is not granted before the expiration date of 11/7/2013, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a signed and dated copy of the consent form(s).

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 11/08/2012 12:54:31 PM EST

IRB Coordinator

APPENDIX B:
TAIWANESE MANDARIN MAIN CONCEPTS FOR PICTURE SET 1-4

The main verb for each main concept is bolded. All the essential items are underlined.

Picture set 1: Cooking in a kitchen	
1	老婆婆 <u>切</u> (紅/胡)蘿蔔。lǎo pó pó <u>qiē</u> (hóng/hú) luó bo “The <u>old lady</u> <u>cuts</u> <u>carrots</u> .”
2	老婆婆 <u>切到</u> 手/手指頭。lǎo pó pó <u>qiē dào</u> shǒu/shǒu zhǐ tou “The <u>old lady</u> <u>cuts</u> her <u>finger</u> .”
3	老婆婆的手/手指頭 <u>流血</u> 。lǎo pó pó de shǒu/shǒu zhǐ tou <u>liú xiě</u> “The <u>old lady’s</u> <u>finger</u> is <u>bleeding</u> .”
4	老婆婆 從急救箱 <u>拿出</u> ok 繃/急救物品/藥。lǎo pó pó cóng jíjiù xiāng <u>ná chū</u> ok bēng/jí jiù wù pǐn/yào/yào pǐn “The <u>old lady</u> is <u>taking</u> out some <u>band-aid/bandages/medicine</u> from the first-aid kit.”
5	老婆婆 <u>貼</u> ok 繃。lǎo pó pó <u>tiē</u> ok bēng “The <u>old lady</u> is <u>sticking</u> a <u>band-aid</u> .” 老婆婆 <u>包紮</u> 傷口。lǎo pó pó <u>bāo zā</u> shāng kǒu “The <u>old lady</u> is <u>dressing</u> the <u>wound</u> .”

Picture set 2: Waking up late for work	
1	那位先生 <u>起床/醒來</u> 。nà wèi xiān sheng <u>qǐ chuáng/xǐng lái</u> “The <u>man</u> <u>wakes up</u> .”
2	那位先生 <u>遲到/睡過頭/驚訝</u> 。nà wèi xiān sheng <u>chí dào/shuì guò tóu/jīng yà</u> “The <u>man</u> is <u>late/shocked</u> .”
3	那位先生 <u>刷牙</u> 。nà wèi xiān sheng <u>shuā yá</u> “The <u>man</u> is <u>brushing</u> his teeth.”
4	那位先生 <u>梳/整理</u> 頭髮。nà wèi xiān sheng <u>shū/zhěng lǐ</u> tóu fǎ “The <u>man</u> is <u>combing</u> his hair.”
5	那位先生 <u>換/穿上</u> 衣服/褲子。nà wèi xiān sheng <u>huàn/chuān</u> shàng yī fú/kù zi “The <u>man</u> is <u>putting on</u> his <u>clothes/pants</u> .”
6	那位先生 <u>穿 錯/不同顏色</u> 的襪子。nà wèi xiān sheng <u>chuān cuò/bù tóng yán sè</u> de wà zi “The <u>man</u> is <u>wearing</u> a pair of <u>socks</u> that are <u>wrong/different</u> in color.” 那位先生 <u>發現</u> 襪子 顏色不一樣/不同。nà wèi xiān sheng <u>fā xiàn</u> wà zi yán sè bù yí yàng/bù tóng “The <u>man</u> <u>found</u> the pair of <u>socks</u> are <u>different</u> in color.”

Picture set 3: Buying ice-cream	
1	媽媽和妹妹 <u>買</u> 冰淇淋/甜筒。mā ma hàn mèi mei <u>mǎi bīng qí lín/tián tong</u> “The <u>mother</u> and the <u>girl</u> are <u>buying</u> <u>ice creams</u> .”
2	媽媽 <u>付/拿</u> 錢。mā ma <u>fù/ná qián</u> “The <u>mother</u> is <u>paying</u> .”
3	老闆 <u>挖/拿</u> 冰淇淋/甜筒。lǎo bǎn <u>wā/ná</u> bīng qí lín/tián tong “The <u>man</u> is <u>scooping/taking</u> an <u>ice-cream</u> cone.”
4	冰淇淋 <u>掉在</u> 地上。bīng qí lín <u>diào zài</u> dì shàng “The <u>ice cream</u> <u>dropped</u> on the <u>floor</u> .”
5	妹妹 <u>難過/在哭</u> 。mèi mei <u>nán guò/zài kū</u> “The <u>girl</u> is <u>sad/crying</u> .”
6	老闆 <u>看到/發現</u> 。lǎo bǎn <u>kàn dào/fā xiàn</u> “The <u>man</u> <u>sees</u> the incident.”

7	老闆 給 妹妹 冰淇淋/甜筒。lǎo bǎn <u>gěi</u> xiǎo péng yǒu/mèi mei/xiǎo mèi mei/tā bīng qí lín/tián tǒng “The <u>man gives</u> the <u>girl</u> an <u>ice-cream</u> .” 老闆 拿/送 冰淇淋/甜筒 給 妹妹。lǎo bǎn <u>ná/sòng</u> bīng qí lín/tián tǒng gěi xiǎo péng yǒu/mèi mei/xiǎo mèi mei/tā “The <u>man gives</u> the <u>girl</u> an <u>ice-cream</u> .”
8	妹妹 笑了/開心/不哭了。mèi mei <u>xiào</u> le/ <u>kāi xīn</u> / <u>bù kū</u> le “The <u>girl</u> is <u>smiling/happy/ not crying</u> .”

Picture set 4: Helping an old man	
1	爸爸跟小朋友在走路/去散步。bà ba gēn xiǎo péng yǒu zài <u>zǒu lù</u> /qù <u>sàn bù</u> “The father and the boy are <u>walking</u> on the street.”
2	老爺爺 提著 袋子/手提袋/提袋。lǎo yé ye <u>tí</u> zhe dài zi/shǒu tí dài/tí dài “The old man is <u>carrying</u> a <u>grocery bag</u> .”
3	袋子/手提袋/提袋 破掉了。dài zi/shǒu tí dài/tí dài <u>pò</u> diào le “The <u>grocery bag</u> is <u>broken</u> .”
4	水果/橘子 掉了/出來。shuǐ guǒ/jú zi <u>diào</u> le/chū lái “The <u>fruits/oranges</u> <u>fall</u> on the floor.”
5	小朋友 看到。xiǎo péng yǒu <u>kàn</u> dào “The <u>boy</u> <u>sees</u> the incident.”
6	小朋友 撿 水果/橘子。xiǎo péng yǒu <u>jiǎn</u> shuǐ guǒ/jú zi “The <u>boy</u> is <u>picking up</u> the <u>fruits/oranges</u> .” 小朋友 幫 老爺爺撿水果/橘子。xiǎo péng yǒu <u>bāng</u> lǎo yé ye jiǎn shuǐ guǒ/jú zi “The <u>boy</u> is <u>helping</u> (the <u>old man</u>) to pick up the <u>fruits/oranges</u> .”
7	老爺爺 稱讚/誇獎 小朋友。lǎo yé ye <u>chēng zàn/kuā jiǎng</u> xiǎo péng yǒu “The <u>old man</u> <u>praises</u> the <u>boy</u> .”

APPENDIX C:
TAIWANESE MANDARIN I-WORDS FOR PICTURE SET 1-4

Picture set 1: Cooking in a kitchen					
Scenarios	Subjects	Objects	Actions	Places	Others
Introduction	老太太 1 老婆婆 老奶奶 老婦人 (old lady)		準備 10 (prepare)		
			做菜 11 切菜 煮菜 (cooking)		
An old lady cuts a carrot (into pieces).		胡蘿蔔 2 紅蘿蔔 蘿蔔 (carrot)	切 12 (cut)		
		片 3 (piece)			
She cuts her finger.		手 4 (hand) 手指頭 (finger)	切 13 (cut)		
She bleeds.		手 5 (hand) 手指頭 (finger)	流血 14 (bleed)		
She reaches for the first-aid kit.		醫護箱 6 醫藥箱 藥箱 (first-aid kit)	到 15 (go) 拿 (take)		
		醫藥 7 (medicine)	拿 16 (take)		
		Ok 繃 (bandage)	擦 17 (apply) 包紮 (wrap)		
She wraps the wound.		Ok 繃 8 (bandage)	包紮 18 (wrap)		
		傷口 9 (wound)	貼 (stick)		
		手 (hand)	用 19 (use) 拿 (take)		

Picture set 2: Waking up late for work					
Scenarios	Subjects	Objects	Actions	Places	Others
The man Wakes up.	先生 20 (sir) 男生 (man)	鬧鐘 21 (alarm clock)	睡過頭 27 (oversleep) 遲到 (late)		
			聽 28 (hear) 看 (watch)		
			驚醒 29 嚇醒 (socked)		
			起床 30 起來 (wake up)		
			響 31 (sound)		
He washes up.		頭髮 22 (hair)	刷牙 32 (brush teeth)		
			梳頭 33 梳 (comb) 整理 (arrange)		
He dresses.		衣櫃 23 衣櫥 (closet)	到 34 (go) 打開 (open)		
		衣服 24 (clothes)	穿 35 (put on)		
		褲子 25 (pants)	換 (change)		
He wears the wrong socks.		襪子 26 (socks)	坐 36 (sit)		錯 39 (wrong) 不一樣 (different)
			發現 37 (find)		白 40 (white)
			穿 38 (wear)		黑 41 (black)
					右 42 (right) 左 43 (left)

Picture set 3: Buying ice-cream					
Scenarios	Subjects	Objects	Actions	Places	Others
A mother and a girl approach an ice cream shop.	媽媽 44 (mother)	冰淇淋 53 (ice-cream)	帶 58 (bring)	冰淇淋攤 70 (ice-cream shop) 冰淇淋店 (ice-cream store)	
	妹妹 45 (sister) 女兒 (daughter) 小女孩 (little girl)		去 59 到 (go) 來 (come) 經過 (pass by)		
			買 60 (buy)		
The mother Pays.	媽媽 46 (mother)	錢 54 (money)	付 61 (pay)		
The boss Scopes an ice cream.	老闆 47 (boss) 先生 (sir) 店員 (salesman)	冰淇淋 55 (ice-cream)	挖 62 (scope) 準備 (prepare)		
	妹妹 48 (sister) 女兒 (daughter) 小女孩 (little girl)		給 63 (give)		
The girl drops the ice cream.	妹妹 49 (sister) 女兒 (daughter) 小女孩 (little girl)	冰淇淋 56 (ice-cream)	拿 64 (take)	地上 71 (floor)	
			掉 65 (drop)		
The man notices the girl cries and gives her another ice cream.	妹妹 50 (sister) 女兒 (daughter) 小女孩 (little girl)	冰淇淋 57 (ice-cream)	哭 66 (cry) 難過 傷心 (sad)		新 72 (new)
			看 67 (see) 發現 (find)		

	老闆 51 (boss) 先生 (sir) 店員 (salesman)		拿 68 (take) 挖 (scope) 送 給 (give)		
The girl smiles.	妹妹 52 (sister) 女兒 (daughter) 小女孩 (little girl)		高興 69 開心 (happy) 笑 (laugh)		

Picture set 4: Helping an old man					
Scenarios	Subjects	Objects	Actions	Places	Others
The father, son and another old man walk.	祖父 73 爺爺 (grandfather) 爸爸 (father)		帶 86 (bring) 牽 (hand in hand)		
	孫子 74 (grandson) 弟弟 (brother) 小男孩 (little boy)		出門 87 出去 出來 (go out)		
	阿公 75 (grandfather) 老爺爺 老先生 (old man)		散步 88 走 (walk) 玩 (play)		
			擦身而過 89 經過 (pass by)		
The old man carries a bag.	阿公 76 (grandfather) 老爺爺 老先生 (old man)	橘子 82 (orange) 塑膠袋 (plastic bag)	提 90 (carry) 拿 (take)		
The son sees the bag broken.	孫子 77 (grandson) 弟弟 (brother) 小男孩 (little boy)	袋子 83 提袋 手提袋 (plastic bag)	轉身 91 (turn body) 回頭 (turn head)		
			看 92 (see) 發現		

			(find)		
			破掉 93 (broken)		
The oranges fall out of the bag.		橘子 84 (orange) 水果 (fruit)	掉 94 (drop) 滾 (roll)		
The son helps pick up the oranges.	孫子 78 (grandson) 弟弟 (brother) 小男孩 (little boy)	橘子 85 (orange) 水果 (fruit)	去 95 過去 (go)		好心 99 (friendly)
	阿公 79 (grandfather) 老爺爺 老先生 (old man)		幫 96 (help)		
			撿 97 (pick)		
The old man praises the son.	阿公 80 (grandfather) 老爺爺 老先生 (old man)		誇讚 98 誇獎 稱讚 讚美 說讚 (praise) 給大拇指 (thumb up)		
	孫子 81 (grandson) 弟弟 (brother) 小男孩 (little boy)				

APPENDIX D:
STEPS AND RULES FOR SCORING THE TAIWANESE MANDARIN
MAIN CONCEPTS

After the language samples related to the four picture sets are orthographically transcribed, a score is provided for each main concept that an examinee provides. Depending on the presence, accuracy and completeness of the essential items in a main concept, one of the scores will be given to that main concept. These scores include AC (accurate and complete), AI (accurate but incomplete), IN (inaccurate) and AB (absent). The following describes the scoring steps and the criteria of each score.

Step 1: Checking for presence

For each main concept an examinee provided, determine if any essential items exist by comparing it to its reference main concept (Appendix A). Note that the numbered main concepts are included in the TM-MCA Scoring Form (Appendix D). If any of the essential items can be found, then proceed to step 2. If not, score AB for this main concept.

Step 2: Checking for accuracy

When a main concept does not include all the essential items, i.e., one or more pieces are missing, determine if these essential items are accurate or not. If they are all correct, then proceed to step 3. If not, score IN for this main concept. Note that this rule also applies to misuse of pronoun or when a pronoun is used to refer to a referent inaccurately. For instance, if an examinee said 他們 tā men “they” instead of 他 tā “he” in the picture set 2, AI is given. Moreover, when any of the essential items include phonemic and/or semantic paraphasias, neologisms and/or jargon, this main concept is counted as IN.

Step 3: Checking for completeness

The next step is to determine whether all of the essential items are included in the main concept. If all of them exactly match to its reference main concept, score the main concept as AC. If not, score it as AI even if there is only one missing. If a non-specific essential item is produced for a specific item, score it as AI. For instance, an examinee produced 媽媽和她的女兒買東西 mā ma hàn tā de nǚ ér mǎi dōng xī “A mother and her daughter buy

something.” to refer to the picture depicting a mother and her daughter buy some ice cream in the picture set 3. When an examinee produced pronouns from the beginning to the end for all of the referents in the pictures, the first main concept that includes a pronoun is scored as AI, but the remaining pronouns in the rest of the main concepts are considered accurate. If a pronoun is used to refer to something, but it is unclear which is referred to, score the main concept as AI. For example, in the second picture in the set 3, if an examinee produced 她在付錢 tā zài fù qián “she is paying.”, AI score is given because it is ambiguous that this pronoun refers to whom.

Note that the essential items do not have to be the same as the reference main concept (Appendix A). Alternative words might be considered AC as long as they are acceptable in the context. Also, if all of the essential items are included in a main concept, but the main concept also includes inaccurate words that are irrelevant to the content, AC score can be given unless those inaccurate words change the essential items’ meaning. Third, considering a Chinese feature that a subject, object, or pronoun might be missing in a statement if it has been correctly produced previously in an oral discourse, a score AC can be given for an elliptical sentence if its referent or pronoun is appropriately provided. In addition, consistent misarticulation due to the presence of motor speech disorders, i.e., not paraphasias in nature, should not compromise the scoring of AC. It is also important to note that when an examinee self-corrects or restates the essential items, determination of the accuracy and completeness should only be based on the final spoken items. Therefore, even if an examinee produces an essential item correctly at the first time, IN is considered when he or she self-corrects or restates inaccurately. Finally, the order of the main concepts produced by an examinee does not have to follow the one listed in the TM-MCA Scoring Form.

**APPENDIX E:
TM-MCA SCORING FORM**

Taiwanese Mandarin Main Concept Analysis

TM-MCA Scoring Form

Name: _____	Speech therapist: _____
Date of birth/Age: _____	Date of testing (CCAT): _____
Gender: _____	CCAT average score: _____
Date of onset: _____	Aphasia severity: _____
Etiology: _____	Date of testing (MC): _____

Remarks:

Summary of TM-MCA

	AC	AI	IN	AB	MC	Time in minute	AC/min
Set 1							
<i>Cooking in a kitchen</i>							
Set 2							
<i>Waking up late for work</i>							
Set 3							
<i>Buying ice-cream</i>							
Set 4							
<i>Helping an old man</i>							
Total							

Introduction:

A subject's personal information and a summary score table are provided in the first page of this scoring form. From the next page to the last are used to analyze the Taiwanese Mandarin main concepts. The column at the beginning of each set is used to write the language sample as well as the total recording time. Under this column, the numbered main concepts and each score (AC, AI, IN, AB) are provided. Under each main concept, there is a dotted column used for writing the main concept that a subject produces, and for scoring at the right side. At the end of each set, there is a summary score table for all the main concept measures (AC, AI, IN, AB, MC and AC per minute). A total number of each score can be written in the column right next to the Index 1, 2, 3, 4. MC can be written in the column right next to the Index 5, and AC per minute can be written in the last column right next to the Index 6. Finally, these numbers can be converted to the summary of TM-MCA in the first page.

The main verb for each main concept is **bolded**. All the essential information is underlined.

Set 1 (Cooking in a kitchen)

Complete language sample:

Time = min sec = minute

AC AI IN AB

- 1 The old lady **cuts** carrots

老婆婆 切 (紅/胡)蘿蔔。

ㄌㄠˊ ㄆㄛˊ ㄆㄛˊ ㄑㄧㄝˊ (ㄏㄨㄥˊ/ㄏㄨˊ) ㄌㄨㄛˊ ㄅㄛˊ

lǎo pó pó qiē (hóng/hú) luó bo

- 2 The old lady **cuts** her finger

老婆婆 切到 手/手指頭。

ㄌㄠˊ ㄆㄛˊ ㄆㄛˊ ㄑㄧㄝˊ ㄉㄠˋ ㄕㄠˊ/ㄕㄠˊ ㄓㄩˊ ㄒㄜˊ ㄊㄠˊ

lǎo pó pó qiē dào shǒu/shǒu zhǐ tou

- 3 The old lady's finger is **bleeding**

老婆婆的手/手指頭 流血。

ㄌㄠˊ ㄆㄛˊ ㄆㄛˊ ㄕㄠˊ/ㄕㄠˊ ㄓㄩˊ ㄒㄜˊ ㄊㄠˊ ㄌㄧㄡˊ ㄒㄩㄝˊ

lǎo pó pó de shǒu/shǒu zhǐ tou liú xiě

- 4 The old lady is **taking out** some band-aid/bandages/medicine from the first-aid kit.

老婆婆 從急救箱 拿出 ㄠ 繃/急救物品/藥。

ㄌㄠˊ ㄆㄛˊ ㄆㄛˊ ㄘㄨㄥˊ ㄐㄧˋ ㄓㄩˊ ㄒㄜˊ ㄊㄠˊ ㄋㄤˊ ㄅㄤˊ ㄐㄧˋ ㄓㄩˊ ㄒㄜˊ ㄊㄠˊ ㄋㄤˊ ㄅㄤˊ ㄐㄧˋ ㄓㄩˊ ㄒㄜˊ ㄊㄠˊ

lǎo pó pó cóng jí jiù xiāng ná/ná chū ㄠ bēng/jí jiù wù pǐn/yào/yào pǐn

- 5 The old lady is **sticking** a band-aid

老婆婆 貼 ㄠ 繃。

ㄌㄠˊ ㄆㄛˊ ㄆㄛˊ ㄊㄧㄝˊ ㄠ ㄅㄤˊ

lǎo pó pó tiē ㄠ bēng

The old lady is **dressing** the wound.

老婆婆 包紮 傷口。

ㄌㄠˊ ㄆㄛˊ ㄆㄛˊ ㄅㄠˊ ㄗㄚˊ ㄕㄠˊ ㄕㄨˊ

lǎo pó pó bāo zā shāng kǒu

AC AI IN AB

Index 1, 2, 3, 4 –

Index 5 – Main concept score (MC) = (3×AC + 2×AI + 1×IN)

Index 6 – AC per minute =

Set 2 (waking up late for work)

Complete language sample:

Time = min sec = minute

AC AI IN AB

1 The man **wakes up**

那位先生 起床/醒來。

3Y'X\T-9PL <-1'X'X'1T-1'力所'

nà wèi xiān sheng **qǐ chuáng/xǐng lái**

--	--	--	--	--

2 The man is **late/shocked**.

那位先生 遲到/睡過頭/驚訝。

3Y'X\T-9PL 1'X'X'1T-1'X'X'1T-1'Y'

nà wèi xiān sheng **chí dào/shuì guò tóu/jīng yà**

--	--	--	--	--

3 The man is **brushing** his teeth.

那位先生 刷牙。

3Y'X\T-9PL PXY-Y'

nà wèi xiān sheng **shuā yá**

--	--	--	--	--

4 The man is **combing** his hair.

那位先生 梳/整理頭髮。

3Y'X\T-9PL PX/1L'X'X'1T-1'Y'

nà wèi xiān sheng **shū/zhěng lǐ tóu fǎ**

--	--	--	--	--

5 The man is **putting on** his clothes/pants.

那位先生 換/穿上衣服/褲子。

3Y'X\T-9PL 1'X'X'1T-1'X'X'1T-1'Y'

nà wèi xiān sheng **huàn/chuān** shàng yī fú/ kù zi

--	--	--	--	--

6 The man is **wearing** a pair of **socks** that are **wrong/different** in color.

那位先生 穿 錯/不同顏色的襪子。

3Y'X\T-9PL 1'X'X'1T-1'X'X'1T-1'Y'

nà wèi xiān sheng **chuān** cuò/bù tóng yán sè de wà zi

The man **found** the pair of **socks** are **different** in color.

那位先生 發現 襪子 顏色不一樣/不同。

3Y'X\T-9PL CYT-9'XY'P-9'mt'kX'-t'kX'gXL'

nà wèi xiān sheng fā xiàn wà zǐ yán sè bù yí yang/bù tóng

--	--	--	--	--

AC	AI	IN	AB

Index 1, 2, 3, 4 –

Index 5 – Main concept score (MC) = (3×AC + 2×AI + 1×IN)

Index 6 – AC per minute =

--

Set 3 (Buying ice-cream)

Complete language sample:

--

Time =

--

 min

--

 sec =

--

 minute

AC	AI	IN	AB
----	----	----	----

- 1 The mother and the girl are buying ice creams.

媽媽和妹妹 買 冰淇淋/甜筒。

MYMYT9P\N\N'N'k-L<-k-k'g-g'gXL'

mā ma hàn mèi mei mǎi bīng qí lín/tián tǒng

--	--	--	--	--

- 2 The mother is paying.

媽媽 付/拿 錢。

MYMYCY\N'Y'<-g'

mā ma fù/ná qián

--	--	--	--	--

- 3 The man is scooping/taking an ice-cream cone.

老闆 挖/拿 冰淇淋/甜筒。

ka'k'g'XY\ZY'k-L<-k-k'g-g'gXL'

lǎo bǎn wā/ná bīng qí lín/tián tǒng

--	--	--	--	--

- 4 The ice cream dropped on the floor.

冰淇淋 掉 在 地上。

k-L<-k-k'k-k'P'k'P'

bīng qí lín diào zài dì shàng

--	--	--	--	--

- 5 The girl is sad/crying.

妹妹 難過/在哭。

N\N\ZY\X'P'k'g'

mèi mei nán guò/zài kū

- 6 The man sees the incident.

老闆 看到/發現。

ㄌㄠˇ ㄅㄢˇ ㄎㄢˋ ㄉㄠˋ / ㄈㄚˋ ㄒㄩㄢˋ

lǎo bǎn kàn dào/fā xiàn

- 7 The man gives the girl an ice-cream.

老闆 給 妹妹 冰淇淋/甜筒。

ㄌㄠˇ ㄅㄢˇ ㄍㄟ ㄇㄟ ㄇㄟ ㄒㄩㄢˋ ㄒㄩㄢˋ ㄉㄠˋ

lǎo bǎn gěi xiǎo péng yǒu/mèi mei/xiǎo mèi mei/tā bīng qí lín/tián tǒng

老闆 拿/送 冰淇淋/甜筒 給 妹妹。

ㄌㄠˇ ㄅㄢˇ ㄋㄚˊ / ㄙㄨㄥˋ ㄅㄢˋ ㄑㄩˊ ㄌㄩㄣˊ / ㄊㄧㄢˊ ㄊㄨㄥˊ ㄍㄟ ㄇㄟ ㄇㄟ

lǎo bǎn ná/sòng bīng qí lín/tián tǒng gěi xiǎo péng yǒu/mèi mei/xiǎo mèi mei/tā

- 8 The girl is smiling/happy/ not crying.

妹妹 笑了/開心/不哭了。

ㄇㄟ ㄇㄟ ㄒㄩㄢˋ ㄌㄠˊ / ㄎㄞˊ ㄒㄩㄢˋ / ㄅㄨˋ ㄎㄨˊ ㄌㄠˊ

mèi mei xiào le/kāi xīn/bù kū le

Index 1, 2, 3, 4 –
Index 5 – Main concept score (MC) = (3×AC + 2×AI + 1×IN)
Index 6 – AC per minute =

AC	AI	IN	AB

Set 4 (Helping an old man)

Complete language sample:

Time = min sec = minute

AC	AI	IN	AB
----	----	----	----

- 1 The father and the boy are walking on the street.

爸爸跟小朋友在走路/去散步。

ㄅㄚˋ ㄅㄚˋ ㄍㄟ ㄒㄩㄢˋ ㄅㄟ ㄅㄟ ㄗㄞ ㄗㄞ ㄌㄨˋ / ㄑㄜˋ ㄙㄢˋ ㄅㄨˋ

bà ba gēn xiǎo péng yǒu zài zǒu lù/qù sàn bù

- 2 The old man is carrying a grocery bag.

老爺爺 提著 袋子/手提袋/提袋。

ㄌㄠˇ ㄧㄝˊ ㄧㄝˊ ㄊㄧˊ ㄗㄞ ㄉㄞˋ ㄗㄞ / ㄕㄞˋ ㄉㄞˋ ㄗㄞ / ㄊㄧˊ ㄉㄞˋ

lǎo yé ye tí zhe dài zi/shǒu tí dài/tí dài

- 3 The grocery bag is **broken**.

袋子/手提袋/提袋 破掉了。

ㄉㄞˋ ㄗㄩˋ ㄕㄞˊ ㄖㄨˋ ㄉㄞˋ ㄒㄩˋ ㄕㄞˊ ㄖㄨˋ ㄉㄞˋ ㄒㄩˋ ㄕㄞˊ

dài zi/shǒu tí dài/tí dài pò diào le

- 4 The fruits/oranges **fall** on the floor.

水果/橘子 掉了/出來。

ㄕㄨㄟˊ ㄍㄨㄛˊ ㄓㄨˊ ㄗㄩˋ ㄉㄞˋ ㄌㄞˊ ㄕㄞˊ

shuǐ guǒ/jú zi diào le/chū lái

- 5 The boy **sees** the incident.

小朋友 看到。

ㄒㄞㄠˊ ㄆㄥˊ ㄩㄠˊ ㄕㄞˊ ㄉㄞˋ

xiǎo péng yǒu kàn dào

- 6 The boy is **picking up** the fruits/oranges.

小朋友 撿 水果/橘子。

ㄒㄞㄠˊ ㄆㄥˊ ㄩㄠˊ ㄕㄞˊ ㄉㄞˋ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ

xiǎo péng yǒu jiǎn shuǐ guǒ/jú zi

The boy is **helping** (the old man) to pick up the fruits/oranges.

小朋友 幫 老爺爺撿水果/橘子。

ㄒㄞㄠˊ ㄆㄥˊ ㄩㄠˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ

xiǎo péng yǒu bāng lǎo yé ye jiǎn shuǐ guǒ/jú zi

- 7 The old man **praises** the boy.

老爺爺 稱讚/誇獎 小朋友。

ㄌㄞˊ ㄩㄠˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ

lǎo yé ye chēng zàn/kuā jiǎng xiǎo péng yǒu

Index 1, 2, 3, 4 –
Index 5 – Main concept score (MC) = (3×AC + 2×AI + 1×IN)
Index 6 – AC per minute =

AC	AI	IN	AB

APPENDIX F:
TWO EXAMPLES OF THE TM-MCA SCORING FORM

Example 1 (Normal Speaker)

Taiwanese Mandarin Main Concept Analysis

TM-MCA Scoring Form

Name:	<u>HYH</u>	Speech therapist:	<u>Chun-Chih Yeh</u>
Date of birth/Age:	<u>07/11/83 ; 29y/o</u>	Date of testing (CCAT):	<u>01/01/13</u>
Gender:	<u>M</u>	CCAT average score:	<u>12</u>
Date of onset:	<u>N/A</u>	Aphasia severity:	<u>Within Normal</u>
Etiology:	<u>N/A</u>	Date of testing (MC):	<u>01/01/13</u>

Remarks:

N/A

Summary of TM-MCA

	AC	AI	IN	AB	MC	Time in minute	AC/min
Set 1 <i>Cooking in a kitchen</i>	4	0	0	1	12	0.33	12.12
Set 2 <i>Waking up late for work</i>	4	0	1	1	13	0.57	7.01
Set 3 <i>Buying ice-cream</i>	4	1	1	2	15	0.72	5.56
Set 4 <i>Helping an old man</i>	4	2	0	1	16	0.78	5.12
Total	16	3	2	5	56	2.4	6.67

Introduction:

A subject's personal information and a summary score table are provided in the first page of this scoring form. From the next page to the last are used to analyze the Taiwanese Mandarin main concepts. The column at the beginning of each set is used to write the language sample as well as the total recording time. Under this column, the numbered main concepts and each score (AC, AI, IN, AB) are provided. Under each main concept, there is a dotted column used for writing the main concept that a subject produces, and for scoring at the right side. At the end of each set, there is a summary score table for all the main concept measures (AC, AI, IN, AB, MC and AC per minute). A total number of each score can be written in the column right next to the Index 1, 2, 3, 4. MC can be written in the column right next to the Index 5, and AC per minute can be written in the last column right next to the Index 6. Finally, these numbers can be converted to the summary of TM-MCA in the first page.

Set 1 (Cooking in a kitchen)

那個奶奶切胡蘿蔔 然後切 不小心切到手 然後呢 走走到前面拿藥擦 拿藥擦
然後 奶奶拿著ok繃 貼在手指頭上

AC	AI	IN	AB
----	----	----	----

- 老婆婆切(紅/胡)蘿蔔。

[illegible]

lǎo pó pó qiē (hóng/hú) luó bo

那個奶奶切胡蘿蔔

AC

- 老婆婆切到手/手指頭。

カハ'タ'タ' 一セ カハ'フ'フ'又'又'又'又'

lǎo pó pó **qiē** dào shǒu/shǒu zhǐ tóu

然後切 不小心切到手

AC

- 老婆婆的手/手指頭流血。

为么'文'文'文'文'尸又'尸又'生'去又'力一又'丁一世'

lǎo pó pó de shǒu/shǒu zhǐ tóu **liú xiě**

AB

- 老婆婆 從急救箱 拿出 ok繃/急救物品/藥。

为么'ㄉㄉ'ㄉㄉ' ㄘㄨㄥ'ㄩ'-'ㄩ'-又'ㄊ'-才 3Y'ㄨㄨ OKㄗㄥ'ㄩ'-'ㄩ'-又'ㄨ'ㄉ'-ㄗ'-'ㄨ'

lǎo pó pó cóng jí jiù xiāng **ná/ná chū** ok bēng/jí jiù wù pǐn/yào/yào pǐn

走走到前面拿藥擦 拿藥擦

AC

- 老婆婆貼ok繃。

为么'文'文'文' 去一世 OKㄣ

lǎo pó pó **tiē** ok bēng

The old lady is **dressing** the wound.

老婆婆包紮傷口。

为么'文'文' 48 PY 尸尤 5又'

lǎo pó pó **bāo zā** shāng kǒu

奶奶拿著ok繃 貼在手指頭上

AC

AC	AI	IN	AB
----	----	----	----

Index 1, 2, 3, 4 –

Index 5 – Main concept score (MC) = (3×AC + 2×AI + 1×IN)

12

Index 6 – AC per minute =

12.12

Set 2 (waking up late for work)

Complete language sample:

小明可能鬧鐘“醒”了 發現自己睡過頭了 自己大聲的叫一聲 然後馬上去刷 刷牙
抹抹抹髮膠 然後發現來不及了趕快穿 穿褲子 然後發現可能真的遲到了 來不及
坐在那邊嘆氣 他又發現說 他的襪子穿穿錯了 一個一個黑一個白

Time = 0 min 34 sec = 0.57 minute

AC AI IN AB

1 The man **wakes up**

那位先生 起床/醒來。

ㄗㄩˋㄒㄩㄢˋㄊㄩㄥˋㄉㄨㄥˋ ㄑㄩㄥˋㄕㄨㄢˋㄗㄩㄥˋ

nà wèi xiān sheng qǐ chuáng/xǐng lái

AB

2 The man is **late/shocked**.

那位先生 遲到/睡過頭/驚訝。

ㄗㄩˋㄒㄩㄢˋㄊㄩㄥˋㄉㄨㄥˋ ㄔㄧˊㄉㄠˋ/ㄕㄨㄟˋㄍㄨㄠˋㄊㄨㄥˋ/ㄐㄧˊㄩˋ

nà wèi xiān sheng chí dào/shuì guò tóu/jīng yà

發現自己睡過頭了 自己大聲的叫一聲

AC

3 The man is **brushing** his teeth.

那位先生 刷牙。

ㄗㄩˋㄒㄩㄢˋㄊㄩㄥˋㄉㄨㄥˋ ㄕㄨㄚˋㄩㄚˊ

nà wèi xiān sheng shuā yá

然後馬上去刷 刷牙

AC

4 The man is **combing** his hair.

那位先生 梳/整理頭髮。

ㄗㄩˋㄒㄩㄢˋㄊㄩㄥˋㄉㄨㄥˋ ㄕㄨㄥˋㄕㄨˊㄌㄩˊㄆㄨˊ

nà wèi xiān sheng shū/zhěng lǐ tóu fǎ

抹抹抹髮膠

IN

5 The man is **putting on** his clothes/pants.

那位先生 換/穿上衣服/褲子。

ㄗㄩˋㄒㄩㄢˋㄊㄩㄥˋㄉㄨㄥˋ ㄏㄨㄢˋ/ㄕㄨㄢˋㄕㄨㄢˋㄕㄨㄢˋ

nà wèi xiān sheng huàn/chuān shàng yī fú/ kù zi

然後發現來不及了趕快穿 穿褲子

AC

6 The man is **wearing** a pair of socks that are **wrong/different** in color.

那位先生 穿 錯/不同顏色的襪子。

ㄗㄩˋㄒㄩㄢˋㄊㄩㄥˋㄉㄨㄥˋ ㄕㄨㄢˋ ㄘㄨㄛˋㄕㄨㄛˋㄕㄨㄛˋㄕㄨㄛˋ

nà wèi xiān sheng chuān cuò/bù tóng yán sè de wà zi

The man **found** the pair of socks are **different** in color.

那位先生 發現 襪子 顏色不一樣/不同。

ㄋㄚˋ ㄨㄟˋ ㄒㄧㄢˊ ㄕㄨㄥ ㄈㄚˋ ㄒㄩㄢˊ ㄨㄚˋ ㄗㄧˊ ㄧㄢˊ ㄙㄜˋ ㄅㄨˋ ㄧˊ ㄧㄤˊ/ㄅㄨˋ ㄊㄨㄥˊ

nà wèi xiān sheng fā xiàn wà zi yán sè bù yí yang/bù tóng

他又發現說 他的襪子穿穿錯了 一個一個黑一個白

AC

AC	AI	IN	AB
4	0	1	1
13			
7.01			

Index 1, 2, 3, 4 –

Index 5 – Main concept score (MC) = (3×AC + 2×AI + 1×IN)

Index 6 – AC per minute =

Set 3 (Buying ice-cream)

Complete language sample:

媽媽帶著小黃 小黃開心的看到店裡的 到冰淇淋店看到冰淇淋 然後媽媽拿著
一張 一張現 一張紙 一張現 一張紙 小黃開心的 說要哪個 要哪種冰淇淋
然後店員拿了兩球冰淇淋給她 然後小黃不小心把冰淇淋球掉了 掉在地上
然後店員看到 很緊張的 / 然後店員就好心的拿了一球冰淇淋拿給小黃
小黃開心的笑了

Time = 0 min 43 sec = 0.72 minute

AC	AI	IN	AB
----	----	----	----

- 1 The mother and the girl are **buying** ice creams.

媽媽和妹妹 買 冰淇淋/甜筒。

ㄇㄚˊ ㄇㄚˊ ㄒㄩㄢˊ ㄇㄟˊ ㄇㄟˊ ㄇㄟˊ ㄅㄩㄞˊ ㄅㄩㄞˊ ㄅㄩㄞˊ ㄅㄩㄞˊ ㄅㄩㄞˊ ㄅㄩㄞˊ

mā ma hàn mèi mei mǎi bīng qílín/tián tǒng

媽媽帶著小黃 小黃開心的看到店裡的
到冰淇淋店看到冰淇淋

AI

- 2 The mother is **paying**.

媽媽 付/拿錢。

ㄇㄚˊ ㄇㄚˊ ㄈㄨˋ/ㄋㄚˊ ㄑㄧㄢˊ

mā ma fù/ná qián

然後媽媽拿著 一張 一張現 一張紙 一張現 一張紙

IN

- 3 The man is **scooping/taking** an ice-cream cone.

老闆 挖/拿 冰淇淋/甜筒。

ㄌㄠˊ ㄅㄢˊ ㄨㄚˊ/ㄋㄚˊ ㄅㄩㄞˊ ㄅㄩㄞˊ ㄅㄩㄞˊ ㄅㄩㄞˊ ㄅㄩㄞˊ ㄅㄩㄞˊ

lǎo bǎn wā/ná bīng qílín/tián tǒng

AB

- 4 The ice cream **dropped** on the floor.

冰淇淋 掉在 地上。

ㄅㄩㄞˊ ㄅㄩㄞˊ ㄉㄩㄞˊ ㄗㄞˋ ㄉㄧˋ ㄕㄨㄤˊ

bīng qílín diào zài dì shàng

然後小黃不小心把冰淇淋球掉了 掉在地上

AC

- 5 The girl is **sad/crying**.

妹妹 難過/在哭。

ㄇㄟˊ ㄇㄟˊ ㄋㄢˊ ㄍㄨㄛˊ/ㄗㄞˋ ㄕㄨˊ

mèi mei nán guò/zài kū

				AB				
6	The <u>man</u> <u>sees</u> the incident. 老闆 看到/發現。 ㄌㄠˇ ㄅㄢˋ ㄕㄢˋ ㄉㄠˋ / ㄈㄚˋ ㄒㄩㄢˋ <u>lǎo bān kàn dào/fā xiàn</u> 然後店員看到				AC			
7	The <u>man</u> <u>gives</u> the <u>girl</u> an <u>ice-cream</u> . 老闆 給 妹妹 冰淇淋/甜筒。 ㄌㄠˇ ㄅㄢˋ ㄍㄟ ㄒㄩㄞˋ ㄆㄥˊ ㄩˇ / ㄇㄟˋ ㄇㄟˋ / ㄒㄩㄞˋ ㄆㄥˊ ㄩˇ / ㄉㄢˊ ㄅㄧㄥˊ ㄑㄩˊ ㄌㄩˊ ㄒㄩㄢˋ / ㄊㄩㄥˊ <u>lǎo bān gěi xiǎo péng yǒu/mèi mei/xiǎo mèi mei/tā bīng qí lín/tián tong</u> 老闆 拿/送 冰淇淋/甜筒 給 妹妹。 ㄌㄠˇ ㄅㄢˋ ㄋㄚˊ / ㄙㄨㄥˋ ㄅㄧㄥˊ ㄑㄩˊ ㄌㄩˊ ㄒㄩㄢˋ / ㄉㄢˊ ㄅㄧㄥˊ ㄑㄩˊ ㄌㄩˊ ㄒㄩㄢˋ / ㄊㄢˊ <u>lǎo bān ná/sòng bīng qí lín/tián tǒng gěi xiǎo péng yǒu/mèi mei/xiǎo mèi mei/tā</u> 然後店員就好心的拿了一球冰淇淋拿給小黃				AC			
8	The <u>girl</u> is <u>smiling/happy/ not crying</u> . 妹妹 笑了/開心/不哭了。 ㄇㄟˋ ㄇㄟˋ ㄒㄩㄞˋ ㄌㄠˊ / ㄕㄢˊ ㄒㄩㄢˋ / ㄅㄨˋ ㄕㄩˋ ㄌㄠˊ <u>mèi mei xiào le/kāi xīn/bù kū le</u> 小黃開心的笑了				AC			

	AC	AI	IN	AB
Index 1, 2, 3, 4 –	4	1	1	2
Index 5 – Main concept score (MC) = (3×AC + 2×AI + 1×IN)	15			
Index 6 – AC per minute =	5.56			

	看到一位 看到一位 老先生 提著水果		AI		
3	The <u>grocery bag</u> is broken . 袋子/手提袋/提袋 破 掉了。 ㄉㄞˋ ㄗㄩˋ ㄕㄞˊ ㄅㄞˋ ㄉㄞˋ ㄅㄞˋ ㄉㄞˋ ㄅㄞˋ ㄉㄞˋ dài zi/shǒu tí dài/tí dài pò diào le				AB
4	The <u>fruits/oranges</u> fall on the floor. 水果/橘子 掉 了/出來。 ㄕㄨㄟˋ ㄍㄨㄛˊ ㄉㄞˋ ㄌㄞˊ ㄉㄞˋ ㄌㄞˊ ㄉㄞˋ ㄌㄞˊ ㄌㄞˊ shuǐ guǒ/jú zi diào le/chū lái 然後老先生水果掉了	AC			
5	The boy sees the incident. 小朋友 看 到。 ㄒㄩㄞˊ ㄆㄥˊ ㄩˊ ㄕㄞˊ ㄌㄞˊ ㄌㄞˊ xiǎo péng yǒu kàn dào 爺爺的孫子看到 往後轉看到了	AC			
6	The boy is picking up the <u>fruits/oranges</u> . 小朋友 撿 水果/橘子。 ㄒㄩㄞˊ ㄆㄥˊ ㄩˊ ㄕㄞˊ ㄌㄞˊ ㄌㄞˊ ㄕㄞˊ ㄌㄞˊ ㄌㄞˊ xiǎo péng yǒu jiǎn shuǐ guǒ/jú zi The boy is helping (the old man) to pick up the <u>fruits/oranges</u> . 小朋友 幫 老爺爺撿水果/橘子。 ㄒㄩㄞˊ ㄆㄥˊ ㄩˊ ㄕㄞˊ ㄌㄞˊ ㄌㄞˊ ㄕㄞˊ ㄌㄞˊ ㄌㄞˊ xiǎo péng yǒu bāng lǎo yé ye jiǎn shuǐ guǒ/jú zi 然後爺爺的孫子就好心的幫 幫 幫 幫老先生撿撿橘子	AC			
7	The old man praises the boy. 老爺爺 稱讚/誇獎 小朋友。 ㄌㄞˊ ㄕㄞˊ ㄌㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ lǎo yé ye chēng zàn/kuā jiǎng xiǎo péng yǒu 然後老先生對著爺爺的孫子說按大拇指說讚	AC			

	Index 1, 2, 3, 4 –	AC	AI	IN	AB
		4	2	0	1
	Index 5 – Main concept score (MC) = (3×AC + 2×AI + 1×IN)	16			
	Index 6 – AC per minute =	5.12			

Example 2 (PWA)

Taiwanese Mandarin Main Concept Analysis

TM-MCA Scoring Form

Name:	<u>XTC</u>	Speech therapist:	<u>Chun-Chih Yeh</u>
Date of birth/Age:	<u>02/01/54 ; 58y/o</u>	Date of testing (CCAT):	<u>12/28/12</u>
Gender:	<u>F</u>	CCAT average score:	<u>8.48</u>
Date of onset:	<u>11/21/2008</u>	Aphasia severity:	<u>Moderate</u>
Etiology:	<u>CVA</u>	Date of testing (MC):	<u>12/28/12</u>

Remarks: N/A

Summary of TM-MCA

	AC	AI	IN	AB	MC	Time in minute	AC/min
<i>Set 1</i> <i>Cooking in a kitchen</i>	0	1	3	1	5	0.40	0.00
<i>Set 2</i> <i>Waking up late for work</i>	2	1	2	1	10	0.67	2.99
<i>Set 3</i> <i>Buying ice-cream</i>	0	5	0	3	10	0.78	0.00
<i>Set 4</i> <i>Helping an old man</i>	0	3	1	3	7	1.20	0.00
Total	2	10	6	8	32	3.05	0.66

Introduction:

A subject's personal information and a summary score table are provided in the first page of this scoring form. From the next page to the last are used to analyze the Taiwanese Mandarin main concepts. The column at the beginning of each set is used to write the language sample as well as the total recording time. Under this column, the numbered main concepts and each score (AC, AI, IN, AB) are provided. Under each main concept, there is a dotted column used for writing the main concept that a subject produces, and for scoring at the right side. At the end of each set, there is a summary score table for all the main concept measures (AC, AI, IN, AB, MC and AC per minute). A total number of each score can be written in the column right next to the Index 1, 2, 3, 4. MC can be written in the column right next to the Index 5, and AC per minute can be written in the last column right next to the Index 6. Finally, these numbers can be converted to the summary of TM-MCA in the first page.

The main verb for each main concept is **bolded**. All the essential information is underlined.

Set 1 (Cooking in a kitchen)

Complete language sample:

她換褲子 / 不小心切斷了褲襪子 / 她換藥換錯 她 她就去拿藥 / 換換
她拿一個繃帶“著”著

Time = 0 min 24 sec = 0.40 minute

AC AI IN AB

- 1 The old lady **cuts** carrots

老婆婆 切 (紅/胡)蘿蔔。

ㄌㄠˊ ㄆㄛˊ ㄆㄛˊ ㄑㄧㄝ (ㄏㄨㄥˊ/ㄏㄨˊ) ㄌㄨㄛˊ ㄅㄛˊ

lǎo pó pó qiē (hóng/hú) luó bo

她換褲子

IN

- 2 The old lady **cuts** her finger

老婆婆 切到 手/手指頭。

ㄌㄠˊ ㄆㄛˊ ㄆㄛˊ ㄑㄧㄝ ㄉㄠˋ ㄕㄨˊ/ㄕㄨˊ ㄓㄩˊ ㄒㄜˊ ㄒㄜˊ

lǎo pó pó qiē dào shǒu/shǒu zhǐ tou

不小心切斷了褲襪子

IN

- 3 The old lady's finger is **bleeding**

老婆婆的手/手指頭 流血。

ㄌㄠˊ ㄆㄛˊ ㄆㄛˊ ㄕㄨˊ/ㄕㄨˊ ㄓㄩˊ ㄒㄜˊ ㄒㄜˊ ㄌㄧㄡˊ ㄒㄩㄝˊ

lǎo pó pó de shǒu/shǒu zhǐ tou liú xiě

AB

- 4 The old lady is **taking out** some **band-aid/bandages/medicine** from the first-aid kit.

老婆婆 從急救箱 拿出 繃帶/急救物品/藥。

ㄌㄠˊ ㄆㄛˊ ㄆㄛˊ ㄘㄨㄥ ㄐㄧˋ ㄐㄩˊ ㄒㄜˊ ㄒㄜˊ ㄋㄞˊ ㄆㄛˊ ㄆㄛˊ ㄑㄩˊ ㄒㄜˊ ㄒㄜˊ ㄌㄧㄡˊ ㄒㄩㄝˊ

lǎo pó pó cóng jíjiù xiāng ná/ná chū ok bēng/jí jiù wù pǐn/yào/yào pǐn

她換藥換錯 她 她就去拿藥

AI

- 5 The old lady is **sticking** a **band-aid**

老婆婆 貼 繃帶。

ㄌㄠˊ ㄆㄛˊ ㄆㄛˊ ㄊㄧㄝ ㄌㄧㄡˊ ㄒㄩㄝˊ

lǎo pó pó tiē ok bēng

The old lady is **dressing** the wound.

老婆婆 包紮 傷口。

ㄌㄠˊ ㄆㄛˊ ㄆㄛˊ ㄅㄠˊ ㄗㄚˊ ㄕㄨㄤ ㄎㄡˊ

lǎo pó pó bāo zā shāng kǒu

換換 她拿一個繃帶“著”著

IN

AC AI IN AB

Index 1, 2, 3, 4 –

0 1 3 1

Index 5 – Main concept score (MC) = (3×**AC** + 2×**AI** + 1×**IN**)

Index 6 – AC per minute =

3Y'X\T-3P₂CT-3'XY'P-3'G₂'G₂X'-一G₂'G₂X'G₂X'G₂X'

nà wèi xiān sheng fā xiàn wà zi yán sè bù yí yang/bù tóng

換錯了 很生氣換錯 很生氣啊 換成白的 黑

IN

Index 1, 2, 3, 4 –
Index 5 – Main concept score (MC) = (3×AC + 2×AI + 1×IN)
Index 6 – AC per minute =

AC	AI	IN	AB
2	1	2	1
10			
2.99			

Set 3 (Buying ice-cream)

Complete language sample:

她買 她要買一個甜筒 / 那個用給她 Probe: 她不要 她拿錢 她拿錢付給他 / 她 um
不小心 不小心弄掉了 / 他 他拿一個給她 Probe: 他換錯了 他不小心拿到
他拿給妹妹吃的時候 不小心拿錯了

Time = 0 min 47 sec = 0.78 minute

AC	AI	IN	AB
----	----	----	----

- 1 The mother and the girl are buying ice creams.

媽媽和妹妹 買 冰淇淋/甜筒。

ㄇㄚˊ ㄇㄚˊ ㄖ ㄅㄛ ㄇㄟ ㄇㄟ ㄇㄟ ㄅㄛ ㄅㄛ ㄅㄛ ㄅㄛ ㄅㄛ ㄅㄛ

mā ma hàn mèi mei mǎi bīng qílín/tián tǒng

她買 她要買一個甜筒

AI

- 2 The mother is paying.

媽媽 付/拿錢。

ㄇㄚˊ ㄇㄚˊ ㄈㄨˊ ㄋㄚˊ ㄑㄧㄢˊ

mā ma fù/ná qián

她拿錢 她拿錢付給他

AI

- 3 The man is scooping/taking an ice-cream cone.

老闆 挖/拿 冰淇淋/甜筒。

ㄌㄠˊ ㄅㄢ ㄨㄚˊ ㄋㄚˊ ㄅㄛ ㄅㄛ ㄅㄛ ㄅㄛ ㄅㄛ ㄅㄛ

lǎo bǎn wā/ná bīng qílín/tián tǒng

那個用給她

AI

- 4 The ice cream dropped on the floor.

冰淇淋 掉在 地上。

ㄅㄛ ㄅㄛ ㄅㄛ ㄅㄛ ㄅㄛ ㄆㄞˊ ㄓㄠˊ ㄕㄨㄛˊ

bīng qílín diào zài dì shàng

她 um 不小心 不小心弄掉了

AI

- 5 The girl is sad/crying.

妹妹 難過/在哭。

ㄇㄟ ㄇㄟ ㄋㄢˊ ㄍㄨㄛˋ ㄗㄞˋ ㄎㄨ

mèi mei nán guò/zài kū

AB

- 6 The man sees the incident.

老闆 看到/發現。

ㄌㄠˇ ㄅㄢˇ ㄎㄢˋ ㄉㄠˊ ㄈㄢˋ ㄒㄩㄢˋ

lǎo bǎn kàn dào/fā xiàn

				AB
--	--	--	--	----

- 7 The man gives the girl an ice-cream.

老闆 給 妹妹 冰淇淋/甜筒。

ㄌㄠˇ ㄅㄢˇ ㄍㄟˇ ㄒㄩㄞˇ ㄆㄥˊ ㄩˇ ㄇㄟˊ ㄇㄟˊ ㄇㄟˊ ㄊㄚˊ ㄅㄩㄥˊ ㄑㄩˊ ㄌㄩˊ ㄊㄩㄥˊ

lǎo bǎn gěi xiǎo péng yǒu/mèi mei/xiǎo mèi mei/tā bīng qílín/tián tong

老闆 拿/送 冰淇淋/甜筒 給 妹妹。

ㄌㄠˇ ㄅㄢˇ ㄋㄚˊ/ㄙㄨㄥˋ ㄅㄩㄥˊ ㄑㄩˊ ㄌㄩˊ ㄊㄩㄥˊ ㄍㄟˇ ㄒㄩㄞˇ ㄆㄥˊ ㄩˇ ㄇㄟˊ ㄇㄟˊ ㄇㄟˊ ㄊㄚˊ

lǎo bǎn ná/sòng bīng qílín/tián tong gěi xiǎo péng yǒu/mèi mei/xiǎo mèi mei/tā

他拿一個給她

		AI		
--	--	----	--	--

- 8 The girl is smiling/happy/ not crying.

妹妹 笑了/開心/不哭了。

ㄇㄟˊ ㄇㄟˊ ㄊㄚˊ ㄒㄩㄞˇ ㄌㄠˊ ㄒㄩㄞˇ ㄌㄠˊ ㄒㄩㄞˇ ㄌㄠˊ ㄒㄩㄞˇ

mèi mei xiào le/kāi xīn/bù kū le

				AB
--	--	--	--	----

Index 1, 2, 3, 4 –
Index 5 – Main concept score (MC) = (3×AC + 2×AI + 1×IN)
Index 6 – AC per minute =

AC	AI	IN	AB
0	5	0	3
10			
0.00			

Set 4 (Helping an old man)

Complete language sample:

他拿 他 他拿行李 / 他拿 ㄅㄢˇ ㄅㄢˇ ㄅㄢˇ 太多了 / 他很棒 Probe 他他拿了很多
他拿了很多啊 / 他經過他的時候 拿錯了 拿 拿太多了 掉了 / 他 他
他弄他幫他弄 / 然後很棒

Time = 1 min 12 sec = 1.20 minute

AC	AI	IN	AB
----	----	----	----

- 1 The father and the boy are walking on the street.

爸爸跟小朋友在 走路/去散步。

ㄅㄚˊ ㄅㄚˊ ㄍㄣ ㄒㄩㄞˇ ㄆㄥˊ ㄩˇ ㄇㄟˊ ㄇㄟˊ ㄇㄟˊ ㄊㄚˊ ㄅㄢˇ ㄅㄢˇ ㄅㄢˇ

bà ba gēn xiǎo péng yǒu zài zǒu lù/qù sàn bù

				AB
--	--	--	--	----

- 2 The old man is carrying a grocery bag.

老爺爺 提著 袋子/手提袋/提袋。

ㄌㄠˇ ㄧㄝˊ ㄧㄝˊ ㄊㄚˊ ㄊㄚˊ ㄊㄚˊ ㄊㄚˊ ㄊㄚˊ ㄊㄚˊ ㄊㄚˊ ㄊㄚˊ ㄊㄚˊ ㄊㄚˊ

lǎo yé ye tí zhe dài zi/shǒu tídài/tídài

他拿 他 他拿行李

		IN		
--	--	----	--	--

- 3 The grocery bag is broken.

袋子/手提袋/提袋 破掉了。

ㄉㄞˋ ㄗㄧˋ / ㄕㄡˋ ㄒㄩˋ ㄉㄞˋ ㄊㄧˋ ㄉㄞˋ ㄆㄛˋ ㄉㄞㄠˊ ㄌㄟˊ
dài zi/shǒu tí dài/tí dài pò diào le

				AB
--	--	--	--	----

- 4 The fruits/oranges **fall** on the floor.

水果/橘子 掉了/出來。

ㄕㄡˋ ㄒㄩˋ ㄉㄞㄠˊ ㄌㄟˊ ㄎㄞˋ ㄌㄞˊ ㄕㄞˊ ㄕㄞˊ

shuǐ guǒ/jú zi diào le/chū lái

他經過他的時候 拿錯了 拿 拿太多了 掉了

	AI			
--	----	--	--	--

- 5 The boy **sees** the incident.

小朋友 看到。

ㄊㄞˋ ㄒㄩˋ ㄌㄞˊ ㄕㄞˊ ㄕㄞˊ

xiǎo péng yǒu kàn dào

				AB
--	--	--	--	----

- 6 The boy is **picking up** the fruits/oranges.

小朋友 撿 水果/橘子。

ㄊㄞˋ ㄒㄩˋ ㄌㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ

xiǎo péng yǒu jiǎn shuǐ guǒ/jú zi

The boy is **helping** (the old man) to pick up the fruits/oranges.

小朋友 幫 老爺爺撿水果/橘子。

ㄊㄞˋ ㄒㄩˋ ㄌㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ

xiǎo péng yǒu bāng lǎo yé ye jiǎn shuǐ guǒ/jú zi

他 他 他弄他幫他弄

	AI			
--	----	--	--	--

- 7 The old man **praises** the boy.

老爺爺 稱讚/誇獎 小朋友。

ㄌㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ ㄕㄞˊ

lǎo yé ye chēng zàn/kuā jiǎng xiǎo péng yǒu

他很棒...然後很棒

	AI			
--	----	--	--	--

Index 1, 2, 3, 4 –
Index 5 – Main concept score (MC) = (3×AC + 2×AI + 1×IN)
Index 6 – AC per minute =

AC	AI	IN	AB
0	3	1	3
7			
0.00			

APPENDIX G:
RULES FOR IDENTIFICATION OF WORDS, I-WORDS, I-WORD
UNITS, CLOSED-CLASS FUNCTORS, OPEN-CLASS MORPHEMES,
AND ERRORS

I. Identification of words

A slash (/) is used to segment the words in the written language samples, followed by counting the total number of words. All of the words, including incorrect words, repeated words, the words self-corrected, irrelevant statement, digression, habitual statement, fragments that seems to be identifiable as broken-off words, paraphasia and neologistic words, are counted as words. However, a false start on a word that is eventually produced, hesitation noises, interjections, and intranscribable mumbles are excluded.

II. Identification of i-words

When an i-word is identified (with reference to Appendix B) for each picture set, this word is underlined. It is not necessary to produce exactly the same words as they are in the i-word table. That is, if a word is acceptable and comparable to an i-word listed in the table, it still can be underlined. When an examinee self-corrects an i-word, only consider the final spoken word(s) as an i-word if it is correct. However, if an examinee repeats the utterance instead of self-correction, select the best version to consider if an i-word exists. When an i-word is a semantic, phonological, and/or mixed paraphasia, it is not counted as a correct i-word but an error.

III. Identification of i-word units

After identifying all of the i-words, the utterances are segmented into phrases. Each phrase should only include one i-word. If a phrase contains more than one i-word, it needs to be further divided into smaller segments until only one i-word is included in a phrase. If a phrase contains some repeated words, only the best version is considered. If any errors (with reference to the following VI. Identification of errors section) or unacceptable words included in a phrase, they are crossed out. That is, only correct information is included in an i-word unit.

IV. Identification of closed-class functors

When a closed-class functor is identified, the item is circled (shown as a rectangular textbox in the current paper). Only correctly used closed-class functors are considered. The closed-class functors contain affixation, pronoun, numeral, classifier, adverb, preposition, conjunction, connective, particle, onomatopoeia, and interjection. The following table provides detailed examples of functors in Chinese (MacWhinney & Tardif, 2010; Teng, 1996; Yip & Don, 2004).

Closed-class functors			Examples
Affixations	Prefixes		<ul style="list-style-type: none"> 阿公 ā gōng “old man^a” 婆婆 lǎo pó pó “old lady” 小男孩 xiǎo nán hái “little boy”
	Suffixes		<ul style="list-style-type: none"> 刀子 dāo zi “knife^a” 前者 qián zhě “former^a” 他們 tā men “they/them^a”
Pronouns	Personals		<ul style="list-style-type: none"> 她在哭 tā zài kū “She is crying.” 他們去散步 tā men qù sǎn bù “They go for a walk.”
	Demonstratives	Person/Object	<ul style="list-style-type: none"> 這 zhè “this”/那 nà “that” (+數詞 numeral)(+量詞 classifier)(+名詞 noun) 這是老奶奶 zhè shì lǎo nǚ nai “This is an old lady.” 那袋水果 nà dài shuǐ guǒ “that bag of fruit”
		Place	<ul style="list-style-type: none"> 這裡有牛奶 zhè lǐ yǒu niú nǎi “Here is some milk.” 他在那裡穿衣服 tā zài nà lǐ chuān yī fu “He is wearing the clothes over there.”
		Time	<ul style="list-style-type: none"> 去年這時我在唸書 qù nián zhè shí wǒ zài niàn shū “I was studying last year this time.” 那時他太小了 nà shí tā tài xiǎo le “He was too young at that time.”
		Level/Manner	<ul style="list-style-type: none"> 你那麼的好 nǐ nà me de hǎo “This is so kind of you.” 這個字應該這麼唸 zhè ge zì yīng gāi zhè me niàn “This word should be pronounced in this way.”
	Interrogatives	Person/Object	<ul style="list-style-type: none"> 誰不去? shéi bú qù? “Who is not

			going?” <ul style="list-style-type: none">這是什麼? zhè shì shén me? “What is this?”哪天? nǎ tiān? “Which day?”
		Place	<ul style="list-style-type: none">她去哪裡? tā qù nǎ lǐ? “Where did she go?”
		Time	<ul style="list-style-type: none">哪天? nǎ tiān? “Which day?”她何時外出的? tā hé shí wài chū de? “When did she go out?”
		Manner/Status	<ul style="list-style-type: none">你怎麼來? nǐ zěn me lái? “How did you come here?”你怎樣了? nǐ zěn yàng le? “What is wrong with you?”
		Number	<ul style="list-style-type: none">冰淇淋多少錢? bīng qí lín duō shǎo qián? “How much is an ice cream?”幾點了? jǐ diǎn le? “What time is it?”
	Enumerative pronouns		<ul style="list-style-type: none">她買了一些水果，如梨子、橘子，等等 tā mǎi le yì xiē shuǐ guǒ rú lí zi jú zi děng děng “She bought some fruits, such as pears, oranges, etc.”
Numerals			<ul style="list-style-type: none">一袋橘子 yí dài jú zi “one bag of oranges”
Classifiers			<ul style="list-style-type: none">一位小男孩 yí wèi xiǎo nán hái “one little boy”
Adverbials	To represent time		<ul style="list-style-type: none">她在切蘿蔔 tā zài qiē luó bo “She is cutting the carrot.”男孩馬上幫他撿橘子 nán hái mǎ shàng bāng tā jiǎn jú zi “The boy helped him to pick up the oranges immediately.”
	To represent range		<ul style="list-style-type: none">他們都晚睡 tā men dōu wǎn shuì “They all sleep late.”她們一起外出 tā men yì qǐ wài chū “They head out together.”
	To represent repetition/frequency		<ul style="list-style-type: none">他再給她一球冰淇淋 tā zài gěi tā yì qiú bīng qí lín “He gave her a scope of ice cream again.”他經常睡過頭 tā jīng cháng shuì guò tóu “He often oversleeps.”
	To represent degree		<ul style="list-style-type: none">她非常高興 tā fēi cháng gāo xìng “She is very happy.”
	To represent mood		<ul style="list-style-type: none">他居然睡過頭 tā jū rán shuì guò tóu “He unexpectedly overslept.”
	To represent affirmation/negation		<ul style="list-style-type: none">他一定遲到 tā yí dìng chí dào “He must be late.”他沒有穿襪子 tā méi yǒu chuān wà zi

		“He does <u>not</u> wear socks.”
Prepositions	To represent space	<ul style="list-style-type: none"> 在廚房 <u>zài</u> chú fāng “<u>in</u> the kitchen” 從家裡來 <u>cóng</u> jiā lǐ lái “come <u>from</u> home” 通<u>向</u>那條馬路 <u>tōng</u> <u>xiàng</u> nà tiáo mǎ lù “pass <u>towards</u> that road”
	To represent time	<ul style="list-style-type: none"> 在煮菜的期間 <u>zài</u> zhǔ cài de qí jiān “<u>when</u> (someone) is cooking” 從早上 <u>cóng</u> zǎo shàng “<u>since</u> this morning”
	To represent agent	<ul style="list-style-type: none"> 她<u>給</u>我們介紹這人 tā <u>gěi</u> wǒ men jiè shào zhè rén “She introduced this person <u>to</u> us.” 她<u>把</u>蘿蔔切成片狀 tā <u>bǎ</u> luó bo qiē chéng piàn zhuàng “She cut the carrot into pieces.”^{a)}
	To represent basis	<ul style="list-style-type: none"> 根據統計 <u>gēn jù</u> tǒng jì “<u>based on</u> statistics” 以他的角度 <u>yǐ</u> tā de jiǎo dù “<u>from</u> his view”
	To represent cause	<ul style="list-style-type: none"> 音樂會被取消是<u>由於</u>下雨 yīn yuè huì bèi qǔ xiāo shì <u>yóu yú</u> xià yǔ “The concert was cancelled <u>because of</u> the rain.” <u>為了</u>讓她高興 <u>wèi le</u> ràng tā gāo xìng “<u>In order to</u> make her happy”
	To represent other aspect	<ul style="list-style-type: none"> 這裡<u>除了</u>我們沒有別人 zhè lǐ <u>chú le</u> wǒ men méi yǒu bié rén “There is no anyone here <u>except</u> us.”
Conjunctions		<ul style="list-style-type: none"> 媽媽<u>和</u>女兒 mā ma <u>hàn</u> nǚ ér “the mother <u>and</u> the daughter” 男孩<u>跟</u>爸爸 nán hái <u>gēn</u> bà ba “the boy <u>and</u> his father”
Connectives		<ul style="list-style-type: none"> <u>因為</u>妹妹在哭，老闆再給她一球冰淇淋 <u>yīn wèi</u> mèi mei zài kū lǎo bǎn zài gěi tā líng yì qiú bīng qí lín “<u>Because</u> she was crying, the boss gave her a scope of ice cream again.” 婆婆在切蘿蔔。<u>然後</u>不小心切到手指頭 pó po zài qiē luó bo <u>rán hòu</u> bù xiǎo xīn qiē dào shǒu zhǐ tóu “The old lady is cutting a carrot. <u>Then</u> she cuts her finger accidently.”
Particles	Structural particles	<ul style="list-style-type: none"> 她的冰淇淋 tā <u>de</u> bīng qí lín “her ice cream”^{a)}

		<ul style="list-style-type: none"> • 睡得很晚 shuì de hěn wǎn “sleep very late”^a • 他高興地說這件事 tā gāo xìng dì shuō zhè jiàn shì “he gladly said this thing.”
	Aspectual particles	<ul style="list-style-type: none"> • 她跳了一下 tā tiào le yí xià “She jumped.” • 他提著袋子 tā tí zhe dài zi “He is carrying a bag.” • 他們討論過這件事情 tā men tāo lùn guò zhè jiàn shì qing “They discussed this thing.”
	Sentence final particles	<ul style="list-style-type: none"> • 怎麼了呢 zěn me le ne “What’s wrong?”^a • 快點吧 kuài diǎn ba “Hurry up!”^a • 他會回來的 tā huì huí lái de “He will come back!”^a
Onomatopoeia		<ul style="list-style-type: none"> • 砰(槍聲) pēng [pēng] “Bang” • 叮咚(滴水聲) dīng dōng [dīng dōng] “drip drip”
Interjections		<ul style="list-style-type: none"> • 嗯，等一下 en děng yí xià [um], hold on.” • 哦，我懂了 ó wǒ dǒng le [oh], I got it.”

Notes: ^a: Lack of a counterpart in English that corresponds to the boxed Chinese character.

V. Identification of open-class morphemes

An open-class morpheme in an i-word unit is highlighted when identified. In an i-word unit, when closed-class factors have been identified, the remaining lexical items, except for the i-word, should be open-class morphemes. Note that morphemes, but not words, are counted. Most Chinese morphemes are monosyllabic and each morpheme is written with one character, though there are still exceptions (Wong, Li, Xu, & Zhang, 2009).

VI. Identification of errors

An error is crossed out when it is found. These errors can include phonemic, semantic, and/or mixed paraphasias, neologisms, and jargons.

**APPENDIX H:
TM-LCM SCORING FORM**

Taiwanese Mandarin Linguistic Communication Measure
TM-LCM Scoring Form

Name: _____
 Date of birth/Age: _____
 Gender: _____
 Date of onset: _____
 Etiology: _____

Speech therapist: _____
 Date of testing (CCAT): _____
 CCAT average score: _____
 Aphasia severity: _____
 Date of testing (LCM): _____

Remarks:

Summary of TM-LCM

	NW	i-word	ILE	minutes	ICE	errors	IEr
<i>Set 1</i> <i>Cooking in a kitchen</i>							
<i>Set 2</i> <i>Waking up late for work</i>							
<i>Set 3</i> <i>Buying ice-cream</i>							

Set 4 <i>Helping an old man</i>							
-------------------------------------------	--	--	--	--	--	--	--

Total							
--------------	--	--	--	--	--	--	--

Closed-class functors	IGS	Open-class morphemes	IEI
-----------------------	------------	----------------------	------------

Set 1 <i>Cooking in a kitchen</i>				
Set 2 <i>Waking up late for work</i>				
Set 3 <i>Buying ice-cream</i>				
Set 4 <i>Helping an old man</i>				

Total				
--------------	--	--	--	--

Introduction:

In the first page of the Scoring Form, a subject's personal information and a summary score table are provided. From the next page to the last, there are a total of eight tables for the four picture sets. Each set owns two tables, one for computing the number of words, i-words, ILE, ICE and IEr, and the other for carrying out IGS and IEI. In the first table, the language sample can be written under "Language Sample" which is at left side of the table. A slash is used to segment words, and an underline is used to recognize a word as an i-word. An error is crossed out. Then, number of words, i-words and errors for each column can be computed and written in the middle of the three columns. Any notes can be written under the Remarks at the right side of the table. Then, a total of the words, i-words, and errors can be calculated and written in the columns at the right side of "Total." The total recording time in minutes can be written, too. ILE, ICE and IEr then can be carried out and written in the last three columns, respectively. In the second table, the left-side columns are for writing i-word units. A rectangular border around a word is used for identifying a closed-class functor, and a highlighting is for an open-class morpheme. Once identifying closed-class functors and open-class morphemes, the number of closed-class functors and open-class morphemes can be written in the middle and right columns, respectively. IGS and IEI then can be calculated and written in the last two columns, respectively. Finally, all of the scores of the indices can be converted to the summary of TM-LCM in the first page.

Set 1 Cooking in a kitchen Language Sample	No. of words	No. of i- words	No. of errors	Remarks
Total				Minutes:
Index of Lexical Efficiency (ILE)				
Index of Communication Efficiency (ICE)				
Index of Error (IEr)				

i-word unit		No. of closed-class functors in an i-word unit	No. of open-class morphemes in an i-word unit
1			
2			
3			
4			
5			
6			
7			
8			
9			
Total			
Index of Grammatical Support (IGS)			
Index of Elaboration (IEl)			

Set 2 Waking up late for work Language Sample	No. of words	No. of i- words	No. of errors	Remarks
Total				Minutes:
Index of Lexical Efficiency (ILE)				
Index of Communication Efficiency (ICE)				
Index of Error (IEr)				

i-word unit		No. of closed-class functors in an i-word unit	No. of open-class morphemes in an i-word unit
1			
2			
3			
4			
5			
6			
7			
8			
9			
Total			
Index of Grammatical Support (IGS)			
Index of Elaboration (IEl)			

Set 3 Buying ice-cream Language Sample	No. of words	No. of i- words	No. of errors	Remarks
Total				Minutes:
Index of Lexical Efficiency (ILE)				
Index of Communication Efficiency (ICE)				
Index of Error (IEr)				

i-word unit		No. of closed-class functors in an i-word unit	No. of open-class morphemes in an i-word unit
1			
2			
3			
4			
5			
6			
7			
8			
9			
Total			
Index of Grammatical Support (IGS)			
Index of Elaboration (IEl)			

Set 4 Helping an old man Language Sample	No. of words	No. of i- words	No. of errors	Remarks
Total				Minutes:
Index of Lexical Efficiency (ILE)				
Index of Communication Efficiency (ICE)				
Index of Error (IEr)				

i-word unit		No. of closed-class functors in an i-word unit	No. of open-class morphemes in an i-word unit
1			
2			
3			
4			
5			
6			
7			
8			
9			
Total			
Index of Grammatical Support (IGS)			
Index of Elaboration (IEl)			

APPENDIX I:
TWO EXAMPLES OF THE TM-LCM SCORING FORM

Example 1 (Normal Speaker)

Taiwanese Mandarin Linguistic Communication Measure
TM-LCM Scoring Form

Name: STL
 Date of birth/Age: 02/11/89 ; 23 y/o
 Gender: F
 Date of onset: N/A
 Etiology: N/A

Speech therapist: Chun-Chih Yeh
 Date of testing (CCAT): 12/22/12
 CCAT average score: 12
 Aphasia severity: Within Normal
 Date of testing (LCM): 12/22/12

Remarks:

N/A

Summary of TM-LCM

	NW	i-word	ILE	minutes	ICE	errors	IEr
<i>Set 1</i> <i>Cooking in a kitchen</i>	30	11	2.73	0.22	50.00	0	0.00
<i>Set 2</i> <i>Waking up late for work</i>	69	17	4.06	0.45	37.78	0	0.00
<i>Set 3</i> <i>Buying ice-cream</i>	57	25	2.28	0.42	59.52	0	0.00

Set 4 <i>Helping an old man</i>	78	17	4.59	0.58	29.31	0	0.00
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Total	234	70	3.34	1.67	41.92	0	0.00
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Closed-class functors	IGS	Open-class morphemes	IEI
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Set 1 <i>Cooking in a kitchen</i>	14	1.27	8	0.73
Set 2 <i>Waking up late for work</i>	29	1.71	24	1.41
Set 3 <i>Buying ice-cream</i>	21	0.84	17	0.68
Set 4 <i>Helping an old man</i>	38	2.24	23	1.35

Total	102	1.46	72	1.03
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Introduction:

In the first page of the Scoring Form, a subject's personal information and a summary score table are provided. From the next page to the last, there are a total of eight tables for the four picture sets. Each set owns two tables, one for computing the number of words, i-words, ILE, ICE and IEr, and the other for carrying out IGS and IEI. In the first table, the language sample can be written under "Language Sample" which is at left side of the table. A slash is used to segment words, and an underline is used to recognize a word as an i-word. An error is crossed out. Then, number of words, i-words and errors for each column can be computed and written in the middle of the three columns. Any notes can be written under the Remarks at the right side of the table. Then, a total of the words, i-words, and errors can be calculated and written in the columns at the right side of "Total." The total recording time in minutes can be written, too. ILE, ICE and IEr then can be carried out and written in the last three columns, respectively. In the second table, the left-side columns are for writing i-word units. A rectangular border around a word is used for identifying a closed-class functor, and a highlighting is for an open-class morpheme. Once identifying closed-class functors and open-class morphemes, the number of closed-class functors and open-class morphemes can be written in the middle and right columns, respectively. IGS and IEI then can be calculated and written in the last two columns, respectively. Finally, all of the scores of the indices can be converted to the summary of TM-LCM in the first page.

Set 1 Cooking in a kitchen Language Sample	No. of words	No. of i-words	No. of errors	Remarks
有/一/位/老太太/在/做菜/時候	7	2	0	
不/小心/切到/自己/的/手	6	2	0	
然後/導致/流血	3	1	0	
所以/她/就/趕緊/到/醫藥箱/拿/拿/ok繃	9	4	0	Repetition
來/貼/自己/的/手	5	2	0	
Total	30	11	0	Minutes: 0.22
Index of Lexical Efficiency (ILE)	30/11=2.73			
Index of Communication Efficiency (ICE)	11/0.22=50.00			
Index of Error (IEr)	0/11=0.00			

i-word unit		No. of closed-class functors in an i-word unit	No. of open-class morphemes in an i-word unit
1	有/一/位/老太太	2	1
2	在/做菜/時候	1	2
3	不/小 心/切到	2	2
4	自己/的/手	2	0
5	然後/導 致/流血	1	2
6	所以/她/就/趕緊/到	4	0
7	醫藥箱	0	0
8	拿	0	0
9	ok繃	0	0
10	來/貼	0	1
11	自己/的/手	2	0
Total		14	8
Index of Grammatical Support (IGS)		14/11=1.27	
Index of Elaboration (IEI)		8/11=0.73	

Set 2 Waking up late for work Language Sample	No. of words	No. of i-words	No. of errors	Remarks
有/一/位/先生/有/一/天/早上/的/時候/突然/驚醒	12	2	0	
然後/他/發現/自己/已經/遲到了	6	1	0	
所以/他/就/趕快/去/廁所/刷牙/洗/臉	9	1	0	
然後/整理/頭髮	3	2	0	
然後/整理/完/之後	4	0	0	
他/趕緊/到/衣櫥/旁邊/換/衣服/穿/褲子	9	5	0	
然後/穿/完/準備/出門/的/時候	7	0	0	
在/穿/鞋子/的/時候	5	0	0	
才/發現/自己/的/襪子/穿/錯	7	4	0	
就/是/穿/一/黑/一/白	7	2	0	
Total	69	17	0	Minutes: 0.45
Index of Lexical Efficiency (ILE)	69/17=4.06			
Index of Communication Efficiency (ICE)	17/0.45=37.78			
Index of Error (IEr)	0/17=0.00			

i-word unit		No. of closed-class functors in an i-word unit	No. of open-class morphemes in an i-word unit
1	有/一/位/先生	2	1
2	有/一/天/早上/的/時候/突然/驚醒	4	5
3	然後/他/發現/自己/已經/遲到了	5	2
4	所以/他/就/趕快/去/廁所/刷牙/洗/臉	4	5
5	然後/整理	1	0
6	頭髮	0	0
7	整理/完/之後/他/趕緊/到	4	2
8	衣櫥/旁邊	0	2
9	換	0	0

10	衣服	0	0
11	穿/褲子	0	1
12	在/穿/鞋子/的/時/候/才/發現	4	4
13	自己/的/襪子	2	0
14	穿	0	0
15	錯	0	0
16	就/是/穿/一/黑	2	2
17	一/白	1	0
Total		29	24
Index of Grammatical Support (IGS)		29/17=1.71	
Index of Elaboration (IEI)		24/17=1.41	

Set 3 Buying ice-cream Language Sample	No. of words	No. of i-words	No. of errors	Remarks
有/一/對/母/女/到/冰淇淋店/買/冰淇淋	9	6	0	
然後/店員/就/開心/挖/冰淇淋/給/小妹妹	8	5	0	
那/媽媽/付/完/錢/之後	6	3	0	
走/出/外面/的/時候	5	0	0	
小妹妹/的/冰淇淋/不/小心/掉到/地上	7	4	0	
剛好/店員/探/頭/出來/有/看到	7	2	0	
所以/於是/他/又/給/小妹妹/補上/一/枝/冰淇淋	10	3	0	
所以/小妹妹/非常/的/開心	5	2	0	
Total	57	25	0	Minutes: 0.42
Index of Lexical Efficiency (ILE)	57/25=2.28			
Index of Communication Efficiency (ICE)	25/0.42=59.52			
Index of Error (IEr)	0/25=0.00			

i-word unit	No. of closed-class functors in an i-word unit	No. of open-class morphemes in an i-word unit
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1	有/一/對/母	2	1
2	女	0	0
3	到	0	0
4	冰淇淋店	0	0
5	買	0	0
6	冰淇淋	0	0
7	然後/店員	1	0
8	就/開/心/挖	1	2
9	冰淇淋	0	0
10	給	0	0
11	小妹妹	0	0
12	媽媽	0	0
13	付/完	1	0
14	錢/之後	1	0
15	走/出/外/面/的/時/候/小妹妹/的	2	6
16	冰淇淋	0	0
17	不/小/心/掉到	2	2
18	地上	0	0
19	剛好/店員	1	0
20	探/頭/出/來/有/看到	1	5
21	於是/他/又/給/小妹妹	4	0
22	補上	0	1
23	一/枝/冰淇淋	2	0
24	所以/小妹妹	1	0
25	非常/的/開心	2	0
Total		21	17
Index of Grammatical Support (IGS)		21/25=0.84	
Index of Elaboration (IEI)		17/25=0.68	

Set 4 Helping an old man Language Sample	No. of words	No. of i-words	No. of errors	Remarks
有/一/對/有/一/個/爺爺/跟/一/個/小孩	11	2	0	Self-correction
他們/一起/去/街上	4	0	0	
然後/跟/一/個/老先生/擦身而過	6	2	0	
然後/走了/幾/步/之後	5	0	0	
老先生/的/手/提/的/東西/掉/在/地上	9	3	0	
小朋友/剛好/回頭/有/看到	5	3	0	
然後/他/就/趕緊/跑/過來/幫/老先生/把/東西/全部/撿/起來	13	4	0	
後來/這/位/老先生/就/覺得/這/個/小朋友/很/乖/也/很/有/愛心	15	2	0	
所以/就/給/他/很/肯定/的/一/個/讚美	10	1	0	
Total	78	17	0	Minutes: 0.58
Index of Lexical Efficiency (ILE)	78/17=4.59			
Index of Communication Efficiency (ICE)	17/0.58=29.31			
Index of Error (IEr)	0/17=0.00			

i-word unit		No. of closed-class functors in an i-word unit	No. of open-class morphemes in an i-word unit
1	有/一/個/爺爺	2	1
2	跟/一/個/小孩	3	0
3	然後/跟/一/個/老先生	4	0
4	擦身而過	0	0
5	走了/幾/步/之後/老先生	4	1
6	手/提/的/東西	1	3
7	掉/在/地/上	1	2
8	小朋友	0	0
9	剛好/回頭	1	0
10	有/看到	1	1
11	然後/他/就/趕緊/跑/過來	4	1
12	幫	0	0

13	老先生	0	0
14	把/東西/全部/撿/起來	1	6
15	後來/這/位/老先生	3	0
16	就/覺得/這/個/小朋友/很/乖/也/很/有/愛心	6	5
17	所以/就/給/他/很/肯定/的/一個/讚美	7	3
Total		38	23
Index of Grammatical Support (IGS)		38/17=2.24	
Index of Elaboration (IEL)		22/17=1.35	

Example 2 (PWA)

Taiwanese Mandarin Linguistic Communication Measure
TM-LCM Scoring Form

Name: XTC
 Date of birth/Age: 02/01/54 ; 58y/o
 Gender: F
 Date of onset: 11/21/08
 Etiology: CVA

Speech therapist: Chun-Chih Yeh
 Date of testing (CCAT): 12/28/12
 CCAT average score: 8.48
 Aphasia severity: Moderate
 Date of testing (LCM): 12/28/12

Remarks:

N/A

Summary of TM-LCM

	NW	i-word	ILE	minutes	ICE	errors	IEr
<i>Set 1</i> <i>Cooking in a kitchen</i>	28	6	4.67	0.40	15.00	11	1.83
<i>Set 2</i> <i>Waking up late for work</i>	28	9	3.11	0.67	13.43	5	0.56
<i>Set 3</i> <i>Buying ice-cream</i>	56	10	5.60	0.78	12.82	4	0.40

Set 4 <i>Helping an old man</i>	48	3	16.00	1.20	2.50	2	0.67
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Total	160	28	5.71	3.05	9.18	22	0.79
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Closed-class functors	IGS	Open-class morphemes	IEI
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Set 1 <i>Cooking in a kitchen</i>	6	1.00	2	0.33
Set 2 <i>Waking up late for work</i>	3	0.33	0	0.00
Set 3 <i>Buying ice-cream</i>	15	1.50	11	1.10
Set 4 <i>Helping an old man</i>	7	2.33	1	0.33

Total	31	1.11	14	0.50
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Introduction:

In the first page of the Scoring Form, a subject's personal information and a summary score table are provided. From the next page to the last, there are a total of eight tables for the four picture sets. Each set owns two tables, one for computing the number of words, i-words, ILE, ICE and IEr, and the other for carrying out IGS and IEI. In the first table, the language sample can be written under "Language Sample" which is at left side of the table. A slash is used to segment words, and an underline is used to recognize a word as an i-word. An error is crossed out. Then, number of words, i-words and errors for each column can be computed and written in the middle of the three columns. Any notes can be written under the Remarks at the right side of the table. Then, a total of the words, i-words, and errors can be calculated and written in the columns at the right side of "Total." The total recording time in minutes can be written, too. ILE, ICE and IEr then can be carried out and written in the last three columns, respectively. In the second table, the left-side columns are for writing i-word units. A rectangular border around a word is used for identifying a closed-class functor, and a highlighting is for an open-class morpheme. Once identifying closed-class functors and open-class morphemes, the number of closed-class functors and open-class morphemes can be written in the middle and right columns, respectively. IGS and IEI then can be calculated and written in the last two columns, respectively. Finally, all of the scores of the indices can be converted to the summary of TM-LCM in the first page.

Set 1 Cooking in a kitchen Language Sample	No. of words	No. of i-words	No. of errors	Remarks
她/換/褲子	3	0	2	Preservation
不/小心/切/斷了/褲 襪子	5	1	3	Preservation
她/換/藥/換/錯/她/她/就/去/拿/藥	11	3	3	Repetition
換/換/她/拿/一/個/繃帶/“著”/著	9	2	3	
Total	28	6	11	Minutes: 0.40
Index of Lexical Efficiency (ILE)	28/6=4.67			
Index of Communication Efficiency (ICE)	6/0.40=15.00			
Index of Error (IEr)	11/6=1.83			

i-word unit		No. of closed-class functors in an i-word unit	No. of open-class morphemes in an i-word unit
1	不/小 心/切	1	2
2	她/就/去	2	0
3	拿	0	0
4	藥	0	0
5	她/拿	1	0
6	一/個/繃帶	2	0
Total		6	2
Index of Grammatical Support (IGS)		6/6=1.00	
Index of Elaboration (IEI)		2/6=0.33	

Set 2 Waking up late for work Language Sample	No. of words	No. of i-words	No. of errors	Remarks
已經/晚了	2	1	0	
還/有/起來/刮/鬍子	5	1	2	
換/褲子	2	0	0	

很/生氣	2	0	0	
梳/頭髮	2	2	0	
換/褲子	2	2	0	
換/錯了/很/生氣/換/錯	6	1	2	
很/生氣/啊/換成/白/的/黑	7	2	1	
Total	28	9	5	Minutes: 0.67
Index of Lexical Efficiency (ILE)	28/9=3.11			
Index of Communication Efficiency (ICE)	9/0.67=13.43			
Index of Error (IEr)	5/9=0.56			

i-word unit		No. of closed-class functors in an i-word unit	No. of open-class morphemes in an i-word unit
1	已經/晚了	2	0
2	起來	0	0
3	梳	0	0
4	頭髮	0	0
5	換	0	0
6	褲子	0	0
7	錯	0	0
8	白/的	1	0
9	黑	0	0
Total		3	0
Index of Grammatical Support (IGS)		3/9=0.33	
Index of Elaboration (IEI)		0/9=0.00	

Set 3 Buying ice-cream Language Sample	No. of words	No. of i- words	No. of errors	Remarks
她/買/她/要/買/一/個/甜筒	8	2	0	Clarification by addition
那個/用/給/她	5	2	0	

她/不要/她/拿/錢/她/拿/錢/付/給/他	11	2	1	Repetition
她/m~不/小心/不/小心/弄/掉了	7	1	0	Repetition
他/他/拿/一/個/給/她	7	1	0	
他/換/錯了/他/不/小心/拿到/他/拿/給/妹妹/吃/的/時候/不/小心/拿/錯了	18	2	3	Self-correction
Total	56	10	4	Minutes: 0.78
Index of Lexical Efficiency (ILE)	56/10=5.60			
Index of Communication Efficiency (ICE)	10/0.78=12.82			
Index of Error (IEr)	4/10=0.40			

i-word unit		No. of closed-class functors in an i-word unit	No. of open-class morphemes in an i-word unit
1	她/要/買	1	1
2	一/個/甜筒	2	0
3	用	0	0
4	給/她	1	0
5	她/拿/錢	1	1
6	付/給/他	1	1
7	她/不/小 心/弄/掉了	3	3
8	他/拿/一/個/給/她	4	1
9	他/拿/給	1	1
10	妹妹/吃/的/時 候	1	3
Total		15	11
Index of Grammatical Support (IGS)		15/10=1.50	
Index of Elaboration (IEl)		11/10=1.10	

Set 4 Helping an old man Language Sample	No. of words	No. of i-words	No. of errors	Remarks
他/拿/他/他/拿/行李	6	0	1	Repetition

他/拿/ちㄅㄣ/ㄅㄣ/太/多了	6	0	0	
他/很/棒	3	0	0	
他/他/拿了/很/多/他/拿了/很/多/啊	10	1	0	Repetition
他/經過/他/的/時候/拿/錯了/拿/拿/太/多了/掉了	12	1	1	
他/他/他/弄/他/幫/他/弄	8	1	0	
然後/很/棒	3	0	0	
Total	48	3	2	Minutes: 1.20
Index of Lexical Efficiency (ILE)	48/3=16.00			
Index of Communication Efficiency (ICE)	3/1.20=2.50			
Index of Error (IEr)	2/3=0.67			

i-word unit		No. of closed-class functors in an i-word unit	No. of open-class morphemes in an i-word unit
1	他/拿了/很/多/啊	4	1
2	掉了	1	0
3	他/幫/他	2	0
Total		7	1
Index of Grammatical Support (IGS)		7/3=2.33	
Index of Elaboration (IEl)		1/3=0.33	

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