A Case Study Of Narrative Production In Primary Progressive Aphasia; Implementation And Testing Of The Linguistic Communication Measure – Speech Sounds

by

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Thesis directed by Associate Professor Gail Ramsberger

ABSTRACT

This thesis is a longitudinal case study of the speech and language of a woman (BYR) with Primary Progressive Aphasia. The data analyzed are a series of Cookie Theft picture descriptions videotaped over the course of two years, two months. The Linguistic Communication Measure (Menn, Ramsberger & Helm-Estabrooks, 1994) and the Cantonese Linguistic Communication Measure (Kong and Law, 2004, CLCM) were previously used to analyze BYR's narratives. These measures captured semantic and morphosyntactic information about the narratives but did not quantify the prominent sound production deterioration in BYR's narrations. In order to capture all aspects of her speech and language deterioration during narration, a new measurement tool, the Linguistic Communication Measure - Speech Sounds (LCM-SS), was created.

The principal index of the LCM-SS, the Index of Sound Error (ISouE), was designed to quantify phonetic and phonological errors differently than existing measures. Existing sound error measures are problematic because they either conflate phonemic and semantic errors as 'paraphasic errors' (CLCM; Shewan, 1988, SSLA), require counting individual phoneme repetitions (SSLA), or rate articulation on a subjective scale (SSLA; Boston Diagnostic Aphasia Exam, Goodglass & Kaplan, 1993). ISouE is defined as number of sound errors plus number of words/phrases with repetitions, divided by number of content units. 'Sound errors' are phonemic paraphasias, attempts at words with incorrect sounds that are eventually produced, and identifiable broken off words ('cook jar' for 'cookie jar'). BYR's phonemic and phonetic errors are exceedingly difficult to tease apart, partly due to increased motor involvement as her PPA progressed, and the measure considers them both to be 'sound errors'.

The LCM-SS showed that semantic, morphosyntactic and phonetic/phonological elements of BYR's narratives changed over time. Lexical access appears to be negatively affected, but there is not a concurrent increase in semantic errors. Morphosyntactic richness of the narratives decreased, but the narratives did not become agrammatic and morphosyntactic errors remained low. Sound errors increased steadily over time indicating BYR had increasing impairment in phonetic/phonological aspects of production. The LCM-SS was tested for validity and reliability on BYR's narratives. Results showed a high negative correlation (-0.95) between ISouE and overall goodness ratings, and a high positive correlation (0.93) between the Index of Communication Efficiency and the overall ratings. Intra-coder reliability for the LCM-SS was high ($k = 0.97$).

The LCM-SS, incorporating the ISouE, is an objective, valid and reliable tool that successfully captures the degeneration in BYR's speech and language that was missed by earlier measures. The ISouE avoids the problems of distinguishing phonemic and phonetic sound errors and of counting the number of repetitions. It may prove to be useful for tracking sound production progress or deterioration in other people with aphasia after more rigorous testing.

Dedicated to my mother and her partner, Deon T. Hilger & Jerry Delaney,

to my sister, Kristin Hilger,

to my father and stepmother, Will Hilger & Susie Kons-Hilger,

and to my stepsister, Christina Kons.

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1. INTRODUCTION

This thesis is a longitudinal descriptive study of English language and English speech production change in BYR, a multilingual woman who had primary progressive aphasia. Primary progressive aphasia (PPA) was first recognized by Mesulam in 1982 (see also, Mesulam, 1987; Mesulam & Weintraub, 1992) and therefore has a relatively short history of study. Most research on multilingual people with aphasia has focused on acute onset forms of aphasia (e.g. from stroke or traumatic brain injury) with less attention given to the insidious onset variety (Filley et al., 2006). In fact, the PPA subtypes were only recently defined with both clinical and imaging criteria (Gorno-Tempini et al., 2011). This thesis adds to the PPA literature along with the concurrent work by Hilger, Kong, Ramsberger and Menn on how PPA affected BYR bilingually (English and Shanghainese were her primary languages). The case is also of interest because Shanghainese and English are linguistically very different, which may shed light on how language is differentially affected by PPA when the language systems are typologically dissimilar.

This study focuses on phonetic and phonemic aspects of PPA, which may be compromised in the logopenic variant[1] (see Gorno-Tempini, et al., 2011, for complete description of the three subtypes). BYR met the clinical and imaging criteria for logopenic PPA (Menn, Kong, Hilger, Ramsberger, and Yan, 2011; Hilger et al., 2011; Filley et al., 2006). As found in the videotaped interviews and formal testing, BYR's speech contained error patterns at the phonetic and/or phonemic level (Menn et al., 2011; Hilger et al., 2011). Her speech contained paraphasias and stuttering-like dysfluencies that impacted her communication ability but is not

[1] Gorno-Tempini et al (2011) characterize logopenic PPA with the presence of at least three of the following features: i) phonological errors, ii) spared single-word compre-hension, iii) absence of frank agrammaticism, iv) spared motor speech. BYR's speech and language reflects the first three and may or may not have spared motor speech.

captured by traditional communication measures, which focus on quantifying semantic and morphosyntactic[2] aspects of speech.

A quantitative tool was created, including a new type of phonetic/phonemic analysis, to comprehensively measure all aspects of speech and language deterioration over time in BYR's language samples. The Linguistic Communication Measure – Speech Sounds (LCM-SS), presented and tested in this thesis, is the result of combining and altering chosen measures from existing narrative measurement tools in order to capture semantic, syntactic and speech sound error impacts on expressive speech/language. Kong & Law (2004) make an important terminological caveat about their measure that is pertinent to the LCM-SS measure as well: "It should be noted that the [LCM-SS] is meant to document or evaluate the linguistic, rather than the communicative or social abilities of aphasic patients" (p. 126-7).

BYR described the Cookie Theft picture from the Boston Diagnostic Aphasia Exam (1983, BDAE) eight times in English over a 28-month period during formal speech and language testing. It was the most frequently produced narrative in English over the course of ten videotaped sessions. These narrations are analyzed diachronically with the LCM-SS to show how speech and language change over time.

The quantification methods from the following preexisting tools were adapted to create the LCM-SS. At its foundation is the original Linguistic Communication Measure (Menn, Ramsberger, and Helm-Estabrooks, 1994, LCM), which was designed to evaluate aphasic patients' progress or deterioration in the areas of semantics and morphosyntax. The Cantonese Linguistic Communication Measure (Kong, 2002; Kong & Law, 2004 & 2009) was adapted

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[2] Armstrong's (2000) review of literature on aphasic discourse analysis has no discussion of phonemic or phonological aspects of aphasia. She reviews "discourse" as defined in the formalist/structuralist perspective of the word, phrase and sentence and the functionalist perspective of discourse as language in use within a given context.

from the LCM for use on narratives by Cantonese speakers with aphasia and was normed on native Cantonese speakers. The Cantonese Linguistic Communication Measure is also an extension of the LCM because it has different calculation methods for several indices and it introduces new indices. The Cantonese Linguistic Communication Measure is important for the present study because of these extensions; it lays additional semantic and morphosyntactic groundwork for LCM-SS index calculations. For ease of reference it will be referred to from now on as the LCM-RC (Linguistic Communication Measure – Revised, Cantonese)[3]. Finally, measures from the Shewan Spontaneous Language Analysis (Shewan, 1988, SSLA) were adapted for and integrated into the LCM-SS in order to account for sound production errors (phonetic/phonemic errors, and stuttering-like speech) found in BYR's speech/language production.

This thesis also lays a framework, provided by the LCM-SS, with which BYR's spoken Shanghainese may be evaluated. As in English, BYR's narrative productions in Shanghainese contained errors at the phonetic and/or phonemic level (Menn et al., 2011; Hilger et al., 2011). Therefore, the narrative quantification indices proposed in the LCM-SS should capture important information about BYR's narrative productions in Shanghainese as well as English. In order to accomplish this the LCM-SS will need to be adapted for Shanghainese. The results of this thesis and of the future work on BYR's Shanghainese language and speech will be utilized in the larger project in which this researcher is involved, of comparing and contrasting how BYR's aphasia affected both languages.

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[3] In their publications, Kong and Law (Kong, 2002; Kong & Law, 2004 & 2009) refer to the Cantonese Linguistic Communication Measure as the CLCM however it is here referred to as the LCM-RC due to its application on BYR's English narratives based on the above references written in English.

1a. Purpose of the Study

This thesis has two purposes. The first is to describe language and speech change over time in BYR's narratives with quantitative language-oriented and speech-oriented measures. The language and speech areas investigated are semantics, morphosyntax and sound production errors (SPEs). The second purpose of this thesis is to develop a tool (the LCM-SS) to describe BYR's narrative productions in terms of semantics, morphosyntax and SPEs. The second purpose includes demonstrating this tool's reliability and validity. Intra-rater reliability is tested for all indices within the LCM-SS. Inter-rater reliability is not tested because the LCM-SS was developed specifically to measure BYR's narratives and is not, at this stage, suggested for general use. Construct validity is tested for the LCM-SS by comparing the indices with raters' judgments of the 'goodness' of BYR's narrations. There is no hypothesis about which LCM-SS index is the most valid based on correlation with listeners' perceptions. The LCM and LCM-RC are also tested for construct validity using the same methods, and the validity results from the three tools are compared. Listeners' perceptions are expected to align better with the LCM-SS indices than with the other measurements' indices.

1b. Scope of the Study

The research domains of this study are language and speech production, in particular, the language and speech errors produced by BYR while describing the Cookie Theft picture. Language is here defined as the use of syntax, morphology, phonology, semantics and pragmatics during verbal communication. The language errors important in this study fall in the domains of syntax, morphology, phonology and semantics; BYR's pragmatic abilities are intact (Filley et al., 2006). Speech encompasses the production aspects of phones and verbalizations,

including motor movement and coordination of the articulators in the vocal tract. Higher-level organization of the narrative is not included in this study.

The distinction between phonetic errors (considered to be an aspect of *speech*) and phonemic/phonological errors (considered to be an aspect of *language*) is not necessary for the purpose of this study because its goal does not include separating and labeling motor and linguistic deficits. In fact, this distinction is very difficult to make. Ash et al. (2010) concluded that errors in subjects with the non-fluent form of PPA were phonemic in nature; therefore, at the level of language processing, and not caused by motor planning impairment. On the contrary, Gorno-Tempini et al. (2011), list the core features of non-fluent PPA as agrammatism and "effortful, halting speech with inconsistent speech sound errors and distortions (apraxia of speech)" (p. 1009). In this study, errors of phonetic and/or phonemic quality are labeled "sound production errors" (SPEs).

SPEs occur in the forms of incorrect speech sound productions and stuttering-like dysfluencies. Words with incorrect speech sounds may result in either true words[4], such as "wish" for "fish," or non-words, such as "fauceth" for "faucet"[5] (3rd Transcription, Appendix D for transcriptions). Neologisms are counted as SPEs; an example from BYR's narrations is /duv/ (4th Transcription). BYR did not produce jargon. The stuttering-like dysfluencies highlighted in this study are repetitions of word-initial sounds such as "sh-short" (4th Transcription) and partial-word repetitions such as "ki-kids" (1st Transcription) and "dish-ishes" (5th Transcription).

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[4] SPEs that result in true words that are different from the target words are not attested to in BYR's narrations; example given was not produced by BYR.

[5] "Fauceth" is an example of a word that may be a distortion (i.e. a speech problem) or a phoneme substitution (i.e. a language problem). Categorization of the error is unnecessary for this study and so the error is labeled an SPE.

2. Background Section

2a. BYR and Her Language History

BYR was born and raised in Shanghai speaking the Shanghainese dialect; however she attended a boarding school where the primary language of instruction was British English. BYR also spoke Mandarin and Cantonese, although she was most proficient with English and Shanghainese as an adult. She went on to study music pedagogy in Ireland at age 17 and received a bachelor's degree in 1951, after which she taught music in Hong Kong for several years. She later worked as a Senior Stewardess for Hong Kong Airways, where she was required to have a conversational level of English for speaking with passengers. At the time of the video recordings (2005-2007) used in this study, BYR had been living in the U.S. approximately 40 years with her monolingual American husband. Positions she held in the U.S. included Legal Secretary and Executive Secretary. She was extremely proficient in English, although she partially retained her British accent. BYR continued to speak Shanghainese much less frequently than English, in particular on the phone with relatives. The following descriptions detail the linguistic and non-linguistic difficulties BYR faced due to PPA and neural degeneration.

BYR began experiencing word-finding problems (anomia) around age 70, in about 2000. BYR was diagnosed with PPA by a speech language pathologist in 2003 when she was 72 or 73 years old. She volunteered to be involved in a study on PPA and recruited Ramsberger and Menn to be the researchers. She met with Ramsberger, Menn and Wu[6] over the course of two and a half years and participated in 10 videotaped sessions during that time (from December, 2004, to May, 2007). Eight of these sessions included formal aphasia and apraxia testing in English and Shanghainese. BYR participated in and co-authored her case study report, "Primary Progressive

[6] Wu was the third researcher working with Ramsberger and Menn. She spoke Mandarin and Shanghainese.

Aphasia in a Bilingual Woman" (Filley et al., 2006), which describes the neurolinguistic, neurological and neuroimaging data that was collected subsequent to her PPA diagnosis.

Initial testing by Ramsberger, Menn and Wu (Filley et al., 2006) revealed word-finding pauses, "occasional articulatory awkwardness" (ibid., p. 297) and phonemic paraphasias in both English and Shanghainese. Because no weakness or discordination of the speech musculature was observed at that time, speech errors were classified as phonemic paraphasias and not as articulatory (i.e. speech) errors. BDAE baseline scores (ibid., p.298), which are designed to be a rating scale profile of aphasic speech characteristics, were similar in English and Shanghainese during initial testing (Figure 1, from Filley et al., 2006). Paraphasic errors and difficulties with

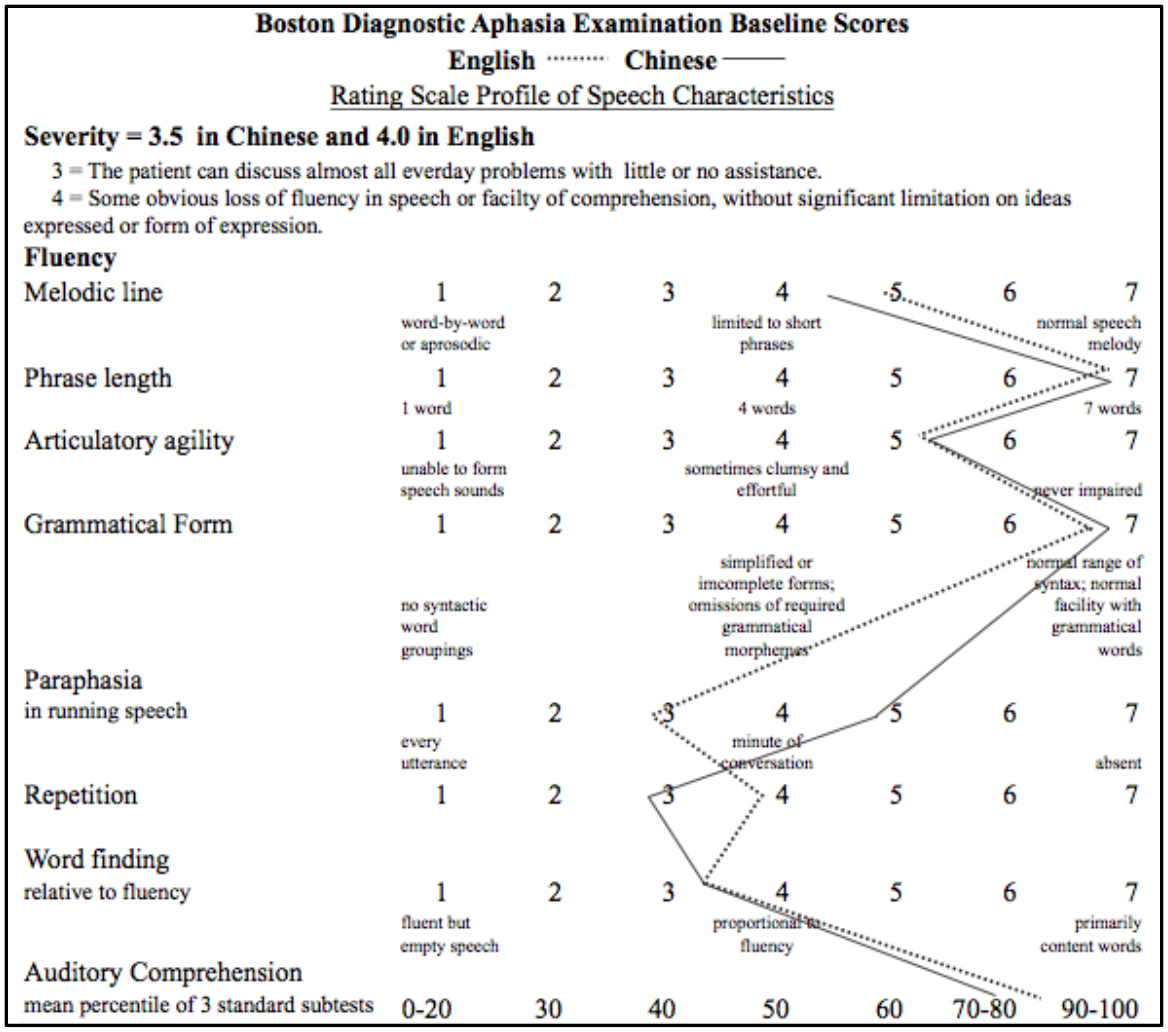

Figure 1: BDAE Baseline Scores for BYR (from Filley et al., 2006)

repetition and word finding were found to a moderate extent in both languages. Phrase length, grammatical form and auditory comprehension were relatively spared in both languages.

Repeated administration of the speech/language measures allowed for longitudinal analyses comparing and contrasting the deterioration of English and Shanghainese. Evaluation of a confrontational naming task performed during seven testing sessions in both English and Shanghainese showed comparable stability in both languages (Menn et al., 2011). BYR was tested on 45 items from the Boston Naming Test (Kaplan et al., 1983, BNT) in English, which were translated by Wu into Shanghainese. Overall, naming scores were better in English than Shanghainese, with English varying from about a 70% to 87% accuracy rate and Shanghainese varying from a 20% to 40% accuracy rate (Figures 2a and b, from Menn et al., 2011).

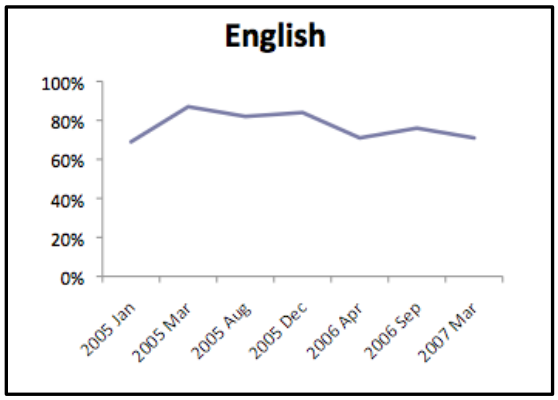

Figure 2a: English (Eng) BNT Scores*
*From Menn et al. (2011).

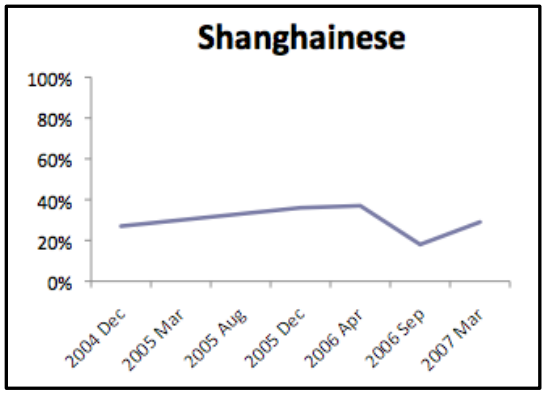

Figure 2b: Shanghainese (Sha) BNT Scores*

Additional evidence for similar language deterioration over time in English and Shanghainese comes from Hilger et al. (2011). A combination of the LCM and LCM-RC measurement tools were used to analyze seven Cookie Theft narratives in both languages[7]. Four measures show similar patterns in English and Shanghainese. The first, word production (total

[7] The Hilger et al. (2011) study combined indices from the LCM and LCM-RC and stayed faithful to neither tool in its entirety. The present study uses each index from each tool as defined by the tools' authors.

number of words produced in each narrative), remained constant in English and varied in Shanghainese but overall linear trends were similar (Figure 3a, from Hilger et al., 2011). The second, communication efficiency, is defined as the rate of content units or information units (discussed and defined in the Methods section) per minute. It had similar trends of decline for both languages (Figure 3b). Taken together these data shows that BYR continued to produced the same amount of words as her PPA progressed, but that either her narratives contained less information that correctly described the Cookie Theft scene, or the correct words took her longer to produce in later testing sessions.

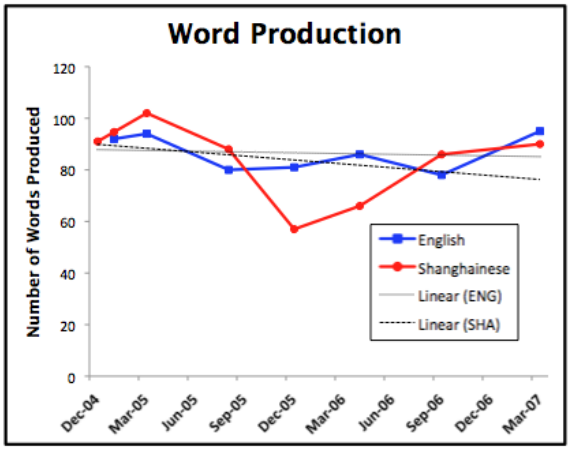

Figure 3a: Eng & Sha Cookie Theft Word Production*

*From Hilger et al. (2011).

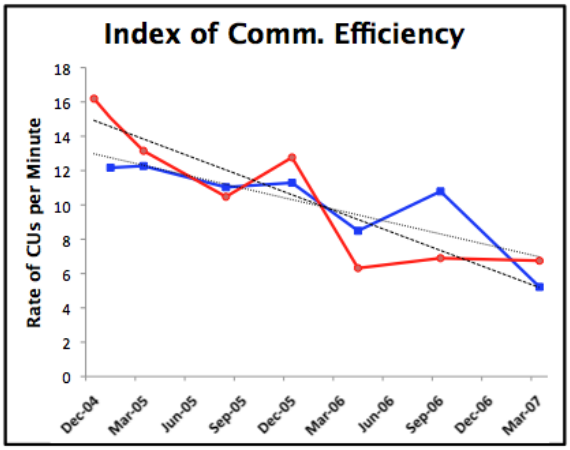

Figure 3b: Eng & Sha Cookie Theft Index of Communication Efficiency*

The decline seen in communication efficiency is similar to the decline in the grammatical richness of BYR's narratives. The Index of Grammatical Support (Figure 3c, IGS) shows that BYR's English narratives were more grammatically rich than her Shanghainese productions, but that they both declined at a similar rate. The IGS is defined as the number of closed-class words[8] and affixes per Content Unit. Hilger et al. (2011) explain that the difference in grammatical support between the languages is due to differences inherent in the languages' morphology, but

[8] Closed-class words are defined as pronouns, conjunctions, prepositions, interjections and articles.

that BYR did not become agrammatic in either language. Shanghainese contains little inflectional and derivational morphology (Kong and Law, 2004), and most words are one to two morphemes long, resulting in fewer opportunities to use morphemes that would be included in the index count. The fourth measure, Index of Error (IEr), is defined as jargons, neologisms, and phonemic and semantic paraphasias per content unit. The IEr increased similarly in both languages (Figure 3d). Because morphological and syntactic errors were not included in the IEr, differences between each language's morphosyntactic requirements did not influence the index outcomes. English requires the use of more grammatical morphemes than Shanghainese, such as obligatory affixes like tense, which results in greater opportunities for morphological errors in English. English and Shanghainese narratives contained similar rates of error as shown in the IEr over the course of the data collection period. This suggests that BYR's lexical productions had a similar amount of phonemic/phonological and semantic impairment in English and Shanghainese.

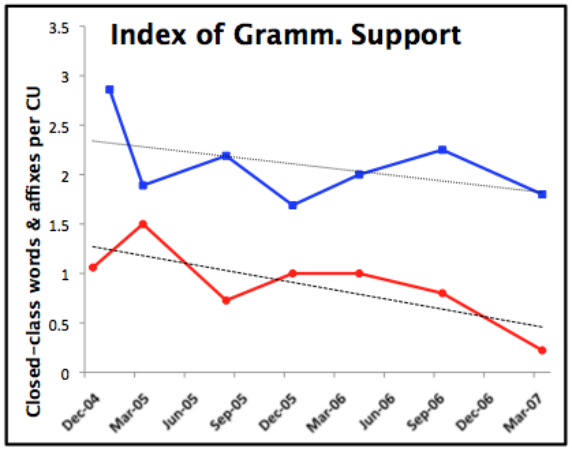

Figure 3c: Eng & Sha Cookie Theft Index of Grammatical Support

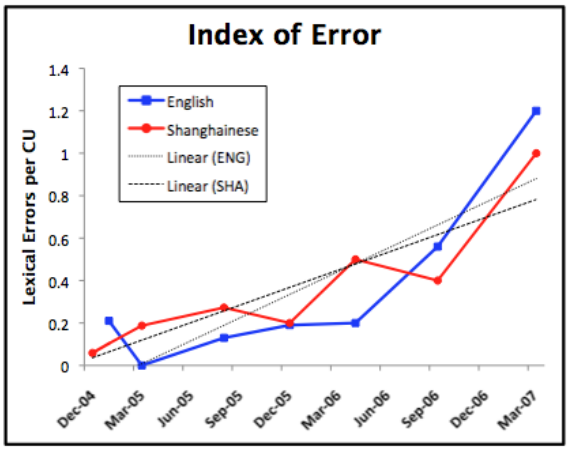

Figure 3d: Eng & Sha Cookie Theft Index of Error

Differences in language deterioration between English and Shanghainese occurred in three measures reported by Hilger et al. (2011). Production of content units (as defined by Yorkston & Beukelman, 1980) and the Index of Lexical Efficiency (number of words per content

unit) reflected deterioration in both languages but at different rates (Figures 4a and b). Number of content units produced declined slightly in English and then dropped sharply in the last session. Similarly, lexical efficiency remained stable in English until the last session when it worsened greatly. In Shanghainese, content units declined steeply at first and then stabilized whereas lexical efficiency gradually worsened over time. Overall, as content unit production declined in both languages, BYR became less efficient at expressing the content units she did produce, indicating an inverse relationship between the two measures. These measures also suggest that lexical retrieval declined first and more consistently in Shanghainese, while English remained fairly stable for about one and a half years.

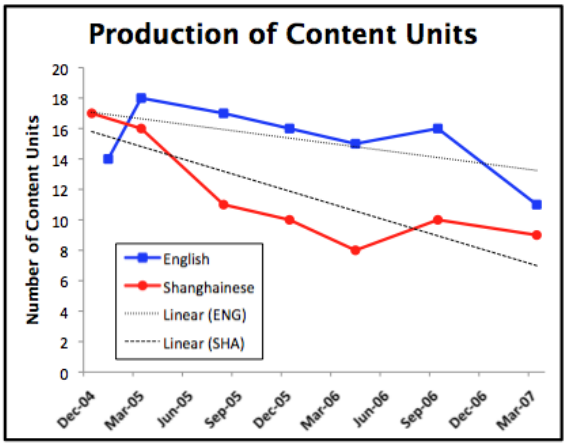

Figure 4a: Eng & Sha Cookie Theft Production of Content Units

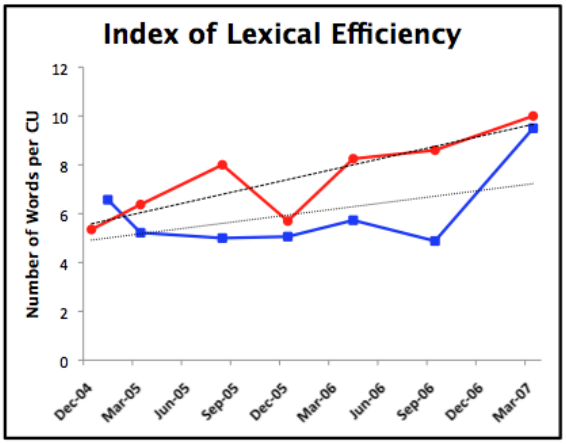

Figure 4b: Eng & Sha Cookie Theft Index of Lexical Efficiency

Finally, the Index of Elaboration shows differences in BYR's English and Shanghainese narratives inherent in structural distinctions between the languages (Figure 4c). The Index of Elaboration is defined as total stem morphemes or morphemes in compound words per content unit. The index was created by Kong (2002) in order to capture compounding, which is an extremely productive aspect of Cantonese morphology; compounds constitute the largest class of Cantonese words (Kong & Law, 2004) and compounding is also important in Shanghainese. BYR's use of compounding in Shanghainese fluctuated over time but there was an overall

downward trend. BYR used few English compounds. This index captures an important aspect of language decline in Shanghainese that appears irrelevant in English, which Hilger et al. (2011), state is a reminder that bilingual aphasia studies need measures that are appropriate to their languages' typologies.

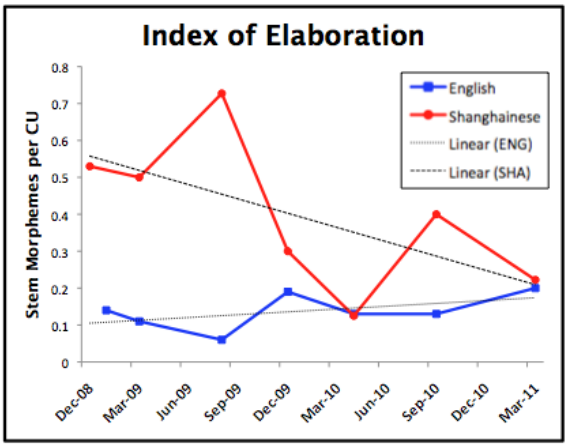

Figure 4c: Eng & Sha Cookie Theft Index of Elaboration

In addition to language difficulties at the time of her case study, BYR presented with increased comprehension problems and initial reading and writing difficulties. In September, 2006, BYR self-reported increased grammatical and spelling errors and frequent intrusion of Shanghainese words when she was speaking English. (Intrusion of Shanghainese words during conversation and testing in English did not occur while BYR was recorded in the video-taped testing sessions.) However, by 2006, BYR had not experienced personality change, memory loss, executive dysfunction, impaired object or face recognition, or visuospatial deficits (according to medical reports released by BYR). These deficits may be present in dementia, in particular memory impairment, but they are not present for at least two years after the initial language symptoms of PPA (Mesulam, 2001). And BYR remained physically active, walking and doing Tai Chi almost daily and gardening seasonally until the summer of 2006. In January, 2007, BYR presented with marked declines in cognition, including executive functioning skills, and in motor skills. By March, 2007, her language difficulties had progressed to non-fluent, global aphasia.

She was diagnosed with parkinsonism, which has similar motor deficits as found in Parkinson's Disease (including the cardinal signs of resting tremor, rigidity, bradykinesia and impaired postural reflexes). The difference between parkinsonism and Parkinson's Disease is that parkinsonism is associated causes such as dementia, multiple system atrophy, certain drugs, and cerebrovascular events (de Rijk et al., 1997). BYR's gross motor skills continued to decrease after this diagnosis. The cluster of her symptoms included declines in cognition, behavior, motor ability and language, which are manifestations of dysfunction in multiple fronto-subcortical brain systems. This is collectively called fronto-temporal lobar degeneration, or frontotemporal dementia. BYR died in September 2008.

2B. MULTILINGUALISM AND APHASIA

2B.I. WHAT IS BI/MULTILINGUALISM?

In defining bi- and multilingualism, few researchers have been as restrictive as requiring native-like receptive and productive capacity (possibly including reading and writing) in two or more languages (Grosjean, 1994). This strict definition would discount the vast majority of people who communicate in second and third languages at a level that is less than fluent. Other proposed definitions of bi- and multilingualism include: "the ability to produce meaningful utterances in two (or more) languages, the command of at least one language skill (reading, writing, speaking, listening) in another language, the alternate use of several languages, … people who use two (or more) languages (or dialects) in their everyday lives" (ibid., p. 1656). All of these definitions can be subsumed into the following broad definition: bi- and multilingual people are "individuals who know (and use) two or more languages" (Wong, 2006, p. 12). According to this definition, BYR was, at the very least, a bilingual English and Shanghainese

speaker. Cantonese and Mandarin were not tested during the sessions with Ramsberger, Menn and Wu, and it is unclear how much BYR spoke these languages during the latter part of her life which was spent in the U.S. It could be these were "dormant" languages. "Bilinguals who are no longer using their different languages but who have retained knowledge of them [are] termed 'dormant bilinguals'" (Grosjean, 1994, p. 1656). Whether they were dormant or not, Cantonese and Mandarin were part of BYR's linguistic history and may have had an influence on her language during her linguistic decline due to PPA.

2B.II. The Importance of Studying Bi/Multilingual People

Based on the broad definition above, there are more bilingual and multilingual speakers in the world than monolingual speakers (Tucker, 1999; Grosjean, 1994). As a direct consequence, the majority of people who have acquired speech and language disorders are also speakers of more than one language (Fabbro, 2001). In the U.S., one of the fastest growing segments of the population is speakers of more than one language. The number of elderly Americans is growing as well (Lorenzen & Murray, 2008). With an aging population comes increased incidences of acquired communication disorders. Given these facts, it is important to understand the factors that influence how multiple languages are processed and represented in the brain in order to determine how languages may be affected by trauma to the brain and by pathological neural degeneration. This, in turn, informs clinical practice of how best to assess and to treat the communicative and cognitive disorders associated with atypical brain changes. Examples of factors that have been shown to influence language storage in bilinguals are: premorbid language use, age of acquisition of the second language, proficiency of both languages, and level and medium of exposure to the second language (Wong, 2006). Therefore,

assessment and treatment of bi- and multilingual people with aphasia warrants different (or additional) considerations from those who are monolingual (Gitterman, Goral & Obler, 2012).

2B.I. Stroke Induced Aphasia in Bi/Multilingual People

The primary cause of aphasia is stroke (Lorenzen & Murray, 2008), and most literature on bi- and multilingual aphasia concerns individuals who have had a stroke (Filley et al., 2006). The two patterns of recovery from language impairments in bilingual people post-stroke are parallel recovery and non-parallel recover, which has several subtypes. It is possible that L1 (the first language learned) and L2 (the second language learned) can take either role in the non-parallel patterns. According to Wong (2006) and Gil and Goral (2004), the following patterns of recovery have been found in bilingual people.

- Parallel recovery: both languages improve at a comparable rate and to a comparable extent (e.g., Green, et al., 2010, looked at bilingual people).
- Selective recovery: only one language improves (e.g., Berthier, Starkstein, Lylyk, & Leiguarda (1990).
- Successive recovery: one language improves before the other (e.g., Halpern, 1941, in Paradis, 1983).
- Differential recovery: one language improves more than the other.
- Antagonistic recovery: one language improves but the other deteriorates (e.g., Paradis & Goldblum, 1989, present a multilingual speaker).
- Alternating antagonistic recovery: improvement and deterioration pattern of antagonistic recovery that alternates between the two languages over time, for example, one language is accessible and used on one day but only the other language is accessible on another day (e.g.,

Paradis, Goldblum & Abidi, 1982, report on a bilingual speaker; Nilipour & Ashayeri, 1989, report on a multilingual speaker).

- Paradoxical recovery: the bilingual recovers a ‘dormant’ or ‘dead’ language that the they knew premorbidly but was never used for ordinary communicative purposes (e.g. Grasset’s, 1884, case study written in French; for English translation see Mitchell, 1983).
- Blending recovery (unintentional language switching): bilingual speakers are unable to prevent switching between their two languages (e.g. Fabbro, Skrap & Aglioti, 2000; Perecman, 1984, presents a multilingual case study); this is different from purposeful code switching, or alternating between languages used in a conversation, which may be an important aspect of normal bilingual discourse (Heller, 1995).

It is unknown which patterns recovery will take based on imaging data about brain lesions and clinical assessment. The single greatest factor that influences the pattern of recovery is also unknown (Paradis, 1998). For example, it is not necessarily the case that the language spoken most proficiently premorbidly will be the one to recover first or best. It is also possible that the degree and type of linguistic impairments (e.g., morphologic, syntactic, semantic or phonological impairments) in bilinguals with aphasia may be reflected by the linguistic structures of the impaired languages (Wong, 2006). For example, a person who struggles with attaching morphological affixes during sentence production would have a harder time speaking syntactically correct German (which is morphologically richer than English) than morphologically-impoverished Cantonese (which does not have morphological affixes like German and English). Studying bi- and multilingual aphasia may also have consequences for theoretical understanding of aphasia categories. For example, a patient diagnosed with one aphasia type due to morphological impairment in one language may present with a different

aphasia type in another language because of the typological differences between the languages. Bi- and multilingual people with aphasia allow researchers to verify the boundaries of which aphasia types are truly different or the same across languages.

2C. Existing Communication Measures

The foundation of the LCM-SS, the Linguistic Communication Measure (Menn et al., 1994; LCM), was chosen for several reasons. First, the LCM provides means to quantitatively analyze the narratives, important for producing reliable within-client comparisons of linguistic productions useful for longitudinal data. Second, the LCM was specifically developed for both clinical and research use, bridging the gap between these two settings. The Cantonese Linguistic Communication Measure (Kong, 2002; Kong & Law, 2004 & 2009; "LCM-RC") also strives to bridge this gap. The Shewan Spontaneous Language Analysis (Shewan, 1988; SSLA) has numerous quantitative techniques for describing narrative samples; however it is too complex to be completed efficiently in clinical settings. Measures are adapted from the SSLA to capture speech sound errors in narratives that the LCM and LCM-RC do not capture.

The third reason for choosing the LCM is that it was designed for "tracking recovery *or decline* of the ability of *fluent and non-fluent* aphasic patients to produce oral narratives" (p. 343, emphasis added) at the phrasal level. Other communication measures do not discuss language deterioration or specifically indicate that they may be used in such cases as PPA. Although none of their subjects had PPA, Menn et al. (1994) analyzed longitudinal data in their study. Kong and Law (2009) did not have subjects with PPA either, but they showed that the LCM-RC is an appropriate tool for monitoring for narrative improvement in patients during the spontaneous recovery period after stroke and for those in the chronic stage who were receiving anomia

therapy. Like Menn et al. (1994), Kong and Law (2009) also had subjects on both sides of the fluency continuum.

Fourth, the LCM was designed for fluent and non-fluent aphasia types, which contrasts with other tools such as Quantitative Production Analysis (Saffran et al., 1989; QPA), created expressly for non-fluent aphasic language. The QPA was designed with the intent of differentiating agrammatic and non-agrammatic non-fluent aphasics. BYR's language had properties of fluent aphasia and BYR's fluency level changed over time; therefore the QPA might not capture important aspects of her speech and language. It is important to use a measure that captures information on both sides of the fluency continuum because BYR's variant of PPA, logopenic PPA, is described as defying the bifurcation of fluent and non-fluent aphasia (Gorno-Tempini et al., 2004). Fluency in aphasia is determined by various dimensions of speech production (Goodglass, 1993) and testing of logopenic PPA results in some dimensions being more fluent-like, some more non-fluent-like, and some landing between the two extremes (Wilson et al., 2010).

The LCM, LCM-RC and SSLA are described in detail below because the LCM-SS borrows directly from them. Also included is a review of narrative rating scales and methods for establishing construct validity.

2C.I. The Original Linguistic Communication Measure

The LCM, developed by Menn, Ramsberger and Helm-Estabrooks (1994), was created for evaluating aphasic narratives in clinical and research settings with a focus on ease of use and rapid scoring. In both arenas it may be used for pre-and post-treatment comparisons, tracking linguistic decline in PPA, and identifying aspects of narration that need remediation or support.

The results of the LCM "can provide quite comprehensive information on patients' verbal expressive ability, which are useful for collecting baseline performance and measuring changes in language performance" (Kong, 2002, p. 8). Menn et al. (1994) made the caveat that the LCM is an inappropriate measurement technique for individuals whose speech is highly unintelligible, and this is true for any tool that only measures spoken output. The LCM may be applied to any intelligible aphasic narrative, which makes it more versatile than Yorkston and Beukelman's (1980) quantification system that was specifically and uniquely designed for Cookie Theft narrations. In order to compare results across patients, normative data for the LCM must be developed for each specific stimulus picture. Normative data has not been published on the LCM for the Cookie Theft picture, but its methods may be used to evaluate for intra-subject change over time. Menn et al. (1994) present longitudinal data on a subset of their subjects; this data is discussed below in the evaluation of the LCM.

The LCM quantifies semantic and morphosyntactic aspects of aphasic narratives based on two indices calculated from four different measurements. Of the four basic measurement counts, the LCM-SS borrows total number of words and content units. Both indices are used in the LCM-SS; however the calculation for the morphosyntactic index is slightly different based on the critiques below. The basic LCM counts are:

1. *Total number of words*: includes word-like paraphasias and neologisms.
2. *Number of content units*: "the number of units or pieces of information supplied by the patient, counting only [the first use of] ones which correctly describe elements of the stimulus picture… 'Correct', for this purpose, means that the word would help the listener to

create [the appropriate] mental picture of the scene…" (Menn et al., 1994, p. 364)[9]. Content units may be single word length or phrase length.

3. *Number of correct words in content units*: Total number of contextually correct words contained in content units.
4. *Number of correct bound/contracted grammatical morphemes ('endings') in content units*: correct grammatical suffixes (e.g.: plural, past -*ed*, possessive -*'s*, etc.) and correct contracted grammatical elements (e.g.: negative -*n't*, verb forms endings -*'s*, -*'ll*, -*'re*, etc. as in "he's", "I'll", "we're") in content units.

Two indices are computed from these measures as follows:

1. *Index of Lexical Efficiency*: total words (1) per CU (2).
2. *Index of Grammatical Support*: add number of correct words in CUs (3) plus correct 'endings' in CUs (4), divide by number of CUs (2).

The LCM captures semantic components of a narrative with the total number of words and the Index of Lexical Efficiency (ILE), the amount and efficiency of information conveyed. They are indicators of the extent and type of word-finding difficulty. The two semantic "types" are people with aphasia who produce few to no function words (also referred to as closed-class words) and those who produce too many function words and/or too many uninformative words. This loosely corresponds to the non-fluent/fluent bifurcation. The lowest value possible is one, which would occur when every word produced is its own content unit. In this scenario, every word is informative and describes an element of the stimulus picture; this should correlate to an absence of function words and may be an indication that the narrator is too efficient at giving

[9] This definition allows for more possible CUs than Yorkston and Beukelman's (1980) quantification system which identified a set list of Cookie Theft content units based on the narrations of 78 normal speakers.

important information about a scene. The highest possible ILE is theoretically an infinite number; it is equal to the total number of words produced divided by total CUs. This could happen if only one CU is produced throughout the narration and all other words are function words or uninformative, or if more than one CU is produced but all other words are grammatically and semantically correct and are at least close enough phonemic productions to be understood. This would be an indication that the narrator is not efficient enough at conveying relevant information about a scene. If no content unit is present then the ILE cannot be calculated.

The ILE is a measure that cannot stand alone in differentiating semantic "types" based on function word production. There are no clear delineations in ILE scores based on this bifurcation of fluency; some non-fluent and fluent speakers with aphasia had ILE scores in the typical speakers' range. Additionally, statistics were not run on the data to capture standard deviation and variance for each group of speakers. This may have been due to relatively small sample sizes (non-fluent, n=13; fluent, n=17; borderline fluent, n=9). Menn et al. (ibid.) found that, longitudinally, ILE scores tended to decrease for fluent subjects and to increase or stay the same for non-fluent and mixed fluent subjects. The objective in using the ILE metric to evaluate BYR's narrations is to find how her score changes over time. It is not used to determine her fluency level or if she falls outside the normal ILE range. If her score stays the same, she will produce the same ratio of total words to CUs over time; however it is possible that her narratives would become more or less efficient (i.e., communicating the same amount of information in more or fewer words) over time.

The LCM captures morphosyntactic properties of a narrative with the Index of Grammatical Support (IGS); grammatical acceptability of the narrative is quantified by counts of

supporting words and grammatical endings. It is reported to be an indicator of grammatical richness and the correctness of narrations and it is also sensitive to morphological errors and omissions. An IGS value of 1.0 indicates an absence of grammatical support. If there are no bound grammatical morphemes in a narrative and only one correct word per content unit, the IGS will result in a value of 1.0. This indicates the speaker has severely impoverished morphology on words correctly describing the stimulus picture. It also indicates the speaker fails to produce supporting words that would increase the size of CUs from individual words to phrase-length. Examples of CUs produced by BYR that are one word in length and have no supporting words are: "mama", "dis-is" (dishes), and "water" (7th Transcription, Appendix D). In the same narration, BYR produced some phrase-length CUs: "the-the the the windows is open", "the children". The IGS will have a value greater than 1.0 when more than one contextually appropriate word and/or bound grammatical morpheme is used in at least one CU. An IGS greater than 1.0 indicates that the speaker produced at least some contextually correct words but it does not necessarily mean that morphology was present.

A critique of the LCM's IGS is that it conflates grammatical and semantic support. Based only on an IGS score that is greater than 1.0, it is impossible to know the ratio of contextually correct words in CUs to bound grammatical morphemes in CUs; both numbers are in the numerator of the IGS equation. Number of contextually correct words in CUs is a concept that includes syntactic and semantic phrasal elements; CUs often contain syntactically supporting words like 'the,' 'of,' 'is,' but they may also contain adjectives and adverbs. Statistics have not been run on the IGS in order to be able to infer the probability of bound grammatical morphemes being present at any particular IGS score. Therefore, it would be unknown whether bound grammatical morphemes are present in a narrative based on the IGS score alone. Research on

BYR's narrations is concerned with distinguishing grammatical morpheme use (morphosyntax) from semantics and the LCM's IGS does not allow for this separation. Therefore, the IGS calculation, modified by Kong and Law (2004) and described below, is borrowed and used in the LCM-SS.

A second critique is that it is unclear how the IGS scores are expected to change over time for a patient with any given aphasia type. Per Menn et al. (1994), "…its [the IGS's] principal value is in comparing changes in a single patient over time" (p. 351). However, the IGS longitudinal data is not interpreted in the LCM research article, and most IGS scores in the longitudinal data chart (Table 5, Ibid., p. 354) fall within the normal range.

The LCM's limitations also include not giving speakers "credit" for multiple references to same characters or items. Only the first reference is counted in a narration, therefore it would not work well for long narratives in which communication includes referencing former discourse items in a cohesive manner (Menn, personal communication, 12/31/10). Capturing "informativeness" or the expression of new information becomes just one component of evaluating a longer narrative.

2C.II. THE CANTONESE LINGUISTIC COMMUNICATION MEASURE

Kong (2002) created the Cantonese Linguistic Communication Measure ("LCM-RC") to fill a gap by providing a culturally and linguistically appropriate tool for aphasic narratives spoken in Cantonese for use in clinical settings. The LCM-RC measurement tool is based on the LCM and includes eight indices, six more than in the original LCM. Kong and Law (2004) present a refined LCM-RC: typical speakers are from different age groups, several indices are added, and four stimulus pictures that are culturally meaningful to Cantonese speakers in Hong

Kong are used instead of the original Cookie Theft from the BDAE. Their following publication on the LCM-RC (2009) presents data showing that the measurement tool is useful for monitoring for language production changes over time. Their stroke subjects were either in the period of spontaneous recovery during the acute phase post-stroke or were receiving anomia therapy during the chronic phase post-stroke. The purpose in reviewing the LCM-RC is to present the new measures that were not part of the LCM.

The newly created LCM-SS includes a few of the new indices; however, some indices are judged as too complex to be completed quickly in a clinical setting, or are more applicable to evaluating Cantonese than English. Kong and Law (2004) offer an impressive amount of normative data and reliability statistics for Cantonese narrations of their four stimulus pictures; however, they are not directly applicable to this study of Cookie Theft narrations and therefore are not discussed below.

The LCM-RC quantifies information produced by a narrator in terms of semantics and morphosyntax as well as lexical and phonemic errors. Two of the seven basic LCM-RC counts are borrowed from the LCM as follows:

1. *Total number of words*: same as LCM.
2. *Number of informative words (i-words)*: based on the LCM's content unit measure; content units and i-words describe the same narrative lexical items, but i-words are limited to the list provided by Yorkston & Beukelman (1980). In the LCM-RC, pronouns may not be i-words; in the LCM, the first use of a correct pronoun is a CU.
3. *Number of minutes of the recording*: includes the entire time from beginning of narration to end, including examiner comments.

4. *Number of correct grammatical morphemes in i-word units*: total correct closed-class words and correct affixes in phrases that contain i-words.
5. *Number of correctly used stem morphemes in i-word units*: number of constituent morphemes in compound words located in i-word units.
6. *Number of jargons, neologisms, phonemic & semantic paraphasias in i-word units*.
7. *Number of word types*: number of different words used in a sample of words from the whole narration. Sample size is held constant across compared narratives to eliminate bias caused by narrative of varying lengths.

Six indices are computed from these measures as follows:

1. *Index of Lexical Efficiency (ILE)*: similar to LCM: total words (1) per i-word (2).
2. *Index of Communication Efficiency (ICE)*: rate of i-words (2) per minute (3).
3. *Index of Grammatical Support (IGS)*: calculated differently than the LCM; correct closed-class words and affixes (4) per i-word (2).
4. *Index of Elaboration (IEl)*: correctly used stem morphemes (5) per i-word (2).
5. *Index of Error (IEr)*: jargons, neologisms and paraphasias (6) per i-word (2).
6. *Index of Lexical Richness (ILR)*: type-token ratio (see Kong & Law, 2004, for complete description).

The LCM-RC captures semantic components of a narrative, including information production and lexical diversity, with four indices. The first two of the four are borrowed from the LCM-RC for the LCM-SS but the second two are not. The first index, ILE (1), is computed the same way as in the LCM; a lower score indicates more efficiently transmitted information about the stimulus picture than a higher score. The second, ICE (2), is the rate of information transmission over time. Kong and Law (2004) found a significant difference in ICE scores

between controls and speakers with aphasia across all four stimuli, consistent with their pilot study (Kong & Law, 2002). Based on the subjective judgment of this researcher, BYR's speech rate slows over time; the ICE metric is added to the LCM-SS in order to quantify information transmission rate. Comparing BYR's ILE and ICE scores clarifies how BYR's narrations change in terms of the efficiency of informational words produced and the efficiency of the amount of time it takes her to express them.

The third semantic index, IEl (4), provides an estimate for semantic support within i-word units. In Cantonese, stem morphemes (the constituent morphemes that make compound words) provide additional information and elaboration to the i-word in an i-word unit. The concept is similar to compound words in English; Cantonese morphological rules result in the more frequent use of compound words than in English[10]. Evaluating Cantonese narratives with the IEl proved productive; aphasic narratives had significantly lower IEl scores than controls' narratives. But calculating IEl for BYR's narrations was shown to be unproductive (Hilger et al., 2011). This was possibly due to the low number of compound words inspired by the Cookie Theft (see footnote 11) and is not necessarily a reflection of BYR's compound word use as a whole. Therefore, this index is not borrowed for the LSM-SS. The fourth semantic index, ILR (6), is a measure of lexical diversity using type-token ratio (TTR). Kong and Law (2004) avoid criticism that TTR is sensitive to sample size by using a complex method to compare the same number of words from different narratives. Their procedures for trimming narrations, such as eliminating every second or fifth word from the narration depending on its length, is useful in a research lab but too complex for clinical application. Consequently, ILR is not borrowed for the LCM-SS.

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[10] For example, of the 57 total possible content units listed in Yorkston and Beukelman (1980), only four have compound "words": three-legged, cupboard, full blast, overflowing.

Additionally, the LCM-RC captures morphosyntactic information about narratives similarly to the LCM, with the IGS (3) measure. Kong (2002) changes the LCM calculation's numerator to the total number of correct closed-class words and affixes in i-word units, which allows the LCM-RC's index to reflect the use of bound and free grammatical morphemes. The IGS numerator in the original LCM is the total number of correct words and word "endings" in CUs, reflecting the use of supporting words in content units and bound grammatical morphemes. The revised numerator is more indicative of the index's goal, quantifying grammatical support, than the original numerator because it focuses on the grammatical elements of a narrative, the bound and free grammatical morphemes. The original numerator confounds closed class and open class[11] words by counting them together; closed class words are better indicators of grammatical support in phrases than open class words. The revised numerator accounts for morphemes specifically used for grammatical support to the exclusion of other morphemes and words that are not used for grammatical support. A downside of the LCM-RC's form of the IGS is that it may be more difficult for a clinician with no linguistics training to compute. However, the LCM-RC computation best suits the purposes of this study because it focuses on quantifying good syntactic and morphologic elements of a narrative, and the coder for this study has linguistics training.

Finally, the LCM-RC captures semantic and phonemic error data in narratives with the IEr (5): all neologisms, jargon segments, phonemic paraphasias and semantic paraphasias are added and divided by number of i-words to find the total errors per i-word. The inclusion of these two paraphasia types results in a confounding of semantic and phonemic errors, which appears to be an appropriate approach for Kong and Law. The objective of this thesis is, in part,

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[11] Open class words include nouns, verbs, adjectives and adverbs.

to describe the change in speech sound errors over time with a measure that focuses on speech sounds; therefore the IEr measure is not included in the LCM-SS as it is defined in the LCM-RC.

2C.III. THE SHEWAN SPONTANEOUS LANGUAGE ANALYSIS

The Shewan Spontaneous Language Analysis (Shewan, 1988; SSLA) was designed to provide a quantitative description of narratives produced in a picture description framework. It includes twelve variables, half of which Shewan categorizes as capturing phonological, semantic and syntactic aspects of narration. The other six variables were included to quantify "general parameters of verbal output" (ibid., p. 103). It was also designed to be "cost effective" (ibid., p. 105), defined as reducing the testing time and strain on the patient. The cost effective use of a clinician's time was not considered. Due to the complexity of the SSLA scoring system and the time it takes to complete, the SSLA does not meet the criterion for the present study because it is not "quick and easy to administer in a clinical setting." However, components of the SSLA are applicable to quantifying BYR's errors.

The SSLA provides the basis for factoring sound production errors (SPEs) and grammatical errors into the LCM-SS. However, the two measures, Articulation and Melody, used in the SSLA to capture phonological components of a narrative are not objective. Both measures are similar to parts of the BDAE; the SSLA's Articulation and Melody measures have seven point scales for subjectively rating articulatory accuracy and prosody, intonation and stress patterns within phrases. Also, Melody is not purely in the realm of phonetics/phonology. The Melody measure is characterized as independent of pauses and pause length; however when there is an interruption in speech flow while the speaker is searching for a word, an effect on melodic intonation and prosody should be expected. Intonation and prosody are supra-segmental

aspects of phonology; however word-finding pauses cause disruptions that are not necessarily phonological in nature. Therefore, Melody cannot be a pure measure of phonology. Other measures from the SSLA, that are not labeled as phonological in Shewan (ibid.), are borrowed instead to capture BYR's SPEs.

The LCM-SS modifies one SSLA measure that is labeled by Shewan as a "general variable of speech and language production" (ibid., p. 114) and one measure that is labeled as semantic. The former, the SSLA's Repetitions measure, includes phonemic, word and phrase repetitions; the latter, the Paraphasia measure, included semantic paraphasias, phonemic paraphasias, jargons and neologisms. All types of repetitions and all but semantic paraphasia are combined into one LCM-SS measure called the Index of Speech Sound Errors. Semantic paraphasias are excluded from the Index of Speech Sound Errors because these paraphasias result from a word selection problem at the semantic level; they are not reflective of speech production errors. Any paraphasias that are both semantic and phonemic are counted as phonemic in order to account for all possible sound production errors. The Index of Speech Sound Errors is different from Kong and Law's (2004) Index of Error, which was also inspired by the SSLA. The Index of Error includes semantic paraphasias, phonemic paraphasias and *word* repetitions. The LCM-SS focuses on phonemic paraphasias, sound errors and broadly defined *speech sound* repetitions (including singleton phoneme, partial word, word and phrase repetitions) rather than focusing uniquely on *word* repetitions.

The SSLA quantifies grammatical errors with the Errors measure. Errors are defined as incorrect morphosyntactic forms that deviate from a standard adult grammatical system, including missing obligatory articles, modifiers, and auxiliary verbs. Incomplete sentences, self-corrections and revisions are not included in the error count. This measure is included in the

LCM-SS and retitled the Index of Grammatical Errors in order to account for possible grammatical errors in BYR's narratives and how they change over time quantitatively.

Thus far, speech sound and morphosyntactic errors have been accounted for in the LCM-SS but not semantic errors. Both Shewan (1988) and Kong and Law (2004) include semantic errors in their paraphasia measures. Semantic errors are purposely excluded from paraphasia counts in the LCM-SS in order to maintain a differentiation between errors of semantics, morphosyntax and speech sounds in the measures. BYR produced no semantic errors during confrontational naming tasks throughout longitudinal testing that could not be explained by confusing the item (e.g.: she repeatedly called the picture of an octopus, "squid"). Additionally, when she was having difficulty producing a word during confrontational naming, semantic clues did not help and she often accurately described the item or function of the item while searching for its name. Therefore, it was not expected that BYR's narratives contain semantic errors. In order to verify this, a separate Index of Semantic Errors was calculated for each narrative. The addition of this index also creates symmetry within the indices; good use of semantics and morphosyntax is reflected in two different measures, and errors in each are captured in two other measures. Speech sound errors are also captured for each narrative.

2D. Establishing Construct Validity with a Rating Scale

This study established construct validity by comparing the results of the LCM-SS's indices with the results of student clinician narrative ratings. Content validity "refers to how a test measures the theoretical trait or construct that it is supposed to measure" (Paul, 2002, p. 53). The theoretical construct being measured is narrative goodness. A similar method using subjective clinician ratings was performed on the SSLA. In Shewan (1988), the procedure is

misidentified as concurrent validity[12] but the definition is that of construct validity: "*Concurrent Validity*: Whether the SSLA measures the construct it purports to measure was assessed in several ways. SSLA scores were compared with independent clinical judgments of the severity of expressive language impairment." (ibid., p. 114). There is no criterion measure in the form of validity used on the SSLA, therefore it cannot be concurrent validity and is instead, construct validity.

The SSLA's construct validity was established by comparing the SSLA composite score to a clinical rating of aphasia severity. Twelve patients with aphasia who "spanned a broad range of type and severity" (ibid., no more details about the participants were given) were chosen and given the Cookie Theft narration task. The SSLA variables were computed and converted to *Z* scores to obtain a summary score for each subject's narrative.[13] The same narratives were rated by an independent judge on a five-point severity scale for expressive language impairment (Mild = 1, Mild-Moderate = 2, Moderate = 3, Moderate-Severe = 4, Severe = 5). The order in which

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[12] Concurrent validity is a criterion-related validity measure defined as "the relationship between an individual's performance on a test and a criterion measure when they are administered at the same time" (Paul, 2002, p. 53). A criterion measure allows for assessment of skill in terms of "absolute levels of mastery… they are extremely helpful in helping to establish baseline skill level, developing intervention targets, and in documenting progress" (ibid., p. 59).

[13] A first critique of the statistics used in Shewan (1988) is that the process is not described for matching raw scores for each variable of the SSLA with a corresponding *z*-score. A *z*-score is meant to be used when the population mean and standard deviation are known, however, the SSLA was only tested on 47 participants with aphasia, 10 older typical speakers and 20 younger typical speakers. Therefore, either the 10 older speakers or the 30 total typical speakers served as a sample that was supposed to represent the population of typical speakers (which has a normal distribution). It was incorrect to assume that the 10 or 30 participants' SSLA variable scores had a normal distribution and also inappropriate to match *z*-scores to the typical speakers' SSLA variables. Consequently, comparing aphasic speaker's raw scores to the faulty *z*-score table is meaningless. A second critique is that the method is not defined for determining a composite *z*-score for the second set of participants with aphasia (12 total, used for establishing concurrent validity). It is unknown whether the composite *z*-score for each of these participants is the mean of his/her SSLA variable *z*-scores or whether the composite is computed some other way.

the narratives were played to the independent judge is not described. Shewan (ibid.) reports that a Pearson's product-moment correlation coefficient showed a 0.652 ($p < 0.02$) relationship between the evaluation methods.

The construct validity methods for rating the narratives and comparing the ratings to the SSLA composite *z*-scores in Shewan (ibid.) is problematic in terms of statistics. First, only one independent coder was used to implement the SSLA on all narratives. A second coder implemented the SSLA on only 10 of the 77 narratives. Second, intra-coder reliability was reported on five of the 20 narratives produced by younger, typical speakers. No intra-coder reliability was reported for the application of the SSLA to aphasic narratives. Third, inter-coder reliability was reported on the same five narratives by younger, typical speakers. There is no inter-coder reliability for aphasic narratives. Fourth, only one judge was used to evaluate all narratives for expressive language impairment. The results would reflect the bias of that one judge and how he/she perceives expressive language impairment. Fifth, the order in which the narratives were presented to the independent judge may have influenced the ratings, given that the 12 aphasic narratives were produced by people with a broad range of aphasia type and severity.

The LCM-SS is tested for construct validity more robustly than the SSLA due to the following procedures. Intra-coder reliability is established across all narratives based on two coding sessions set more than a month apart; fifteen independent raters' judgments are used to establish narrative goodness; the narratives, including control narratives, are presented to raters in random order; narratives are presented three times to each rater to allow for intra-rater reliability assessment; the most representative rating for each narrative is found by using a principal components analysis.

The other measurement tools discussed in this study were shown to be at least partially valid using different validity procedures. Most established predictive validity: "how well [an] individual's current performance on [a] test predicts future performance on a criterion test" (Paul, 2002, p.53). None, other than the SSLA, used qualitative rating scales as a comparison. The tools were compared against results from standardized (criterion) tests such as the BDAE, Western Aphasia Battery (Kertesz, 1982) and the Cantonese Aphasia Battery (Yiu, 1992) to demonstrate their ability to differentiate between typically speaking participants and participants with aphasia (LCM-RC: Kong 2002, Kong & Law, 2004; Yorkston & Beukelman, 1980; QPA: Saffran et al., 1989), between fluent versus non-fluent aphasia (LCM: Menn et al., 1994; Kong 2002), and between aphasia severity levels (Yorkston & Beukelman, 1980). For establishing the QPA's validity, differentiation of participants with agrammatic and non-agrammatic forms of non-fluent aphasia was "based on the clinical judgments of the investigators concerning [the participants'] tendency to produce or to omit grammatical morphemes" (Saffran et al., 1989, p. 446). Exact procedures are not described and the clinical judgments were not subject to reliability testing.

It is not possible to use a standardized test as a comparison criterion for establishing predictive validity for the LCM-SS based on BYR's narratives because no assessment tool was administered to BYR in its entirety during any of the recorded sessions. Subsections of the BDAE were used to assess particular aspects of BYR's oral productions during the ten recorded sessions. In order to create a comparison for establishing validity, a qualitative rating scale was used as in the SSLA.

3. Research Questions & Objectives

3a. Research Questions

This study asks three questions about BYR's speech and language: 1. How do her speech and language change over time? 2. Which LCM-SS indices best reflect BYR's speech and language difficulties? 3. Does the LCM-SS quantify those changes better than the LCM and LCM-RC?

3b. Descriptive Objective

The first objective is to create a longitudinal description of how BYR's "goodness of expression" changes over time, given that she had a degenerative form of aphasia. This was accomplished by calculating the measures and indices of the LCM-SS, a tool designed to capture ability and amount of errors in the domains of semantics, morphosyntax and speech sounds. Each LCM-SS index is compared longitudinally.

3c. Reliability Objective

The second objective is to establish intra-coder reliability for the LCM-SS. All LCM-SS indices were compared from two different coding sessions. Krippendorff's alpha coefficient is used to determine intra-coder reliability.

3d. Validity Objective

The third objective is to establish construct validity for the LCM-SS indices by comparing them to raters' judgments of "narrative goodness." The same procedure is applied to the LCM and LCM-RC and validity measures are qualitatively compared for the three tools.

4. Methods Section

4a. Participants

4a.i. Typical Speakers

Four elderly female speakers of English without aphasia or other neurological impairments were recorded narrating the Cookie Theft scene. These recordings were included as controls and presented to the raters for "goodness" judgments. The goal was to present raters with possible baseline examples of what "good" narrations sound like from people with elderly, female voices. The control speakers were female in order to match the sex of the main participant, BYR, and they were elderly (65-95 years old) in order to match the voice quality of an elderly speaker (BYR was 75-77 years old during the recordings).

One control speaker who was recruited speaks English as a second language and has a foreign accent. Raters heard this particular narration during the training portion of the rating task. The goal was to familiarize raters with accented speech so that BYR's slight accent (British English) did not factor into narrative goodness ratings. One recording was made of each control speaker. All four control speakers who were recruited signed consent forms and completed the narrative description task.

4a.ii. Raters

Raters were recruited from the Speech, Language, Hearing Sciences (SLHS) Department and were all current graduate students. Potential raters were screened to find participants whose primary language is English, but those who know other languages were not excluded from the study.

Number of raters recruited was determined by performing a power analysis of the difference between two pilot raters. One expert rater's judgment of goodness (thesis advisor, Gail Ramsberger) and one novice rater's judgment (a graduate student in the SLHS department) were compared and the difference between ratings was used as the variability in the power analysis. Analysis thresholds were set at an alpha level of 0.05 and a power level of 0.80. The power analysis determined that 14-15 participants would be needed; 15 were recruited. All 15 raters completed the goodness rating task.

4B. SOURCE OF DATA

4B.I. BYR NARRATIVE ELICITATION

Ramsberger, Menn, and Wu recorded a total of eight narratives from December, 2004, to May, 2007, with a digital audio and video recorder. BYR described the Cookie Theft picture to either Ramsberger or Menn in her own home. Her husband and dog were also present in the room although not on camera. Narratives were recorded either on a sofa in the living room or at the dining room table, both of which were generally quiet, non-distracting environments. Either Ramsberger or Menn instructed BYR to tell what was happening in the Cookie Theft picture; the examiners did not provide cues or leading questions after providing the task instructions.

4B.II. BYR NARRATIVE TRANSCRIPTION

The researcher transcribed the spoken words during Cookie Theft narrations using standard English spelling plus some phoneme symbols written in IPA when necessary (Appendix B). An example of IPA use for words pronounced differently than expected is /kʌki/, for "cookie" (5th Transcription, see Appendix D for Cookie Theft transcriptions), which is a sound

production error. IPA was also sometimes needed to represent the sounds in neologisms; the pronunciation of "bishin" (6th Transcription) is clear from the spelling but the pronunciation of /woʊf/ (7th Transcription) is more clearly expressed with IPA than with English spelling. Transcription conventions were similar to Ash et al. (2006, Appendix E-2) except that silence of approximately ½ second was indicated by a single dot and longer silences were indicated by three dots. Additional notation included putting dashes between partial-word and full-word stuttering-like repetitions, inserting unrealized targets into straight brackets after a dysfluency, and noting each time the article *a* was pronounced as a diphthong (so that it would not be confused with filler word *uh*).

4B.III. BYR Narrative Segmentation

The first narrative BYR produced (December, 2004, Appendix C) is excluded entirely from analysis and classified as a non-standard administration of the picture description task. This is because, after initially viewing the picture, BYR did not look at it again after beginning to narrate. Although not directed to do so, she described the picture from memory. (When she indicated she was finished narrating, she was told she could look at the picture, but she did not add anything additional to her narration.)

For analysis purposes, narratives began after the instructions were given, when BYR began describing the picture. Narratives end when BYR indicated verbally or with head nod and eye gaze (towards the administrator) that she was done narrating. BYR's commentary on how she perceived her performance was excluded from analysis (e.g.: "God!" from the 3rd Transcription, Appendix D). Verbalizations by the administrators were also excluded. The resulting narratives were evaluated using the analyses described below.

The Cookie Theft narratives were located on the digital recordings of the chosen seven sessions with the iMovie '09 application (version 8.0.6 (821)) on a Mac OS X (version 10.6.8). Each narrative movie segment was copied and pasted into a collective iMovie Project for analysis purposes. The audio portion of each narrative was segmented and saved by using the iMovie function "Export Using QuickTime" which saved the audio recordings in .wav format. The audio recordings were then uploaded into a preset rating program run in MATLAB, version 1.0. The audio recordings averaged about one minute 30 seconds in length, with a range of 1:09 to 1:56 in length.

4B.IV. ADDITIONAL COOKIE THEFT NARRATIVE ELICITATIONS

The control speakers were asked, "Tell me what you see going on in this picture", as per standard assessment using the Cookie Theft picture from the BDAE. Only their responses to this question, their narration of the Cookie Theft picture, were recorded. Narrative recordings were made on a Mac OS X version 10.6.8 with Praat version 5.2.46. Only audio was recorded and the recordings were used for research purposes only. Names of narrators or any other identifying information were not included in the Cookie Theft narrative recordings.

One additional Cookie Theft narrative by a person with aphasia was obtained from AphasiaBank (MacWhinney, Fromm, Forbes & Holland, 2011) for use during rater training. AphasiaBank is "a shared database of multimedia interactions for the study of communication in aphasia… [which was created with the] goal of improving evidence-based therapy for aphasia" ("TalkBank/AphasiaBank", 2012). The purpose of this narrative was to familiarize raters with the voice of someone with aphasia before they heard all of BYR's recordings.

It should be noted here that the audio recordings of BYR, the control speakers and the speaker from AphasiaBank were made with different equipment, in different locations and at different distances from the microphones. Therefore, the amplitude of all audio recordings was normalized for RMS (root mean squared) amplitude in Audacity, version 1.3.14-beta.

4C. Measures and Procedures

4C.I. Measurement Tool Implementation on All Narratives

Communication measure criteria included that the measures be quick and easy to administer in a clinic, with the goal of bridging the gap between application in research versus clinical settings.

4C.I.a. LCM-SS Implementation

The LCM-SS includes eight preliminary counts that must be tallied in order to compute its six indices. Basic counts are listed first and labeled with a 'c' before the number; indices are listed second and labeled with an 'i' before the number. The seven chosen BYR Cookie Theft narratives were evaluated using the basic counts and indices listed below by the researcher. (See Appendix E for a detailed description of each count and index.)

4C.I.a.i. LCM-SS Basic Counts

c1. *Total number of words*: same as LCM.

c2. *Number of content units*: same as LCM.

c3. *Number of correct bound and free grammatical morphemes in CUs*: same as the LCM-RC count 'correct grammatical morphemes.'

c4. *Number of morphosyntactic errors*: total errors of morphology and syntax in the narrative, including errors found in initial word/phrase attempts. The following are NOT errors: a phrase left incomplete or abandoned, an omitted opening subject (e.g. 'it' in 'looks like the faucet is overflowing'). The following ARE errors: errors of tense/person/number agreement, missing auxiliary verb, missing obligatory article or modifier.

c5. *Number of semantic errors*: total semantic (verbal) paraphasias and errors in the narrative (i.e. switching male/female pronoun), including errors found in initial word/phrase attempts.

c6. *Number of sound errors*: total sound errors in the entire narration. Sound errors include phonemic paraphasias, jargons and neologisms, even if self-corrected; sound errors include phonetic errors but do not include distortions.

c7. *Number of words with repetitions*: total number of words that have full-word and partial-word (i.e. phoneme and cluster repetitions) repetitions in the entire narration.

c8. *Number of minutes of narration*: same as LCM-RC.

4C.I.a.ii. LCM-SS INDICES

i1. *Index of Lexical Efficiency (ILE)*: same as LCM.

i2. *Index of Communication Efficiency (ICE)*: calculated the same way as LCM-RC.

i3. *Index of Grammatical Support (IGS)*: calculated the same way as LCM-RC.

i4. *Index of Grammatical Errors (IGramE)*: total morphosyntactic errors within CUs (c4) divided by number of CUs (c2); indicates the level of morphosyntactic impairment during narration.

i5. *Index of Semantic Errors (ISemE)*: total semantic (verbal) paraphasias within CUs (c5) divided by the number of CUs (c2); indicates the level of semantic impairment during narration.

i6. *Index of Sound Errors (ISouE)*: sum the total sound errors (c6) and the number of words with repetitions (c7), then divide by the number of CUs (c2); indicates the level of sound production impairment during narration.

4C.1.b. LCM IMPLEMENTATION

The LCM, developed by Menn et al. (1994), was created for evaluating aphasic narratives in clinical and research settings with a focus on ease of use and rapid scoring. In both arenas, it may be used for pre-and post-treatment comparisons, tracking linguistic decline in PPA, and identifying aspects of narration that need remediation or support. The LCM was applied to each of BYR's chosen narratives by the researcher. (See section 3A above for Counts and Indices.)

4C.1.c. LCM-RC IMPLEMENTATION

Kong (2002) created the Cantonese Linguistic Communication Measure (LCM-RC) to fill a gap and provide a culturally and linguistically appropriate tool for aphasic narratives spoken in Cantonese for use in clinical settings. The Cantonese measurement tool is based on the LCM, and it includes eight indices, six more than in the original LCM. Although designed for evaluating narrative spoken in Cantonese, it has been published in English and the English version was used to evaluate BYR's English narratives. The LCM-RC was applied to each of BYR's chosen narratives by the researcher. (See section 3B above for Counts and Indices.)

4C.II. INTRA-CODER RELIABILITY FOR LCM-SS

The researcher performed all of basic counts and computed all indices for each narrative. More than one month later, the researcher performed all basic counts across all narratives for a second time and computed all indices from those counts. Intra-coder reliability was determined by comparing the index scores from the first results with the second results using Krippendorff's Alpha. Krippendorff's Alpha is a statistical measure used to determine "agreement achieved when coding a set of units of analysis in terms of the values of a variable" (Hayes and Krippendorff, 2007).

4C.III. COOKIE THEFT GOODNESS RATING

The raters were asked to judge the "goodness of each narrative sample" based on audio recordings of the narratives. During the training portion of the session, raters listened to two Cookie Theft narrations not included in the test portion of the session. One of these recordings was of a person with aphasia that was downloaded from AphasiaBank. The second recording was of the control speaker with a foreign accent. The raters were shown how to select a rating for a narrative and proceed to the next narrative.

During the test portion of the session, the seven recordings of BYR narrating the 'Cookie Theft' were presented a total of three times to each rater. In addition, three control Cookie Theft narrations were presented during a single rating session. All audio clips (24 total) were presented in random order to each rater.

Narratives were presented in a MATLAB, Version 1.0, program. This program was downloaded onto a Mac Book Pro laptop with Mac OS X, version 10.6.8, and the narratives were listened to with over-the-ear headphones. Raters were able to adjust the loudness to a

comfortable level. The researcher started the program by entering in a different rater identification number (1-15) for each participant. The raters saw a screen containing the Cookie Theft picture, a progress indicator displaying "Sample #: x of y" where x is the current narrative number and y is the total number of narrative, a "Play" button, a Visual Analog Scale with "Bad" labeled above the left end of the scale and "Good" labeled above the right end, and a "Next" button. Raters dragged a slider to move a bar along the rating scale to rate the goodness of the speech sample. Raters could not go to the next narrative recording until the current narrative had played all the way through at least once. After listening, rating and clicking "Next", a text box popped up and asked if the rater is sure he/she wanted to proceed. The raters clicked "OK" and then listened to the next narrative continuing until all narratives are rated. Raters could pause the program between ratings when needed; without a break, rating time was estimated at one hour but took on average 45-50 minutes.

4C.III.a. Information Captured by MATLAB

MATLAB captured narrative and rating information, saved them to a text file, and identified them by rater ID number. Narratives were identified by both chronological order in which they were spoken and by the number in which they were presented, because they were presented randomly. Ratings were converted from the visual analog scale to a number from zero to one. Rate time, the amount of time elapsed from when the Rater presses "Play" until the last slider movement, was recorded as well. MATLAB also saved information on the number of times the raters move the slider during the rating period (listening period) for each narrative, the rating at each place the slider stopped, and the elapsed time for each slider movement. At this point, none of the additional information recorded by MATLAB has been analyzed.

4C.III.b. Intra-Rater Reliability for Goodness Ratings

Intra-rater reliability was performed on the ratings for BYR's narratives in order to determine each participant's rating consistency. Rating reliability was determined using Krippendorff's Alpha ("*k* values") as opposed to Pearson's correlation because the *k* values account for similarity by chance and the correlations do not. There is no predetermined minimum level for alpha coefficients because alphas should be interpreted with respect to the data that is being analyzed. However, it is expected that *k* values would be lower than correlational values because of the difference between the two, mentioned above. However, the mean alpha level for raters and standard deviation were computed and individual alpha levels were judged for where they fell in terms of standard deviations from the mean.

4C.IV. Construct Validity

Construct validity was determined by comparing the overall goodness rating scores with the LCM-SS indices. First, a principal components analysis (PCA) was run in MATLAB on scores from all of the raters for each narrative in order to find an overall goodness rating score for each narrative. The PCA accounted for variability in individual raters' use of the entire goodness scale continuum; some raters used a small range on the scale in which to score all BYR narratives while other raters used a large range on the scale. "Principal components analysis 'extracts' a factor from the overall data matrix by determining what combination of variables shows the strongest linear relationship and accounts for a large portion of the total variance in the data. The first factor that is 'extracted' will account for as much of the variance in the data as possible" (Portney and Watkins, 2009, p. 708). Scores that are the first principal component of the PCA are reported. Next, correlational and multiple regression analyses were performed to

determine the indices that best explain the variance in the overall goodness rating scores for the different narratives. There analyses were run in the NCSS 2007 (Hintze, 2007) software program.

4C.V. Comparison of Measurement Tools

After the LCM and LCM-RC analyses were performed and their indices calculated, correlational and multiple regression analyses were performed on them separately. First the LCM's indices and then the LCM-RC's indices were compared to the overall goodness rating score for each BYR narrative. The goal was to determine which index/indices from each tool best explained the variance in the overall goodness rating scores. Finally, analyses of the three measurement tools were compared qualitatively to determine which tool's indices best accounts for the variance in the overall goodness rating scores.

5. Results

5A. Measurement Tools

5A.I. LCM-SS

The LCM-SS's basic counts and indices were calculated for each BYR Cookie Theft narrative. Results are listed in Table 1 but are perhaps better viewed as graphs. Basic counts are listed in unshaded boxes while indices are listed in shaded boxes. This convention is used in the LCM and LCM-RC tables as well.

All LCM-SS basic counts are shown in Graph 4a. The horizontal axis depicts time linearly, with every third month labeled. Due to narrative dates occurring two to six months apart, there is greater or less distance along the x-axis between data points. All graphs that have

time along the x-axis are constructed this way. Graph 4a has a break between 40 and 75; the scales above and below the break are different in order to fit all the counts on one graph.

	Jan 2005	Mar 2005	Aug 2005	Dec 2005	Apr 2006	Sept 2006	Mar 2007
Total words (TW)	93	94	80	86	85	78	94
Total content units (CU)	18	22	17	21	19	18	16
Correct gram. morph. in CUs (GM)	29	37	30	28	28	27	22
Morphosyntactic errors (ME)	5	1	2	6	1	5	6
Semantic errors (SemE)	3	2	0	2	3	2	3
Sound errors (SouE)	4	3	2	11	8	12	21
Words with repetitions (Rep)	12	11	14	13	24	19	35
Minutes of narration (Min)	1.17	1.47	1.47	1.42	1.68	1.5	1.93
Index of Lexical Efficiency (ILE)	5.2	4.3	4.7	4.1	4.5	4.3	5.9
Index of Communicative Effic. (ICE)	15.4	15.0	11.6	14.8	11.3	12.0	8.3
Index of Grammatical Support (IGS)	1.6	1.68	1.76	1.33	1.47	1.50	1.38
Index of Grammatical Errors (IGramE)	0.05	0.01	0.03	0.07	0.01	0.06	0.06
Index of Semantic Errors (ISemE)	0.03	0.02	0.00	0.02	0.04	0.03	0.03
Index of Sound Errors (ISouE)	0.17	0.15	0.20	0.28	0.38	0.40	0.60

Table 1: Linguistic Communication Measure –Speech Sounds (LCM-SS) Results

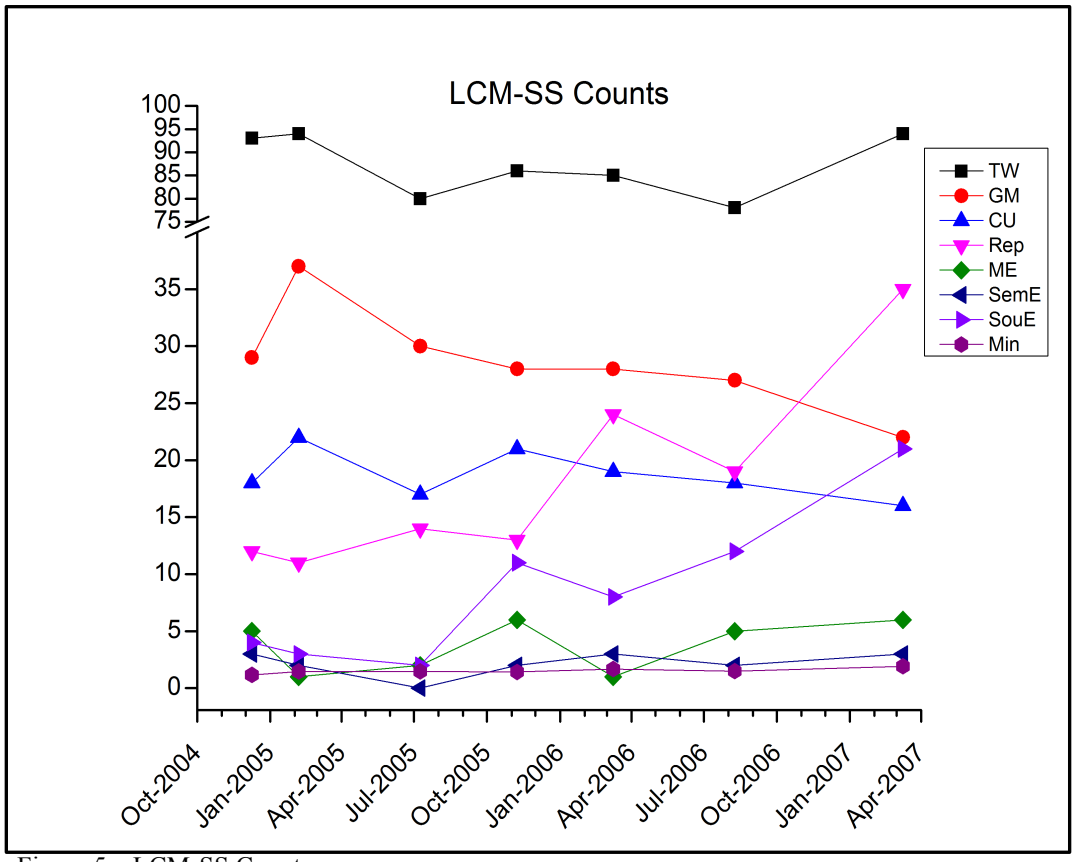

Figure 5a: LCM-SS Counts

Total words (TW) appears to be the most volatile with no clear trend over time. Total CUs, morphosyntactic errors (ME), semantic errors (SemE) and minutes per narration (Min) appear to have flat trends, with varying degrees of volatility. Overall, BYR's narratives did not worsen or get better over time for these four counts. Number of grammatical morphemes used (GM) appears to be fairly stable with a negative trend over time whereas repetitions (Rep) and sound errors (SouE) have positive trends. A decrease in grammatical morpheme use and increases in repetitions and sound errors are indicators of increased difficulty with narration.

All LCM-SS indices are shown in Figure 5b; the three indices on the top part of the figure are on a different scale than the three indices on the lower part of the figure. The ICE indicates the narrator's levels of verbal fluency and of word finding ability; increased pause time lowers the ICE score. BYR's ICE scores are volatile over time but have a general negative trend indicating decreased fluency and increased word finding difficulty. The ILE indicates the narrator's level of efficiency for telling correct information about the scene. A low ILE indicates that the narrator uses few words other than those that are highly informative; a high ILE indicates the narrator uses many words that have little to no informativeness. This index is fairly stable over time with a flat trend but increases greatly from the penultimate to ultimate narration. A rising ILE score suggests that BYR's word use became less informative over time. The Index of Grammatical Support (IGS) has a perhaps non-significant negative trend that is not apparent on this figure. The IGS gives an indication of the morphosyntactic richness of a narrative within the informative parts of the narrative. An IGS with a negative trend indicates that morphosyntax becomes more impoverished over time.

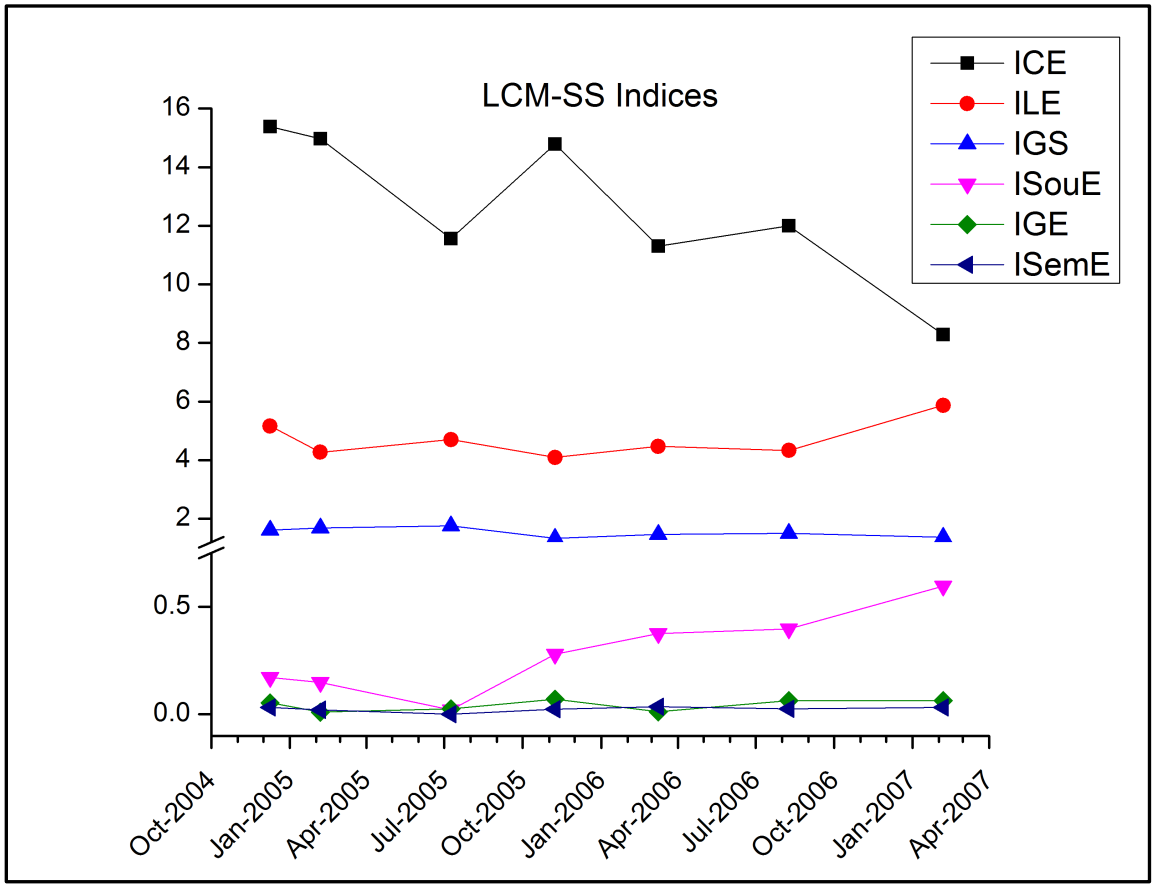

Figure 5b: LCM-SS Indices

A positive trend in the Index of Sound Errors (ISouE) is visible in the lower portion of Figure 5b. This index is shown in high resolution because it is shown to be important in the construct validity results section below. The ISouE indicates the level of sound production impairment during narration. Over time, this index has a stable and positive slope, suggesting that BYR's sound production became increasingly impaired. The final two Indices of Grammatical Errors (IGramE) and Semantic Errors (ISemE) appear to be stable with no slope and have values close to zero. Low IGramE and ISemE values indicate that BYR did not have morphosyntactic or semantic errors in her narratives, and that these aspects of her language did not deteriorate as her PPA progressed.

5A.II. LCM

The LCM's basic counts and indices were calculated for each BYR Cookie Theft narrative. Results are listed in Table 2. The TW count was performed the same way in the LCM-SS as in the LCM; therefore, the counts are the same and Figure 6a shows a familiar visual of the TW's volatility. Number of correct words in content units (CW) has volatility between the first few narratives and the last two, but is stable for about a year during the middle section of BYR's recording sessions. Overall, there is a decreasing trend for CW, but CUs has a less steep negative

	Jan 2005	Mar 2005	Aug 2005	Dec 2005	Apr 2006	Sept 2006	Mar 2007
Total words (TW)	93	94	80	86	85	78	94
Total content units (CU)	18	22	17	21	19	18	16
Correct words in CUs (CW)	54	63	48	48	48	49	36
Correct gramm. morph. in CUs (GM)	7	8	8	7	9	6	5
Index of Lexical Efficiency (ILE)	5.2	4.3	4.7	4.1	4.5	4.3	5.9
Index of Grammatical Support (IGS)	3.4	3.2	3.3	2.6	3.0	3.1	2.6

Table 2: Linguistic Communication Measure (LCM) Results

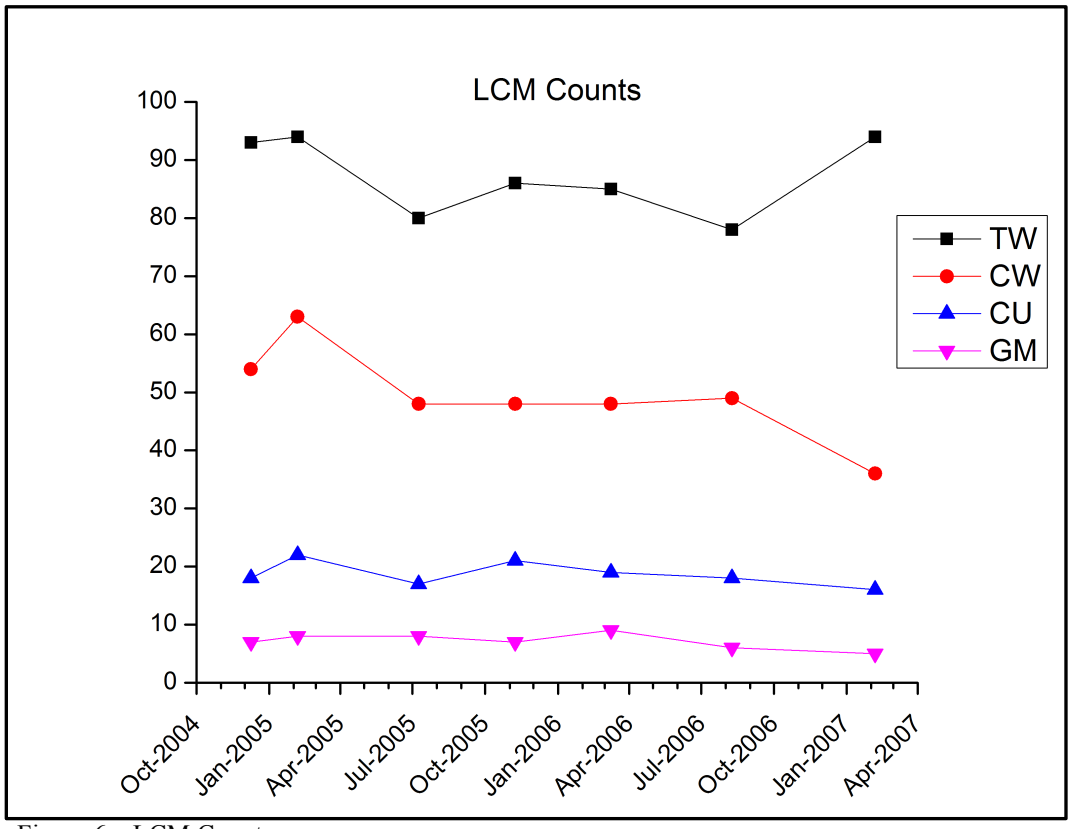

Figure 6a: LCM Counts

trend. This indicates that BYR's narrations gradually resulted in fewer informative and contextually correct words over time. The final count, correct grammatical morphemes in CUs (GM), is fairly stable with close to no slope at all. This GM trend is different from the LCM-SS's GM trend because the two defined "grammatical support" differently.

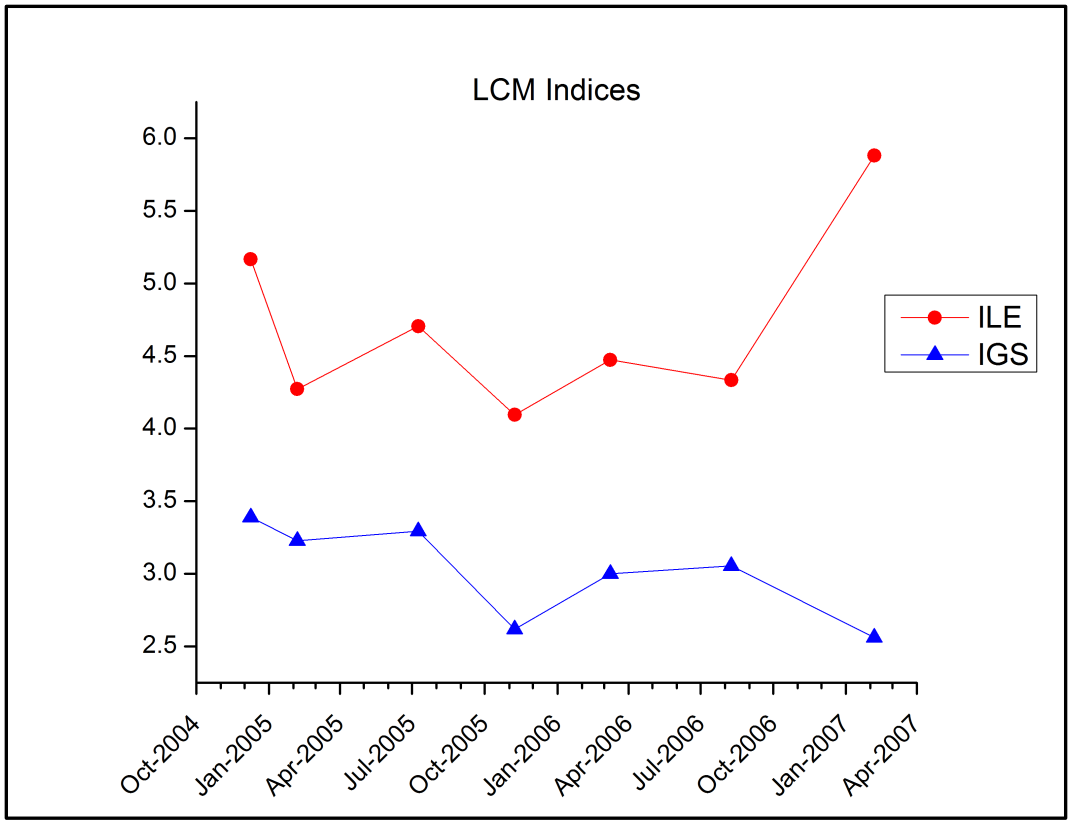

Figure 6b: LCM Indices

The LCM indices are shown in Figure 6b. The ILE is not stable but does have a positive trend. Recall that an ILE score near one indicates that the narrator is too efficient at conveying information about a scene; BYR's scores ranged from approximately four to six. Over time, it appears that BYR became less efficient in her narrations and conveyed less information about the Cookie Theft image because more words were used that were not integral to a description of the scene. The IGS is designed to reflect deterioration with a negative slope, the opposite of the ILE. The IGS data points are fairly stable over time and have a negative trend. This indicates that

BYR's narratives have reduced grammatical richness over time but that she continues to successfully use grammatical morphemes to some extent even in the last narrative.

5A.III. LCM-RC

The LCM-RC's basic counts and indices were calculated for each BYR Cookie Theft narrative. Results are listed in Table 3. Again, the TW was performed the same way as in the LCM-SS; therefore, the TW data points are the same in all three measurement tools. Figure 7a shows the volatility of TW, as was seen previously. Again, this figure has a break because TW numbers are high compared with the other basic counts, but the scales are the same on either side of the break in this figure.

	Jan 2005	Mar 2005	Aug 2005	Dec 2005	Apr 2006	Sept 2006	Mar 2007
Total words (TW)	93	94	80	86	85	78	94
Total i-words (IW)	15	19	17	16	17	16	14
Minutes of narration (Min)	1.17	1.47	1.47	1.42	1.68	1.5	1.93
Gramm morph. in i-word units (GM)	25	33	32	25	27	25	22
Stem morph. in i-word units (SM)	0	0	2	0	0	2	0
Errors in i-word units (Er)	6	2	2	7	4	7	13
Word types (WT)	41	37	34	42	31	40	31
Index of Lexical Efficiency (ILE)	6.2	4.9	4.7	5.4	5.0	4.9	6.7
Index of Communication Efficiency (ICE)	12.8	12.9	11.6	11.3	10.1	10.7	7.3
Index of Grammatical Support (IGS)	1.7	1.7	1.9	1.6	1.6	1.6	1.6
Index of Elaboration (IEl)	0.0	0.0	0.1	0.0	0.0	0.1	0.0
Index of Error (IEr)	0.4	0.1	0.1	0.4	0.2	0.4	0.9
Index of Lexical Richness (ILR)	0.59	0.53	0.49	0.60	0.44	0.57	0.44

Table 3: Linguistic Communication Measure – Revised Cantonese (LCM-RC) Results

Of the six remaining basic counts, half appear to have almost no slope (Figure 7a). Word types (WT) counts are very volatile, with a slightly negative sloping trend indicating word diversity may have decreased over time. Number of minutes per narration (Min) and number of stem morphemes in i-word units (SM) are stable and have almost no slope. The consistency of the Min count is fairly surprising because it was expected BYR would take longer to produce narratives as her PPA progressed. The constancy of the SM count is not surprising (see footnote

11). Five of the seven narratives contained zero SM, which indicates that this count is not reflective of BYR's narration ability. Number of i-words (IW) and the GM count have large jumps from the first to second narrations. Then their trends stabilize with negative slopes, which indicates that fewer grammatical morphemes and i-words were produced over time. Finally, the error count (Er) increased fairly steadily after the third narrative session in August, 2005.

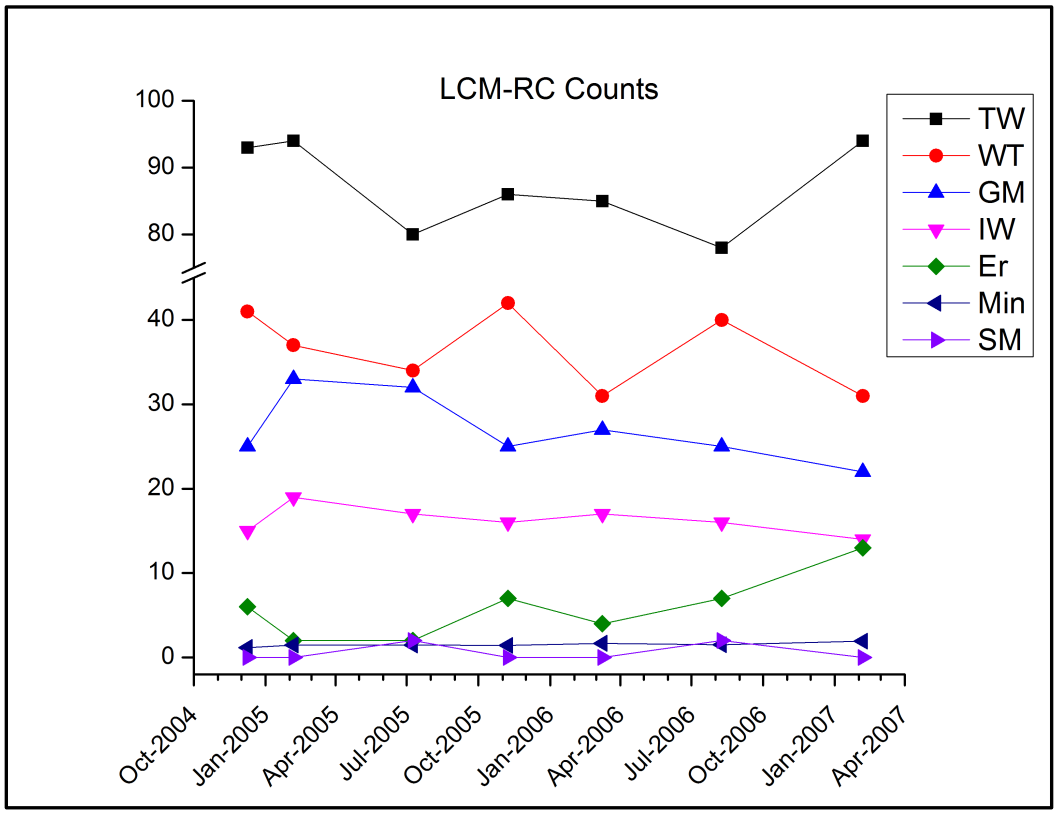

Figure 7a: LCM-RC Counts

The LCM-RC indices are depicted on Figure 7b and the ICE and ILE vary the most compared to the other indices. The ICE has a steady, negative trend, which indicates that BYR's narratives contained decreasing amounts of pertinent information about the Cookie Theft scene over time. The ILE has the same computation as the LCM and LCM-SS (total words per i-word); however i-words and content units are counted differently. Despite this, all three ILE results (Figures 5b, 6b, 7b) are fairly stable with flat trends for the middle five narrations. There are slight increases in lexical efficiency (indicated by a negative trend) from the first to the second

narrations but larger decreases in lexical efficiency (indicated by a positive trend) from the penultimate to ultimate narrations.

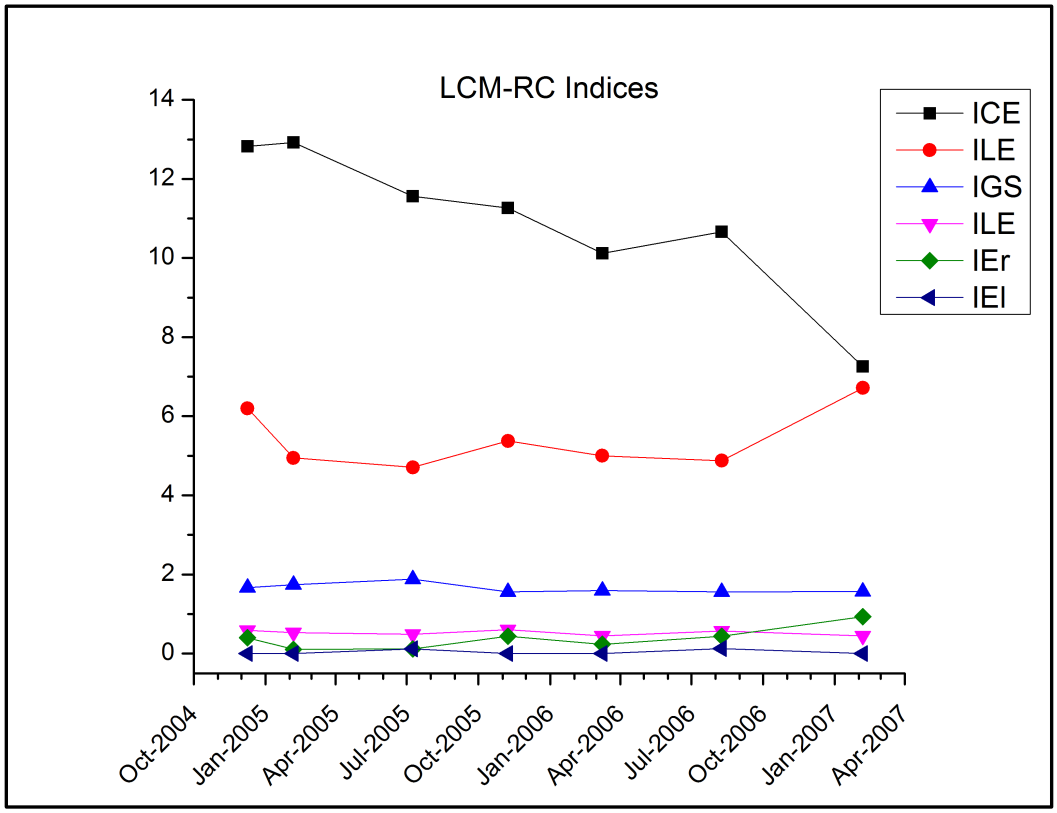

Figure 7b: LCM-RC Indices

The final four LCM-RC indices are stable with relatively little slope. The IGS plateaus and remains constant during the final four narrations indicating that BYR's use of bound and free grammatical morphemes is unchanged during the latter sessions. The Indices of Lexical Richness (ILR) and Elaboration (IEl) are also flat. The ILR results indicate that BYR had a similar amount of word diversity throughout the seven narrations. The IEl results indicate that BYR did not often use compound words during narrations; however, a lack of compound words is not necessarily an indicator of poor narrative ability in English (see footnote 11). Finally, the Index of Error (IEr) is somewhat unstable and it has a positive trend over the last five narratives, which indicates that BYR generally produced more errors as time went on.

5B. INTRA-CODER RELIABILITY FOR LCM-SS

Intra-coder reliability was performed using Krippendorff's alpha coefficient. The analysis resulted in a *k* value of 0.9731 indicating very high coding reliability. See Appendix G for LCM-SS count and index results performed for intra-coder reliability.

5C. COOKIE THEFT GOODNESS RATING

The ratings results for each audio clip of BYR are in Table 4 and the ratings for each control audio clip are in Table 5. The horizontal axis of Table 4 shows the BYR clips listed chronologically from January, 2005, to March, 2007, (clip 1-7) and gives the rating for the first, second and third time (T1-T3) each rater heard the clips. The vertical axis shows rater number. Table 5 shows rater number along the horizontal axis and control clips on vertical axis. Control clips are numbered for identification purposes and are not reflective of the order in which raters heard them; raters heard the control clips only once apiece.

Raters differed in the range of ratings they gave for BYR's narratives as a whole (i.e. how much of the analog scale they used during the rating task) and in the range of ratings they gave to each specific clip. For example, Rater 2 rated all instances of BYR's first narrative above 0.75 and all of the last narrative below 0.30; Rater 12 rated all instances of BYR's first narrative *below* 0.45 and all of the last narrative below 0.25. These raters' use of the analog scale is best visually presented on graphs. Figure 8 shows that Rater 2 used most of the analog scale and Figure 9 shows that Rater 12 used a much smaller proportion of the scale. Additionally, the graphs show that Rater 2 had a much wider range of ratings for the three presentations of each BYR clip than Rater 12.

Rater	BYR Clip 1*			BYR Clip 2			BYR Clip 3			BYR Clip 4			BYR Clip 5			BYR Clip 6			BYR Clip 7		
	T1[t]	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
1	0.35	0.63	0.65	0.43	0.45	0.34	0.27	0.24	0.31	0.44	0.39	0.34	0.20	0.13	0.23	0.28	0.39	0.10	0.02	0.01	0.02
2	0.99	0.94	0.77	0.66	0.62	0.64	0.63	0.35	0.36	0.43	0.60	0.64	0.21	0.26	0.29	0.39	0.31	0.72	0.27	0.27	0.19
3	0.77	0.68	0.85	0.59	0.79	0.69	0.70	0.60	0.69	0.70	0.58	0.65	0.36	0.34	0.61	0.66	0.70	0.57	0.26	0.27	0.27
4	0.50	0.35	0.17	0.33	0.26	0.14	0.32	0.28	0.28	0.17	0.31	0.29	0.29	0.16	0.26	0.11	0.28	0.25	0.01	0.03	0.03
5	0.71	0.70	0.70	0.44	0.53	0.57	0.59	0.43	0.48	0.40	0.63	0.58	0.30	0.21	0.32	0.30	0.26	0.40	0.27	0.14	0.08
6	0.85	0.72	0.57	0.58	0.81	0.71	0.40	0.53	0.65	0.48	0.50	0.47	0.37	0.41	0.41	0.46	0.29	0.39	0.09	0.03	0.08
7	0.36	0.24	0.25	0.23	0.25	0.22	0.28	0.15	0.22	0.16	0.24	0.22	0.12	0.14	0.20	0.21	0.19	0.15	0.00	0.00	0.01
8	0.63	0.61	0.50	0.50	0.70	0.51	0.44	0.50	0.33	0.40	0.46	0.43	0.15	0.23	0.25	0.30	0.27	0.31	0.05	0.06	0.04
9	0.71	0.63	0.62	0.71	0.61	0.58	0.53	0.32	0.46	0.40	0.39	0.41	0.28	0.32	0.29	0.40	0.26	0.33	0.11	0.10	0.07
10	0.55	0.72	0.66	0.53	0.62	0.61	0.71	0.57	0.69	0.75	0.78	0.76	0.61	0.45	0.40	0.58	0.62	0.51	0.25	0.25	0.25
11	0.68	0.60	0.52	0.56	0.50	0.68	0.44	0.50	0.46	0.45	0.52	0.60	0.35	0.45	0.32	0.20	0.41	0.46	0.21	0.16	0.18
12	0.44	0.36	0.43	0.41	0.33	0.33	0.37	0.34	0.38	0.34	0.32	0.35	0.33	0.29	0.33	0.34	0.37	0.38	0.22	0.19	0.20
13	0.50	0.57	0.61	0.31	0.46	0.57	0.50	0.53	0.63	0.57	0.58	0.63	0.24	0.24	0.25	0.14	0.21	0.36	0.05	0.06	0.23
14	0.58	0.46	0.46	0.43	0.29	0.32	0.52	0.28	0.30	0.42	0.32	0.33	0.13	0.13	0.22	0.21	0.21	0.32	0.16	0.09	0.05
15	0.54	0.41	0.41	0.58	0.47	0.41	0.39	0.50	0.42	0.46	0.35	0.35	0.27	0.32	0.30	0.29	0.38	0.32	0.11	0.22	0.10
Mean; SD		**0.58; ±0.18**			**0.50; ±0.16**			**0.44; ±0.14**			**0.46; ±0.15**			**0.29; ±0.11**			**0.35; ±0.15**			**0.13; ±0.09**	

Table 4: Rating Results for BYR Audio Clips

* Audio clips listed chronologically.

[t] T1-T3 are the first-third times the rater heard the clip.

	Rater:														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Control Clip 1	0.88	1.00	1.00	0.92	1.00	1.00	1.00	1.00	1.00	1.00	0.60	0.96	1.00	0.87	0.94
Control Clip 2	0.94	1.00	0.93	0.75	0.98	1.00	0.96	1.00	1.00	1.00	1.00	0.88	1.00	0.90	0.91
Control Clip 3	0.88	1.00	1.00	0.96	1.00	0.98	0.98	0.98	1.00	1.00	0.80	0.88	0.97	0.89	0.88

Table 5: Rating Results for Control Audio Clips

	Rater:															**Mean *k* value**	***k* value Standard Deviation**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**		
Krippendorff's Alpha (*k* value)	0.79	0.72	0.82	0.61	0.69	0.81	0.58	0.92	0.91	0.88	0.73	0.86	0.66	0.68	0.75	0.76	+/- 0.11

Table 6: Krippendorff's Alpha Coefficient for Each Rater. With mean *k* value and standard deviation

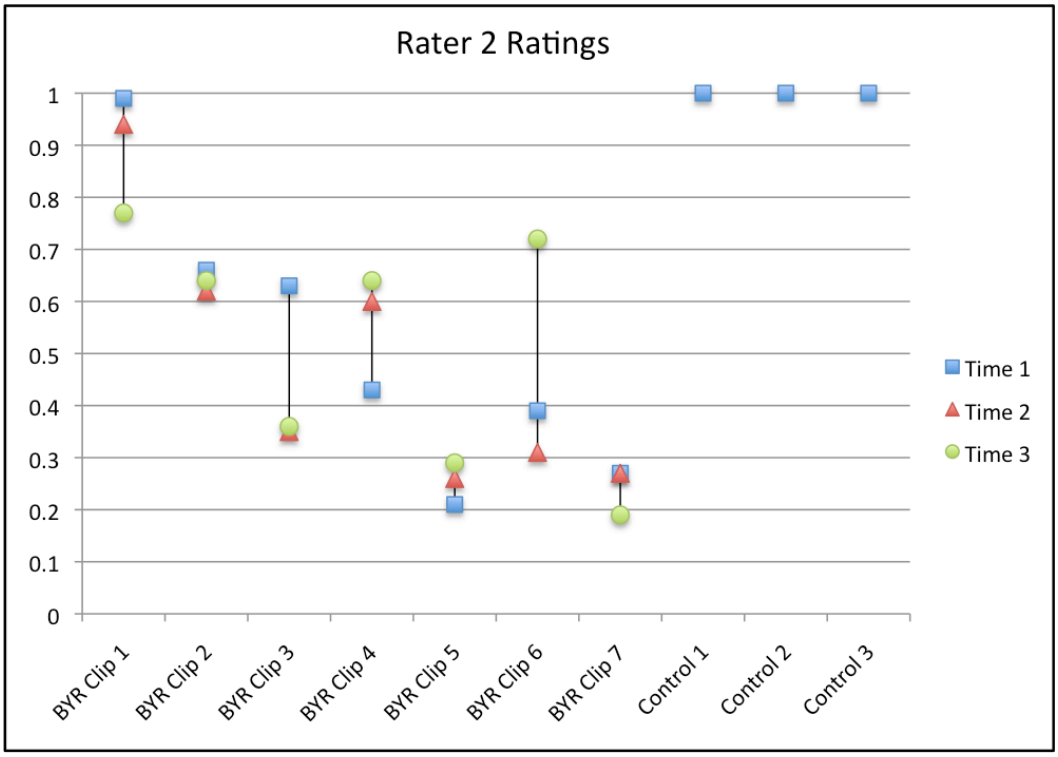

Figure 8: Rating Results for Rater 2 – Wide Rating Distribution

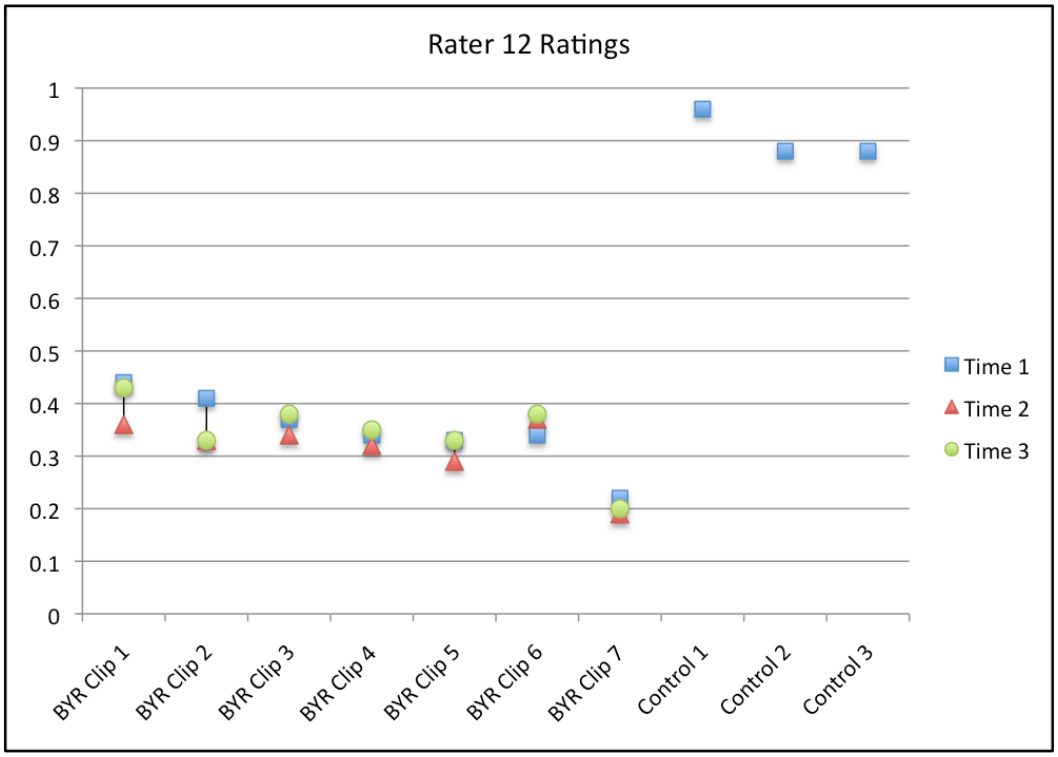

Figure 9: Rating Results for Rater 12 – Narrow Rating Distribution

The downward trend of ratings for BYR's narratives over time seen in the data from Rater 2 and Rater 12 is also present in the aggregated ratings from all raters (Figure 10). Average ratings for BYR narratives dropped from about 0.58 to about 0.12; however not every narrative was progressively rated as being worse than the chronologically previous one. BYR's clip 4 had a slightly higher average rating than clip 3 and the same is true for clips 5 and 6. This may reflect the day-to-day variability BYR experienced with speech and language production rather than speech and language improvements during the course of PPA's progression. It is also possible that her medications where changed at various points in time; some medications are known to affect cognition and language. Figure 10 also shows standard deviations (SD) from each mean of ratings. SDs ranged from 0.58 for clip 1 to 0.13 for clip 7. Overall SDs decreased over time. This may mean that raters' judgments were more consistent on poorer narratives than better narratives. Alternatively, it may mean that there was more room on the analog scale for making judgments on the better narratives; the converse of this is that the scale bottomed out because zero was the lowest rating a narrative could receive. At the very least, this floor effect most likely influenced the small SD outcome for the final clip.

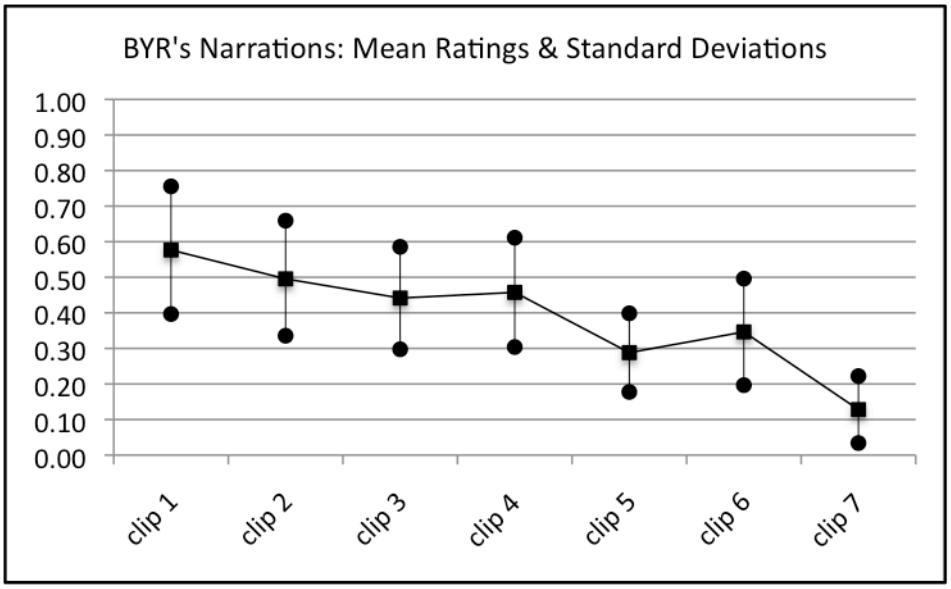

Figure 10: Mean Ratings and Standard Deviations for Each BYR Narrative

5C.I. INTRA-RATER RELIABILITY FOR GOODNESS RATINGS

Intra-rater reliability was determined to verify how consistently each rater scored BYR's narratives. Krippendorff's alpha or '*k* value' was calculated for each rater. Results are shown in Table 6 (above) and Figure 11 (below). Raters' *k* values ranged from 0.58 to 0.92 indicating that at least some raters were highly reliable and others were not as reliable. A *k* value of 1.00 would indicate that a rater was perfectly reliable for all ratings of each narrative (i.e. each of the three instances of each clip was scored exactly the same, which would be extremely difficult if not statistically impossible to do on an analog scale). A *k* value of zero would indicate no scoring reliability. Outliers may have the affect of exaggerating the range of *k* value variability. To determine if this was the case, the mean *k* value (0.76) and SD (±0.11) were found. Error bars on

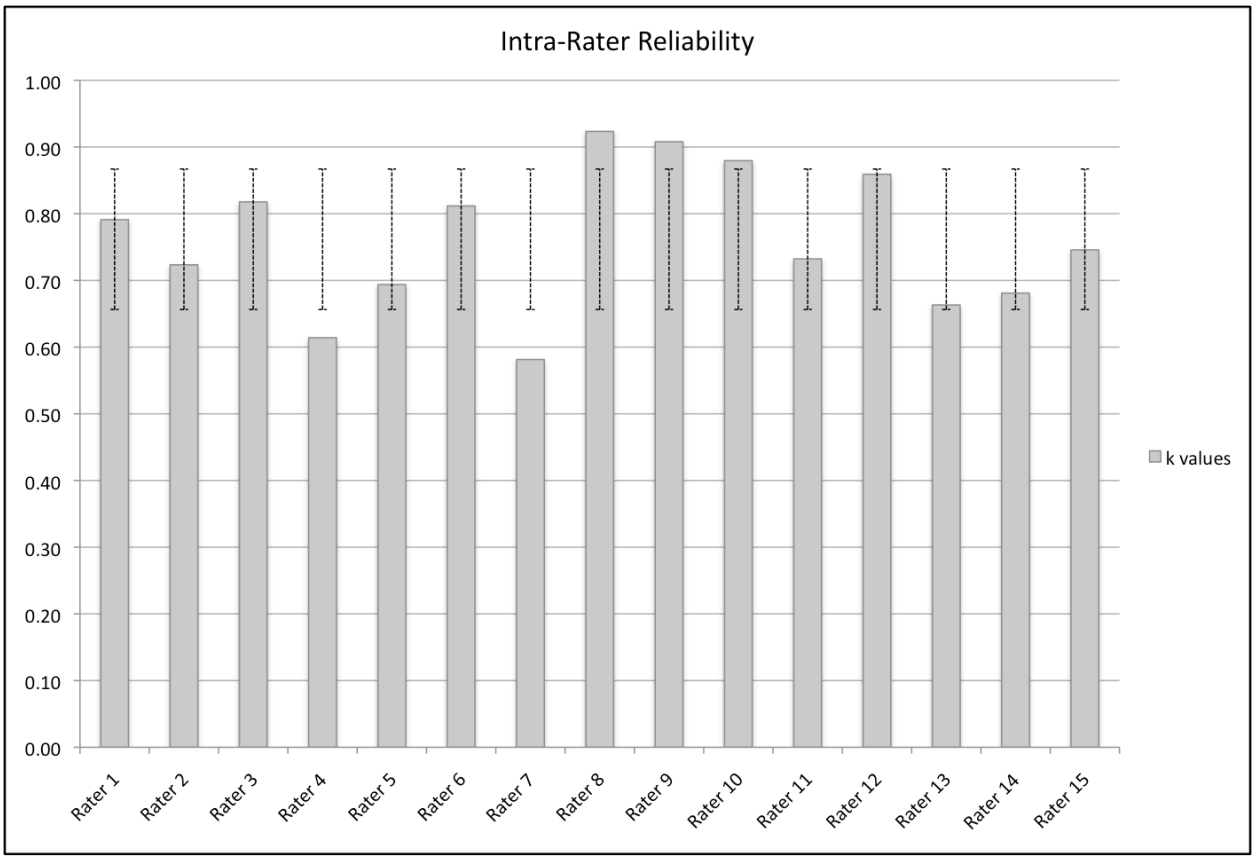

Figure 11: Krippendorff's Alpha Coefficient for Each Rater
* Error bars indicate one standard deviation from the mean *k* value.

Figure 11 show the span of one SD above and below the mean. Ten of fifteen reliability scores fell within one SD of the mean. An additional three scores were above this range and two scores were below it. Two SDs above and below the mean have values of 0.97 and 0.55; all reliability scores were within two SDs from the mean. These results indicate that no rater was a singular outlier in terms of rating reliability and so the results most likely reflect the variability of perception and rating for BYR's narratives presented in the manner described above.

5D. CONSTRUCT VALIDITY

Construct validity for the LCM-SS was determined by comparing overall goodness rating scores with the LCM-SS indexical results. First, the goodness rating score for each narrative was determined by running a principal components analysis. The resulting first principal component (PC1) for each narrative was very similar to the averages of all ratings (Figure 12), as expected.

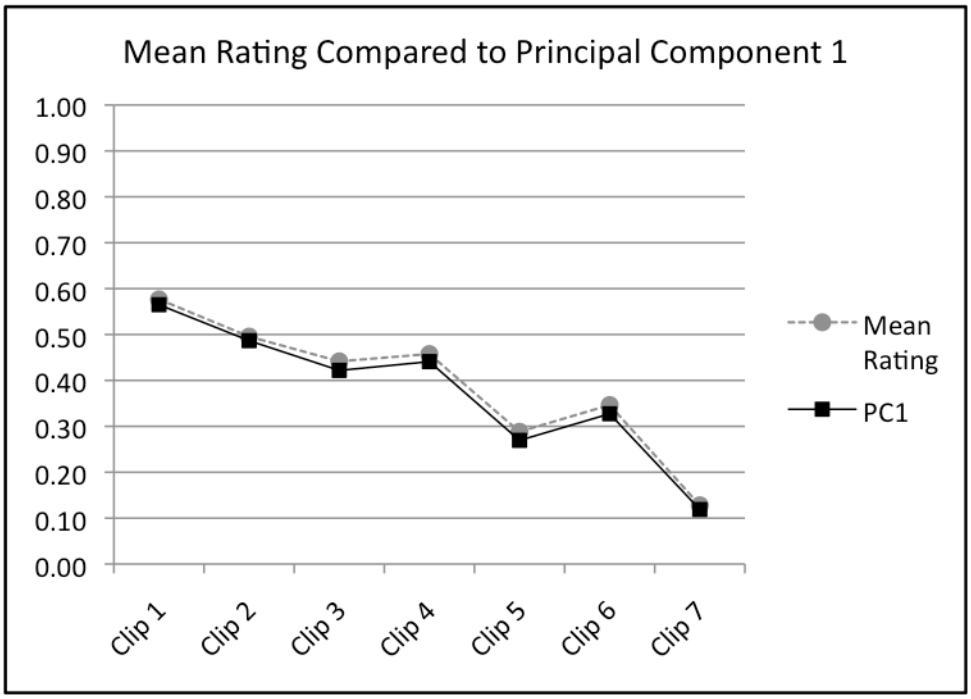

Figure 12: Overall Ratings for BYR Narratives

Next the PC1 scores were compared with each index's scores using Pearson's correlation and multiple regression analysis. Index scores were normalized so that they were on a

comparable scale relative with each other. Pearson's correlations showed that the ICE and the ISouE were individually highly correlated to the PC1 scores (Table 7). Narrative ratings and the ICE decreased over time (0.93 correlation). This implies that raters might have been responding to the decreasing number of CUs produced per unit time. Narrative ratings and the ISouE had an inverse relationship (-0.95 correlation). This suggests that the rate of sound errors had an impact on raters' judgments.

Table 1: Pearson correlation between index results and overall goodness rating of narrative

LCM-SS Index	R	*p*-value
Index of Sound Error	-0.95	0.00096
Index of Communication Efficiency	0.93	0.00209
Index of Grammatical Support	0.54	0.20731
Index of Lexical Efficiency	-0.46	0.29675
Index of Semantic Error	-0.3	0.51118
Index of Grammatical Error	-0.16	0.73486

Table 7: Pearson's Correlations for LCM-SS Indices

For the multiple regression analysis, all possible paired combinations of LCM-SS indices were compared with the PC1 scores. This analysis was in the form of a hierarchical regression with forward switching; indices were only grouped binarily because increasing the number of best-matching indices would have reduced the power of the statistical results. The two indices that resulted in the best regression equation were the IGramE and ISouE (Table 8). Together, they rejected the null hypothesis at a threshold *p*-value of <0.05; the null hypothesis was that no relation existed between overall ratings scores and the LCM-SS indices. In other words, the IGramE and ISouE together are better predictors of PC1 scores than any other combination of indices. This may be an artifact of the raters involved in the rating task that could change if a larger group of raters were used. It may also be an artifact of the narrators (BYR compared with the control speakers) that the raters listened to. The two indices that best predict the overall

goodness rating might have been different if the raters were exposed to more varied speech and language produced by additional narrators with aphasia.

LCM-SS Regression Equation						
Independent Variable	**Regression Coefficient b(i)**	**Standard Error Sb(i)**	**T-Value to test H0:B(i)=0**	**Prob Level**	**Reject H0 at 5%?**	**Power of Test at 5%**
Intercept	0.5818	0.0227	25.665	0.0000	Yes	1.0000
IGramE	0.2139	0.0535	3.996	0.0162	Yes	0.8427
ISouE	-0.8715	0.0613	-14.224	0.0001	Yes	1.0000
Estimated Model: 0.5818 + 0.2139 * IGramE - 0.8715 * ISouE						

Table 8: Regression Analysis Results for LCM-SS Indices

In addition to the regression analysis, analysis of variance (ANOVA) is provided below (Table 9). The ANOVA shows that together (listed as "model" in the "Model Term" column), IGramE and ISouE predict 98% of the variability (R^2) found in the overall rating scores for BYR's narratives. In this model, ISouE accounted for 96% of the variability and IGramE accounted for 8%, which means that ISouE is the more important factor in this ANOVA. Furthermore, these statistics suggest that in order to accurately quantify BYR's narratives in terms of how raters perceive her speech and language, only the ISouE and IGramE need to be calculated.

LCM-SS Analysis of Variance Detail							
Model Term	**DF**	**R^2**	**Sum of Squares**	**Mean Square**	**F-Ratio**	**Prob Level**	**Power (5%)**
Intercept	1		0.88	0.88			
Model	2	0.98	0.12	0.0587	103.81	0.0004	1.0000
IGramE	1	0.08	0.000902	0.00902	15.97	0.0162	0.8427
ISouE	1	0.96	0.11	0.11	202.34	0.0001	1.0000
Error	4	0.02	0.000226	0.000565			
Total(Adjusted)	6	1.00	0.12	0.0199			

Table 9: ANOVA Results for LCM-SS Indices

5E. COMPARISON OF MEASUREMENT TOOLS

The above construct validity procedures used to compare the LCM-SS indices with the PC1 scores were also used on the LCM and LCM-RC. Pearson's correlation analyses revealed that neither LCM index was strongly correlated with the PC1 scores (Table 10). Of the LCM-RC indices, only ICE had a strong correlation (0.97) with the scores. As goodness ratings decreased over time so did the ICE and this was expected, given the correlation result for the LCM-SS above. The multiple regression analysis for the LCM (Table 11) shows that the null hypothesis cannot be rejected; the LCM's ILE and IGS cannot predict overall rating scores with confidence. Additionally, the two indices only predict 58% of the variance in PC1 scores based on the ANOVA (Table 12). In other words, this data shows that the LCM is not an appropriate tool for quantifying BYR's narratives in terms of raters' judgments in a goodness rating task.

Measurement Tool	Measurement Index	Pearson's Correlation
LCM	IGS	0.68
	ILE	-0.46
LCM-RC	**ICE**	**0.97**
	ILR	0.71
	IEr	-0.65
	IEl	-0.60
	IGS	0.45
	ILE	-0.30

Table 10: Pearson's Correlations for LCM & LCM-RC Indices

LCM Regression Equation						
Independent Variable	**Regression Coefficient b(i)**	**Standard Error Sb(i)**	**T-Value to test H0:B(i)=0**	**Prob Level**	**Reject H0 at 5%?**	**Power of Test at 5%**
Intercept	-0.0875	0.6063	-0.144	0.8923	No	0.0515
IGS	2.1672	1.1538	1.878	0.1335	No	0.3038
ILE	-0.9944	0.9330	-1.066	0.3466	No	0.1322
Estimated Model: -8.7464E-02 + 2.1672 * IGS - 0.9944 * ILE						

Table 11: Regression Analysis Results for LCM Indices

LCM Analysis of Variance Detail							
Model Term	**DF**	**R^2**	**Sum of Squares**	**Mean Square**	**F-Ratio**	**Prob Level**	**Power (5%)**
Intercept	1		0.88	0.88			
Model	2	0.58	0.0696	0.0348	2.785	0.1747	0.2890
IGS	1	0.37	0.0441	0.0441	3.528	0.1335	0.3038
ILE	1	0.12	0.0142	0.0142	1.136	0.3466	0.1322
Error	4	0.42	0.05	0.0125			
Total(Adjusted)	6	1.00	0.12	0.0199			

Table 12: ANOVA Results for LCM Indices

The multiple regression analysis for the LCM-RC and PC1 shows that the ICE and IEr were the most highly predictive combination of indices (Table 13). Together they are able to reject the null hypothesis and the test has a high level of power. The ANOVA performed on the LCM-RC indices (Table 14) shows that the ICE and IEr together are able to predict 97% of the variability of PC1 scores. These results suggest that only the ICE and IEr are needed to reliably quantify the BYR narratives in terms of raters' perceptions of goodness.

LCM-RC Regression Equation						
Independent Variable	**Regression Coefficient b(i)**	**Standard Error Sb(i)**	**T-Value to test H0:B(i)=0**	**Prob Level**	**Reject H0 at 5%?**	**Power of Test at 5%**
Intercept	-0.6799	0.1296	-5.244	0.0063	Yes	0.9685
ICE	2.6123	0.2892	9.034	0.0008	Yes	1.0000
IEr	0.1924	0.0825	2.333	0.0800	No	0.4292
Estimated Model: -.6799 + 2.6123 * ICW + 0.1924 * IEr						

Table 13: Regression Analysis Results for LCM-RC Indices

LCM-RC Analysis of Variance Detail							
Model Term	**DF**	**R^2**	**Sum of Squares**	**Mean Square**	**F-Ratio**	**Prob Level**	**Power (5%)**
Intercept	1		0.88	0.88			
Model	2	0.97	0.12	0.0582	71.874	0.0007	1.0000
ICE	1	0.55	0.07	0.07	81.611	0.0008	1.0000
IEr	1	0.04	0.00441	0.00441	5.445	0.0800	0.4292
Error	4	0.03	0.00324	0.000809			
Total(Adjusted)	6	1.00	0.12	0.0199			

Table 14: ANOVA Results for LCM-RC Indices

A qualitative comparison of the analyses results in the finding that the LCM-SS and LCM-RC are perhaps equally good at rejecting the null hypothesis and predicting the variability

of the dependent variable, the PC1 scores. First, the ICE values in both tests and the ISouE values from the LCM-SS are all highly correlated with PC1. Second, the combination of the ISouE and IGramE indices from the LCM-SS and the ICE and IEr indices from the LCM-RC result in a rejection of the null hypothesis. Finally, the R squared values for these two indices from the LCM-SS and LCM-RC are so close (98% and 97%, respectively) that without further statistical analysis, it is not possible to judge one as better than the other. The one index that appears to dominate in terms of correlating with the dependent variable and accounting for the most PC1 variance is the ICE, which was calculated very similarly in both tools. Even though the ISouE has a higher correlation with the PC1 than other LCM-SS indices, the ICE performs better overall within the two measurement tools and therefore has the best association with how raters quantify the goodness of BYR's narratives.

6. Discussion

The central questions and objectives of this study involved describing BYR's speech and language change over the time period of the Cookie Theft recordings and evaluating the measurement indices used to describe BYR's narrative productions. The first question asked for a description of semantic, morphosyntactic and phonetic/phonological properties of BYR's speech and language changes using the LCM-SS measurement tool; answering this question also meets the criteria of this study's descriptive objective. Results of the study's reliability objective showed that the new LCM-SS tool has very high intra-rater reliability (0.97 *k* value).

The Indices of Lexical Efficiency, of Communicative Efficiency, and of Semantic Errors (ILE, ICE, ISemE) capture semantic components of narration that include efficiency of lexical access, narrative fluency and word finding difficulty. Together, the ILE and ICE showed that while BYR was fairly consistent with producing content units until the last recording, it took her

longer to produce the same amount of information about the Cookie Theft picture. This suggests that her lexical access was affected by PPA because narrative fluency decreased while word finding difficulty increased. However, problems with lexical access did not result in an increase in semantic errors; the ISemE remained constant and close to zero across all narratives. This indicates that while lexical access slowed, it did not become more error prone.

Morphosyntactic richness and correctness of BYR's narratives were reflected in the Indices of Grammatical Support and Grammatical Errors (IGS, IGramE). Use of free and bound grammatical morphemes decreased over time, but only slightly. Morphosyntactic components of BYR's narratives can not be characterized as impoverished, even in the later narratives. The IGramE showed that grammatical errors remained low to almost absent in all narratives. Together, the morphosyntactic indices indicate that PPA did not affect grammatical aspects of BYR's language production during narration.

The final component of speech/language analysis looked at phonetic and phonological properties of BYR's speech. The Index of Sound Errors (ISouE) increased steadily over all recordings, which indicates that BYR had increasing impairment with phonetic and phonological aspects of narrative production. Presumably, an ability index would have decreased over time in an inverse relationship with the ISouE. This is the only component that did not have an ability index along with an error index. The only ability index for phonetic/phonological components of a language sample analysis this researcher is familiar with is the LIPP program. This program requires phonemic transcription of the whole language sample, which is a procedure that is not compatible with the criteria set forth for the measurement tool developed for this study. Criteria include that the tool be quick and easy to use in either a clinical or research setting (see Measures and Procedures, above).

The second question this study answered involves the LCM-SS indices that best reflect BYR's speech and language difficulties and change over time. The LCM-SS's construct validity was tested to answer this question. The ISouE and ICE were individually highly correlated with raters' judgments of narrative goodness. By itself, either of these would be an appropriate substitution in lieu of implementing the entire LCM-SS in order to achieve results similar to the raters' judgments for BYR's narratives. The IGramE, ISemE and IGS were not individually highly correlated with the narratives ratings presumably because BYR made few grammatical and semantic errors, and she continued to use grammatical morphemes throughout all narratives. The ILE was also not highly correlated with narrative ratings because BYR's ratio of words to CUs remained fairly constant. If two indices are collectively substituted for the entire LCM-SS then the combination of the ISouE and the IGramE best predict BYR's narrative ratings. This finding was surprising given that the IGramE by itself only had a -0.16 correlation with the ratings. The effect of combining this fairly uncorrelated index with the highly correlating ISouE was an ability to predict 98% of the variance in the rating data. Therefore, in addressing the study's second question, LCM-SS indices proved to be highly correlated with and predictive of narrative ratings. Identifying the overall "best" indices depends if individual indices are wanted or a paired combination of indices is wanted.

This study's third question focused on determining how the three measurement tools compared with the rating data in terms of construct validity. The LCM indices did not have high correlations with overall rating data and the multiple regression analysis and ANOVA did not produce significant results The LCM-SS and LCM-RC were shown to have the most construct validity with the rating method used in this study. Both had indices that were highly correlated with the narrative ratings and that had significant regression and ANOVA results. However,

because construct validity results were so similar for the LCM-SS and LCM-RC, a qualitative comparison cannot be made as to which tool matches best with the goodness ratings. A definitive answer would require additional statistical analyses beyond the purview of the present study.

7. Conclusion

The purposes of this study were accomplished. First, BYR's narratives are described in terms of speech and language deterioration at a level not captured by past analyses. Second, a new measurement tool, the LCM-SS, was developed that captures semantic, morphosyntactic and phonetic/phonological aspects of BYR's narratives. Third, this tool is shown to be reliable and valid.

A future goal is to extend the use of the LCM-SS to other aphasic narratives. Inter-coder reliability needs to be established before the LCM-SS could be offered for general use. It must be tested on additional narratives spoken by people whose aphasia affects phonetic/phonological components of their speech/language. It must also be tested on people whose aphasia primarily impacts semantics and/or morphosyntax. It will not possible to determine if any of the indices are consistently non-significant, when matching quantitative results with qualitative judgments, until the LCM-SS is tested on narratives by people with different types of aphasia. A caveat to the idea of paring down the LCM-SS is that, in the case of PPA, it is unknown what course the deterioration of speech and language will take. The converse of this is also true; it is unknown which direction the course of recovery will take after brain injury (as discussed in the Background section above). Showing the LCM-SS's usefulness for this case study is the first step towards making a larger impact on how aphasic narratives are evaluated.

The impact of this thesis also includes presenting a new way to quantitatively capture speech sound errors. The Index of Sound Errors from the LCM-SS was created to capture phonetic/phonological errors including sound errors and stuttering-like speech. It was shown to be one of the most significant indices that quantitatively identified what listeners perceive as speech and language deterioration. Unlike previous error measures, the ISouE does not conflate the paraphasia types. Semantic paraphasia are captured in the Index of Semantic Errors because they are categorically different from phonemic errors, and so they should be counted separately from phonemic paraphasias. The ISouE also simplifies the way stuttering-like speech is accounted for. Instead of counting each repeated phoneme, which would be a task almost impossible to do online during a clinic session, words with repetitions are counted. This method of accounting for stuttering-like speech was shown to be reliable and it contributed to the ISouE's significant correlations with perception of narrative quality.

Finally, the narrative rating and construct validity procedures used in this study are suggested for use on current and future narrative measurement tools. An intuitive goal for narrative tools is for them to be both statistically significant and clinically meaningful. To be statistically significant, results must be unlikely to have occurred by chance. However, to be clinically meaningful, results must be more than just significant, they must reflect perceived changes. The procedures in this study accomplish this by evaluating the measurement tools based on what educated listeners perceive as changes in BYR's narrative goodness. Narrative measurement tools should be grounded in what is clinically meaningful, and this thesis presents a method for doing that.

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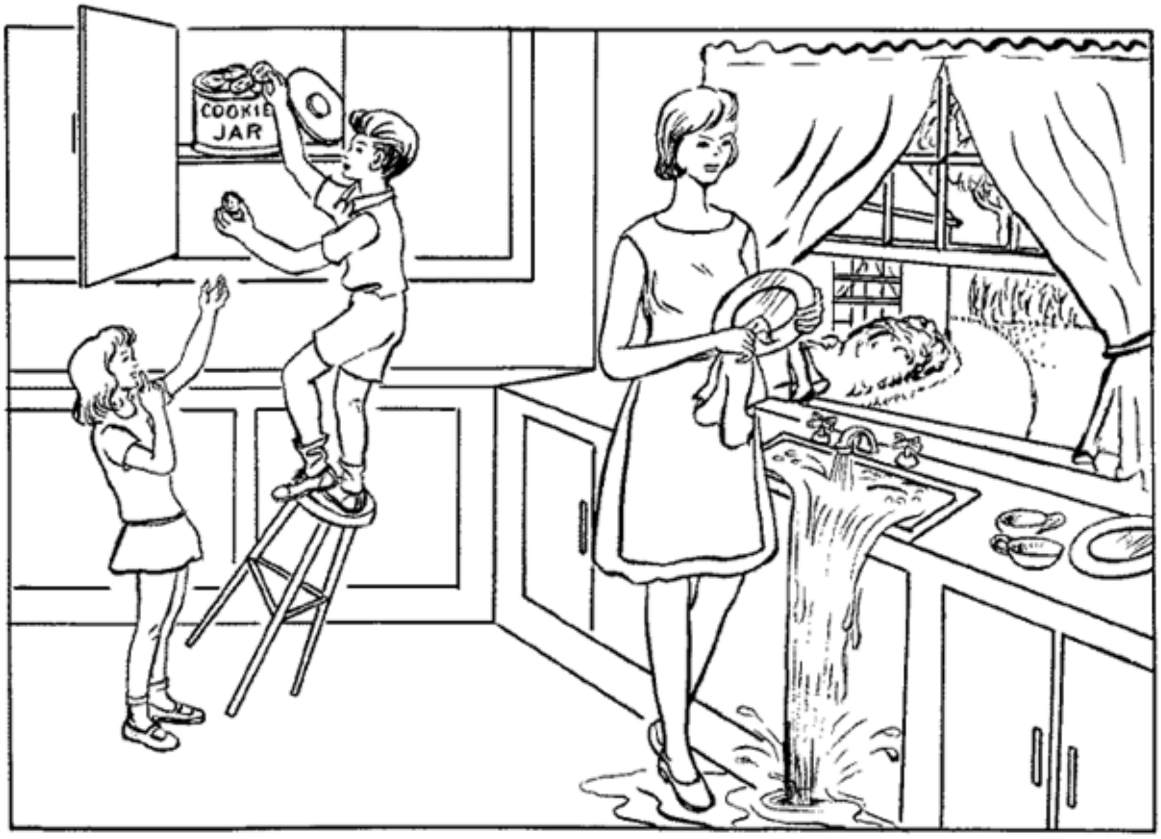
9. APPENDICES

APPENDIX A: BDAE'S COOKIE THEFT PICTURE



APPENDIX B: TRANSCRIPTION CONVENTIONS

A comma represents a pause following an intonation contour that would be transcribed by a comma in ordinary orthography.

A dash at the end of a partial or full word indicates an abrupt stop to the final sound

A dash between partial or full words indicates stuttering-like repetitions of phonemes, phoneme clusters or words.

A colon after a letter indicates a sound that BYR produced for a longer time than sounds normal in typical narrative speech, as judged by the researcher.

Within an utterance, a short silence is indicated by one dot, a medium length of silence is indicated by two dots and a long silence is indicated by three dots.

Anomalous pronunciations are given in phonemic notation set off by slashes: / /. If the word she intended to say is clear given the context, the word appears orthographically after the phonemic production in parentheses and quotations: ("word").

Notes, comments, and glosses of anomalously pronounced words are given in parentheses: ( ).

Overlapping speech lines by two speakers are indicated by greater than/less than signs around the words that overlap: < >.

APPENDIX C: COOKIE THEFT NARRATION NOT INCLUDED IN STUDY

C.i. Narrative dated January 2004 during BYR's first interview and testing session

GR: I want you to take a minute and look at this picture and then what I'd like you to do is, to tell me everything that's going on.
BYR: Hm. Mhm. Okay.
GR: Mhm.
BYR: You wə-want me to-to tell you wə-
GR: Tell me what's going on in the picture.
BYR: uh- yeah. Um the boy tried to uh steal some cookies. And uh.. and uh.. the girl, the sister said d-don't make any.. um make a s-sou-sound. And uh and the mother is um. washing the dishes and sh-she is uh dreaming, thinking and the w-water water was overflow- um fl-fl- flooded. And there was... um dishes on the fling?
GR: You can look at the picture. That's okay.
BYR: OK, alright. And-and-and yeah. And the-the boy was going to fall off.
GR: Mhm... Okay. Good.

APPENDIX D: TRANSCRIBED COOKIE THEFT NARRATIONS

D.i. 1st Transcription: 12 January 2005

GR: Tell me everything you see going on in that picture.
BYR: Yeah.
**[begin analyses]*
BYR: The boy is uh, trying to get uh, to the cookie cookie jar. And the sister is, she /iz/ ("is") uh.. climb up on the /sku/-uh-stool. And the sister wants one of the /ka?/-uh cookie too and ask of the, the boy to uh get hi- get her one. And uh, uh. Meanwhile the, the mother is uh doing dishes an-an ("and-and") she's she's uh daydreaming and uh water-water uh- on the fl-fl-floor and uh an ("and") it's a nice day outside. The window is o- is uh open and so must be nice uh outside.. and she is /noʊ/ ("not") uh a-aware at all about uh what the ki-kids are doing.
**[end analyses]*
GR: That's fine.

D.ii. 2nd Transcription: 7 March 2005

LM: so we're going to ask you again to tell us what you see (puts Cookie Theft picture in front of BYR) in this picture.
**[begin analyses]*
BYR: um the mother i:s doing, uh di– washing the, uh. dishes and uh she- is thinking and uh and she- uh she uh i-i-is not aware the, water is uh. f-flooded the floor and the wo-
BYR: it is a nice day,.. the win-win-window is open, an' children were. uh trying to, um get some – cookies uh in the. um... the higher… (gesture, something horizontal, laughs) the.. on a upper. shelf
LM: mhm!

BYR: and they, the boy- boy had to, uh:. uh step on a – sto-ol to, reach, to the… n– the cookies, and u:m, and sh- he is going to fall uh– fall down, and the uh, the, the sister was saying I wanted one- I want, one too…

**[end analyses]*

LM: that's fine. OK, thanks!

D.iii. 3rd Transcription: 17 August 2005

LM: So, again, if you would look at that picture and tell us the story of what's happening. Okay?

BYR: Mhm…

BYR: You want me to-to-to < Yeah. Okay.>

LM: <you-you can start. Yeah. >

**[begin analyses]*

BYR: um. the mother is uh doing the, um.. dishes and she's thinking and then she, th-uh the uh water was uh.. uh.. um… (hand movement, laughs) uh.. uh… uh, the water. is um… the faucet, she-she let the, f-fauceth. um.. (laughs) the sink, f-full and it was spilling: down to the: floor. And the children were. um, boy and a girl and the uh, the boy is uh.. uh… i:s getting the co-cookies a-and then he's gonna /duv/ fa- fall from the stool, and um. and the girl, his sister, wa-wants to uh.. to uh- ask him to-to get, get her a cookie

**[end analyses]*

BYR: God!

LM: Good!

D.iv. 4th Transcription: 19 December 2005

LM: So, can you tell us the story in English, <of > what's <here?>

BYR: <Yes,> <yes. >

**[begin analyses]*

BYR: Um, mother is-is um. uh. washin. dishes. and she is thinking and uh and she have /eɪd/ (possibly "made"?) the water.. flooded. And the children were-were s-.. um.. try to reach to the /kʊk taɪt/ cookie.. cookie (points to husband, laughs) jar, and the girl, the girl said brother give me /ʌnə/ ("another") one, and he /I-/ the /I-/ the the stool is-is gonna um: fall down. The um… mm.. (makes hand gesture) skip? No. Trip? No. (laughs) Anyway, huh- /I/-/I/-/I/ he is going to fall down.

LM: mhm

BYR: The w-w-win ("window") /I/-/I/-it's a duh- warm day the- one win-window is ob^ ("open")

LM: mhm

BYR: They have all sh-short sleeves… and cups.. all done. (appears to be comment on state of the cups, not a comment about finishing the narrative)

**[end analyses]*

LM: Mhm. That's fine.

D.v. 5th Transcription: 22 April 2006

LM: Alright, so what's going on here?

BYR: (clears throat) xxx (mumbled sounds) okay,

[begin analyses]

BYR: Aaahm… the g- the, the, mother is: doing.. doing.. w-washing dish-ishes, and she is uh.. is uh… dreaming.

LM: (nods, but BYR continues to look at the picture and does not see this)

BYR: and the the the w-w-w-wa-water was- was… (~8 sec pause)

BYR: /ði/ ("the") /ðə/ ("the") sink i:s. over-… (5 sec pause)

BYR: She should-d-d <turn-turned off the-the… (~5 sec pause; small gesture while looking at picture, might be writing)>

LM: <(nods, not seen) >

BYR: the /waər/ ("water")

LM: mhm.

BYR: And the w-. w-w-. w-w-. window is o-o-. is o-over uh, open, and the boy is-is getting-getting cookies from the. she-shelf, and-and the- buh- uh-. his sister wants a-a /k^ki/ ("cookie") also, An' then she- he was-as going to f-fall. fall-all down, because the the stool is-is.. is uh um... is going to fall down.

[end analyses]

LM: (nods) Right.. Okay.

BYR: (laughs and looks up)

D.vi. 6th Transcription: 30 September 2006

GR: (Opens stimulus notebook) Okay. So, you've seen this <picture>

BYR: <Yes > uh ch- (laughs)

GR: Many times.

BYR: Yeah.

GR: What I want'cha t'do is tell <me >

BYR: <Yeah.>

GR: what's happening in the picture.

[begin analyses]

BYR: /ɪ-ɪ/-it's a nə-nice. day. warm. /thæ-/ the w-wi-winda is open.

GR: (nods, but BYR isn't looking – she's continuing to look at the picture)

BYR: and uh. uh. s- the mother is-is. uh.. thy bishin. w-washing dish-dishes

GR: mhm

BYR: and uh- s- an' she is s-sə-sith-thi-think sə-something-thing because of the water-r /ɔ/- /ɔ/- /ɔ/ ("all"?) um. fl-flow over the to the uh the. uh, uh. /fwɔ/- <floors> an' she didn't even see it

GR: <mhm>

GR: mhm

BYR: and the childrens went uh… t-tr-ch-. try to get th:e cookies

GR: mhm

BYR: and the- the. the um the the /bo/ ("boy")- is going to fall down from the stool

GR: mhm

BYR: and uh. the sister want to say heluh- also. uh- also /wəwə/- duh.. uh /k^p-kok-ko-/ /kʊ-/ cookies (screws up face, nods while saying "/kʊ-/ cookies")

[end analyses]

GR: mhm! mhm! Good, good.

D.vii. 7th Transcription: 4 March 2007

BYR: (breathing audibly throughout Cookie Theft description)
GR: And I want you to look at it and tell me everything that's going on.
BYR: xxx um. brea-breathe you know?
GR: Yeah. Do you want to wait until you get your breath?
BYR: (breathes audibly and coughs, waits ~15 seconds)
**[begin analyses]*
BYR: mama is-is pa-pa.. sh- wa- washin. d-.. dis-is,
GR: mhm.
BYR: an-u-tus.. water the-the… is-is st- fili-. s:-sli-. uh. the-the.. uh.. the windows is o-. open. and it's ni-. days. ousi-si-si outside,..
GR: (nods, BYR does not see, BYR looking at the picture)
BYR: the children have, a boy and-and a. gir- (brings hands together, then apart again to resting)
GR: (nods, BYR does not see, BYR looking at the picture)
BYR: ther-there's um girls and uh.. the guh-, the boy is a-a a cook-cook jar-ar-ar, all- ga-a a-a again-s-s-… o-a-a the-the-the. lid and-and he-he is uh-get he is… getting the goo-coo-cookie uh to-to the. sister,..
GR: mhm.
BYR: and uh the- he i-is-is. go. go-going to.. fall-lo-lo ("fall off"?) from the uh stoo-,
GR: mhm.
BYR: and the hallo-of wofe,. uh.. wa- water is-is-is is-is uh. o-over the-the-the fu-fu-floor
**[end analyses]*
GR: Mhm.
BYR: (exhales deeply)
GR: Alright. Good.

APPENDIX E: DETAILED INSTRUCTIONS FOR IMPLEMENTING THE LCM-SS

i: Identifying total number of words

1. Count all of the words in the transcription.
2. Include: incorrect words, neologisms, phonemic paraphasias, semantic paraphasias, full word repetitions, self-corrections (however, false starts on a word that is eventually produced are not included), irrelevant statements, digressions, habitual statements, comments, and fragmants that seem to be identifiable as broken-off words.
3. Exclude: Cross out all hesitation noises, interjections, intranscribable mumbles, false starts on a word that is eventually produced, and a subject's direct responses to questions or probes from the examiner. (When the subject produces a schwa vowel sound, it can be either the hesitation "uh" or the indefinite article 'a'. When 'a' would be grammatically correct, give the subject credit for it and count it as a word.)

ii: Identification of Content Units (CUs)

1. Underline all of the correct informative words. "Correct" means that the word would contribute to the listener's understanding of the scene being narrated, and would not give a listener an incorrect mental picture of the scene. "Informative" means that the word adds significantly to the information that a listener is obtaining for building a mental picture about the scene. Informative words may be any part of speech.
    a. The following are not informative words: neologisms, semantic paraphasias and phonemic paraphasias that result in real non-target English words (i.e.: 'burger' for 'burglar'). A word that echoes a word supplied by the examiner is not considered an informative word.
    b. The following should be included as informative words: broken-off words that a listener would be able to reconstruct correctly with the help of the context a subject provides in the narrative.
    c. Personal pronouns used correctly are counted as informative the first time they appear. Subsequent uses are treated like other repeated words (see step 3).
2. Put parentheses around each informative word and the phrase of words surounding the informative word. The narrative should be divided into the phrases or natural word groups surrounding each informative word. If there is more than one informative word in a set of parentheses, make shorter phrases such that there is one informative word in each set of parentheses.
3. The parentheses are the boundaries of potential Content Units.
4. In a single picture description (i.e.: the 'Cookie Theft'), count only one instance of each informative word, if some are used more than once. Choose the CU to keep based the richness of the surrounding phrase; keep the informative word and its CU that has the most surrounding words and morphology, and cross out the informative word with the less rich CU. In a narrative describing a sequence of actions, count repeated words as informative when their re-use is necessary to make clear who or what is being referred to. Also, if a word is re-used and refers to a different person or object from the earlier referent, it should be counted as an additional correct informative word because it is adding to the listener's understanding.
5. If a CU contains an incorrect or incomplete word that has not been fully self-corrected, cross it out. If a CU contains a self-correction sequence, cross out all of the sequence except for the subject's best effort.

6. All CUs now contain correct informative words and the 'supporting words' that make up the rest of the CU phrases.

iii: Identification of Bound and Free Grammatical Morphemes Within CUs

1. Put a box around (by hand) or italicize (on a computer) the correct <u>bound</u> grammatical morphemes. Word 'endings' are considered bound grammatical morphemes (i.e.: plural, third person *–s*, past tense *–ed*, possessive *–'s*, progressive *–ing*, etc.). Contracted grammatical elements are also considered bound grammatical morphemes (i.e.: negative *–n't*, contracted 'verb + is' forms *–'s* as in 'he's going' and *–'re* as in 'we're going', future tense 'will + verb' form *–'ll* as in 'I'll go', etc.). Additional bound gramatical morphemes include prefixes such as *un-* such as 'unaware' and 'undoing'.
2. Exclude and put a line through: semantically incorrect endings (e.g. plural ending when singular item is being referred to, use of verb + *-ing* when the action referred to is completed. In a syntactically ill-formed phrase like 'you have going', exclude either the 'have' or the *–ing*, as they cannot both be correct.
3. Put a box around (by hand) or italicize (on a computer) the correct <u>free</u> grammatical morphemes. These are also known as closed-class words and consist of articles, pronouns, conjunctions, prepositions, interjections, and numbers. Additional closed-class words are the 'is/are' part of a progressive verb as in 'is going', 'is/are' part of a future tense verb as in 'are going to go', modal verbs (i.e. 'would', 'could', 'should'), negation words 'not' and 'no' as in 'not aware' and 'no one', and the verb infinitive form marker 'to' as in 'to eat'.
4. Count all bound and free grammatical morphemes within CUs that have been circled/italicized.

iv: Identification of Morphosyntactic Errors

1. Look for morphosyntactic errors in the complete narrative as opposed to inside CU boundaries.
2. Highlight in one color all errors of morphology (i.e.: incorrect bound grammatical morphemes, also referred to as word endings and prefixes).
3. Highlight in the same color all syntactic errors, including incorrect forms of words (e.g. 'you have going' which should be 'you have *gone'* or 'you *are* going') and words that are missing (e.g. 'I gave it you' which should be 'I gave it *to* you'). When a phrase is abandonned and a second phrase is started that is syntactically incogruous with the first, do not count it as a syntactic error (e.g. the phrase 'and the water was the sink is over' has no syntactic errors although it does have an abandonned word 'overflowing' which is categorized as a sound error).
4. Include as errors changes in tense and aspect within a phrasal unit, however do not count as errors changes in tense and aspect across the narrative as a whole. It is difficult to determine if the latter changes are correct or incorrect pragmatically durng a narration, therefore determination of correct and consistent use of tense and aspect is kept at a phrasal level.
5. Syntax also includes word order. Highlight each word group that was not spoken in the correct, grammatical order. For instance, the phrase "she was going pool to laps swim" contains three syntactic errors: 'going pool' is missing the preposition 'to' and and either

article ‘the’ or ‘a’ depending on context, and ‘laps’ should come after ‘swim’. The correct form is: ‘she was going *to the/a* pool to *swim laps*’.

6. Count all highlighed morphosyntactic errors.

v: Identification of Semantic Errors

1. Look for semantic errors in the complete narrative as opposed to inside CU boundaries.
2. Highlight in a second color all semantic errors. These will often be considered semantic paraphasias (e.g. ‘spoon’ for ‘fork’). The wrong gender terms are used in the example ‘the sister is, she is uh climb up on the stool’, spoken in reference to the Cookie Theft picture. Count this as a single semantic error because the gender error (i.e. ‘sister’ for ‘brother’ and ‘she’ for ‘he’) is repeated and not corrected.
3. Include first attempts at a word that is eventually produced correctly such as the phrase ‘she, he was…’, produced in reference to a boy.
4. Include attempts at a word which is not eventually produced correctly, even if the spearker recognizes the attempts are incorrect (e.g. “Skip? No. Trip? No. Anyway…” in reference to a boy falling off a stool).
5. Count all of the highlighted semantic errors.

vi: Identification of Sound Errors

1. Look for sound errors in the complete narrative as opposed to inside CU boundaries.
2. Highlight in a third color all sound errors. Sound errors are phonemic paraphasias, neologisms, jargon segments, words that are broken off (e.g. ‘cook jar’ for ‘cookie jar’), and words produced incorrectly that are eventually corrected (e.g. ‘getting the goo-coo-cookie’ has one sound error, ‘goo’ and also has repetition of ‘cookie’).
3. Count all of the highlighted sound errors.

vii: Identification of Repetitions

1. Look for repetitions in the complete narrative as opposed to inside CU boundaries.
2. Circle or highlight all full & partial word, and phrasal repetitions.
    a. For full word repetition, count each instance of the repeated word.
    b. For partial word repetition, count each word that has a partial word repeptition(s) as opposed to counting the number of repetitions. Partial repetition may be producted quickly, therefore counting the number of repetitions may be difficult. If a non-word is repeated, count this as both a sound and a repetition error.
    c. In the example, ‘water is-is-is is-is o-over the-the-the fu-fu-floor’, two words have full word repetition (‘is’ and ‘the’) and one word has a partial word repetition (‘over’). The partial word repetitions of ‘floor’ are considered sound errors and would be counted as two instances of sound errors during the Identification of Sound Errors.
    d. Count each phrasal repetition as a single unit (e.g. ‘the sister is, she is’ contains one phrasal repetition, even though the exact words were not used the second time). Do not count repeated phrases that provide additional information during the second production (e.g. the repetition in ‘and the girl, his sister wants’ provides clarafication as to the girl’s identity and should not be treated as a repetition error).

3. Do not include repetitions when the subject repeats in order to correct a semantic error in the first utterance (e.g. ‘to get hi- get her one’), as these are captured during Identification of Semantic Errors.
4. Do not include repetitions of words that have sound errors and are eventually produced correctly (e.g. ‘/sku/ uh stool’). These are captured during Identification of Sound Errors. In the sequence ‘s-sə-sith-thi-think sə-something-thing’, the first ‘think’ part is counted as both a sound error (because of ‘sith’) and a repetition error (because of ‘thi-think’). The seond, ‘something’, part is counted only as a repetition error because there are no incorrect phonemes in this production.
5. Count all of the partial words with repetitions, and full word and phrasal repetitions.

APPENDIX F: DETAILS OF MEASUREMENT TOOL IMPLEMENTATION ON BYR'S NARRATIONS

F.i. 1st Transcription: 12 January 2005

LCM- total # of words: 93

(17) The boy is ~~uh~~, trying to get ~~uh~~, to the cookie cookie jar. And the sister is, she /iz/
(11) ~~("is")~~ ~~uh~~.. climb up on the ~~/sku/-uh~~-stool. And the sister wants one of the ~~/ka?/-uh~~
(16) cookie too and ask of the, the boy to ~~uh~~ get hi- get her one. And ~~uh, uh~~. Meanwhile
(12) the, the mother is ~~uh~~ doing dishes an-an ~~("and-and")~~ she's she's ~~uh~~ daydreaming and
(13) ~~uh~~ water-water ~~uh-~~ on the ~~fl-fl-~~floor and ~~uh~~ an ~~("and")~~ it's a nice day outside. The
(14) window is ~~o-~~ is ~~uh~~ open and so must be nice ~~uh~~ outside.. and she is /noʊ/ ~~("not")~~ ~~uh~~
(9) ~~a-~~aware at all about ~~uh~~ what the ~~ki-~~kids are doing.

LCM- # of content units (CUs): 18

(4) (The boy) (is trying to get) (to the cookie cookie) (jar.) and the ~~sister~~ is
(3) ~~she~~+ /iz/ ~~["is"]~~ climb up on (the stool.) and (the sister) (wants one of the cookie too)
(3) and (ask of the the boy) (to get hi- get her one.) and meanwhile (the the mother)
(4) (is doing dishes) an-an (she's she's daydreaming) and (water-water) (on the floor) and
(3) an (it's a nice day outside). (The window) (is is open) and so must be nice outside..
(1) and (she is /noʊ/ ~~["not"]~~ aware at all) about what the kids are doing.

LCM- # of correct words in CUs: 54

(14) (The boy) (is trying to get) (to the ~~cookie~~ cookie) (jar) (the stool) (the sister)
(14) (wants one of the cookie too) (ask of the ~~the~~ boy) (to ~~get hi-~~ get her one.)
(8) (~~the~~ the mother) (is doing dishes) (~~she's~~ she's daydreaming) (~~water~~-water)
(12) (on the floor) (it's a nice day outside) (The window) (~~is~~ is open)
(6) (she is /noʊ/ ~~["not"]~~ aware at all)

LCM- # of correct bound/contracted gramm. morphemes in CUs (endings): 7

(1) (The boy) (is try*/ing* to get) (to the cookie) (jar) (the stool)
(1) (the sister) (want*/s* one of the cookie too) (ask of the boy) (to get her one)
(4) (the mother) (is do*/ing* dish*/es*) (she*/'s* daydream*/ing*) (water) (on the floor)
(1) (it*/'s* a nice day outside). (The window) (is open) (she is /noʊ/ ~~["not"]~~ aware at all)

LCM-RC- total # of words: 93

(17) The boy is ~~uh~~, trying to get ~~uh~~, to the cookie cookie jar. And the sister is, she /iz/
(11) ["is"] ~~uh..~~ climb up on the ~~/sku/-uh~~-stool. And the sister wants one of the ~~/ka?/-uh~~
(16) cookie too and ask of the, the boy to ~~uh~~ get hi- get her one. And ~~uh, uh~~. Meanwhile
(12) the, the mother is ~~uh~~ doing dishes an-an ["and-and"] she's she's ~~uh~~ daydreaming and
(13) ~~uh~~ water-water ~~uh-~~ on the ~~fl-fl-~~floor and ~~uh~~ an ["and"] it's a nice day outside. The
(12) window is ~~o-~~ is ~~uh~~ open and so must be nice ~~uh~~ outside.. and she is /noʊ/ ["not"] ~~uh~~
(9) ~~a-~~aware at all about ~~uh~~ what the ~~ki-~~kids are doing.

LCM-RC- # of informative words (i-words): 15

(4) (The boy) (is trying to get to) (the cookie ~~cookie~~) (jar). And the ~~sister~~ is, ~~she~~ /iz/
(2) ["is"] ~~climb up~~ (on the stool). And (the sister) wants one of (~~the cookie~~) too and
(2) (ask of the, ~~the~~ boy to get ~~hi- get~~ her one). And Meanwhile (the, ~~the~~ mother)
(4) (is doing) (dishes) an-an ["and-and"] (she's ~~she's~~ daydreaming) and (water-~~water~~)
(2) (on the floor) and an ["and"] it's a nice day outside (The window is ~~is~~ open) and so
(1) must be nice outside and she is /noʊ/[not] aware at all about what (the kids) are doing.

LCM-RC- # of minutes of narration: 1:10 = 1 + (10/60) = 1.17

LCM-RC- # of grammatical morphemes in i-word units: 25

(9) (**The** boy) (**is** try/**ing to** get **to**) (**the** cookie) (jar) (**on the** stool) (**the** sister)
(8) (ask ~~of~~ **the** boy **to** get **her one**) (**the** mother) (**is** do/**ing**) (dish/**es**)
(8) (**she/'s** daydream/**ing**) (water-) (**on the** floor) (**The** window is open) (**the** kid/**s**)

LCM-RC- # correctly used stem morphemes in i-word units: 0

(*0*) (**The** boy) (**is** *try/***ing to** get **to**) (**the** cookie) (jar) (**on the** stool) (**the** sister)
(*0*) (ask ~~of~~[+] **the** *boy* **to** *get* **her one**) (**the** mother) (**is** *do/***ing**) (dish/**es**)
(*0*) (**she's** daydream/**ing**) (water) (**on the** floor) (**The** window *is open*) (**the** kid/**s**)

LCM-RC- # of jargons, neologisms, phon. & sem. para. in i-word units: 6

(2) The boy is uh, trying to get uh, to the cookie cookie jar. And the **sister** is, **she**
(2) **/iz/** ["is"] uh.. **climb up** on the ~~/sku/-~~uh-stool. And the sister wants one of the ~~/ka?/-~~uh
(1) cookie too and ask of the, the boy to uh get **hi-** get her one. And uh, uh. Meanwhile
(0) the, the mother is uh doing dishes an-an ["and-and"] she's she's uh daydreaming and
(0) uh water-water uh- on the ~~fl-fl-~~floor and uh an ["and"] it's a nice day outside. The
(1) window is ~~o-~~ is uh open and so must be nice uh outside.. and she is **/noʊ/** ["not"] uh
(0) ~~a-~~aware at all about uh what the ~~ki-~~kids are doing.

LCM-RC- # of different word types in 70 words from narrative: 41

LCM-SS- total # of words: 93

(17) The boy is ~~uh~~, trying to get ~~uh~~, to the cookie cookie jar. And the sister is, she /iz/
(11) ["is"] ~~uh~~.. climb up on the ~~/sku/-uh-~~stool. And the sister wants one of the ~~/ka?/-uh~~
(16) cookie too and ask of the, the boy to ~~uh~~ get hi- get her one. And ~~uh, uh~~. Meanwhile
(12) the, the mother is ~~uh~~ doing dishes an-an ["and-and"] she's she's ~~uh~~ daydreaming and
(13) ~~uh~~ water-water ~~uh-~~ on the ~~fl-fl-~~floor and ~~uh~~ an ["and"] it's a nice day outside. The
(14) window is ~~o-~~ is ~~uh~~ open and so must be nice ~~uh~~ outside.. and she is /noʊ/ ["not"] ~~uh~~
(9) ~~a-~~aware at all about ~~uh~~ what the ~~ki-~~kids are doing.

LCM-SS- # of content units (CUs): 18

(4) (The boy) (is trying to get to) (the cookie ~~cookie~~) (jar) And the sister is she /iz/
(3) ["is"] climb up on (the stool). And (the sister) (wants one of the cookie too) and
(3) (ask of the, ~~the~~ boy) (to get ~~hi- get~~ her one). And Meanwhile (the, ~~the~~ mother)
(3) (is doing dishes) an-an ["and-and"] (she's ~~she's~~ daydreaming) and (water-~~water~~)
(4) (on the floor) and an ["and"] (it's a nice day outside) (The window) (is ~~is~~ open) and so
(1) ~~(must be nice outside..)~~ and (she is /noʊ/ ["not"] aware at all) about what ~~(the kids)~~
(0) are doing.

LCM-SS- # of minutes of narration: 1:10 = 1 + (10/60) = **1.17**

LCM-SS- # of correct bound & free gramm. morphemes in CUs: 29

(7) (**The** boy) (**is** try/**ing to** get **to**) (**the** cookie) (jar) (**the** stool) (the sister)
(9) (want/**s one of the** cookie too) (ask ~~of~~ the, boy) (**to** get **her one**) (**the** mother)
(8) (**is** do/**ing** dish/**es**) (**she/'s** daydream/**ing**) (water) (**on the** floor)
(5) (**it**/'s **a** nice day outside) (**The** window) (is open) (**she** is /**noʊ**/ ["not"] aware at all)

LCM-SS- # of morphosyntactic errors: 5

(0) The boy is uh, trying to get uh, to the cookie cookie jar. And the sister is, she /iz/
(1) ["is"] uh.. climbxxx*/ing* up on the /sku/-uh-stool. And the sister wants one of the
(2) /ka?/-uh cookiex*/s* too and askx*/s* of the, the boy to uh get hi- get her one. And uh, uh.
(0) Meanwhile the, the mother is uh doing dishes an-an ["and-and"] she's she's uh
(1) daydreaming and uh water-water uh- xx*/is* on the fl-fl-floor and uh an ["and"] it's a
(1) nice day outside. The window is o- is uh open and so xx*/it* must be nice uh outside..
(0) and she is /noʊ/ ["not"] uh a-aware at all about uh what the ki-kids are doing.

LCM-SS- # of semantic errors: 3

(0) The boy is uh, trying to get uh, to the cookie cookie jar. And the
(1) sister*/brother* is, she*/he* /iz/ ["is"] uh.. climb up on the /sku/-uh-stool. And the sister
(2) wants one of the /ka?/-uh cookie too and ask of the, the boy to uh get hi-*/her* get her
(0) one. And uh, uh. Meanwhile the, the mother is uh doing dishes an-an ["and-and"]
(0) she's she's uh daydreaming and uh water-water uh- on the fl-fl-floor and uh an
(0) ["and"] it's a nice day outside. The window is o- is uh open and so must be nice uh
(0) outside.. and she is /noʊ/ ["not"] uh a-aware at all about uh what the ki-kids are doing.

LCM-SS- # of sound errors: 4

(1) The boy is uh, trying to get uh, to the cookie cookie jar. And the sister is, she /iz/
(1) ["is"] uh.. climb up on the /sku/-uh-stool. And the sister wants one of the
(1) /ka?/-uh cookie too and ask of the, the boy to uh get hi- get her one. And uh, uh.
(0) Meanwhile the, the mother is uh doing dishes an-an ["and-and"] she's she's uh
(0) daydreaming and uh water-water uh- on the fl-fl-floor and uh an ["and"] it's a
(0) nice day outside. The window is o- is uh open and so must be nice uh outside..
(1) and she is /noʊ/ ["not"] uh a-aware at all about uh what the ki-kids are doing.

LCM-SS- # of repetitions: 12

(2) The boy is uh, trying to get uh, to the cookie cookie jar. And the sister is, she /iz/
(0) ["is"] uh.. climb up on the /sku/-uh-stool. And the sister wants one of the
(1) /ka?/-uh cookie too and ask of the, the boy to uh get hi- get her one. And uh, uh.
(3) Meanwhile the, the mother is uh doing dishes an-an ["and-and"] she's she's uh
(3) daydreaming and uh water-water uh- on the fl-fl-floor and uh an ["and"] it's a
(1) nice day outside. The window is o- is uh open and so must be nice uh outside..
(2) and she is /noʊ/ ["not"] uh a-aware at all about uh what the ki-kids are doing.

F.ii. 2nd Transcription: 7 March 2005

LCM- total # of words: 94

(12) ~~um~~ the mother is doing, ~~uh~~ ~~di~~ – washing the ~~uh~~. dishes and ~~uh~~ she- is thinking and
(14) ~~uh~~ and she- ~~uh~~ she ~~uh i-i-~~is not aware the water is ~~uh. f-~~flooded the floor and the
(13) wo- ~~["woman"]~~ it is a nice day,.. the ~~win-win-~~window is open, an' children were. ~~uh~~
(15) trying to ~~um~~ get some cookies ~~uh~~ in the. ~~um~~ the higher… the.. on a upper. Shelf and
(16) they, the boy- boy had to, ~~uh:. uh~~ step on a stool to reach to the… ~~n~~ – the cookies,
(16) and ~~u:m~~, and sh- he is going to fall ~~uh~~ – fall down, and the ~~uh~~, the, the sister was
(8) saying I wanted one- I want, one too…

LCM- # of content units (CUs): 22

(4) (the mother) is doing, di- (washing) (the dishes) and (she is thinking) and and
(4) (she- she is not aware) (the water) (is flooded) (the floor) and the wo- ~~["woman"]~~
(4) (it is a nice day) (the window) (is open) an' children (were trying to get)
(3) (some cookies) in the the higher… the.. (on a upper. shelf) and they, (the boy- boy)
(3) (had to step) (on a stool) (to reach) to the… the cookies and and
(3) (sh- he is going to fall fall down) and (the the the sister) (was saying)
(1) (~~I wanted one-~~ I want, one too)

LCM- # of correct words in CUs: 63

(12) (the mother) (washing) (the dishes) (she is thinking) (~~she-~~ she is not aware)
(15) (the water) (is flooded) (the floor) (it is a nice day) (the window) (is open)
(12) (were trying to get) (some cookies) (on a upper. shelf) (the boy- ~~boy~~)

(14) (had to step) (on a stool) (to reach) (~~sh-~~ he is going to fall ~~fall~~ down)
(8) (~~the the~~ the sister) (was saying) (~~I wanted one-~~ I want, one too)

LCM- # of correct bound/contracted gramm. morphemes in CUs (endings): 8

(3) (the mother) (wash*/ing*) (the dish*/es*) (she is think*/ing*) (she is not aware) (the water)
(2) (is flood*/ed*) (the floor) (it is a nice day) (the window) (is open) (were try*/ing* to get)
(1) (some cook*/ies*) (on a upper shelf) (the boy) (had to step on a stool) (to reach)
(2) (he is go*/ing* to fall down) (the sister) (was say*/ing*) (I want one too)

LCM-RC- total # of words: 94

(12) ~~um~~ the mother is doing, ~~uh~~ ~~di~~– washing the ~~uh~~. dishes and ~~uh~~ she- is thinking and
(14) ~~uh~~ and she- ~~uh~~ she ~~uh i-i-~~is not aware the water is ~~uh~~. ~~f-~~flooded the floor and the
(13) wo- ["woman"] it is a nice day,.. the ~~win-win-~~window is open, an' children were. ~~uh~~
(15) trying to ~~um~~ get some cookies ~~uh~~ in the. ~~um~~ the higher… the.. on a upper. Shelf and
(16) they, the boy- boy had to, ~~uh:.~~ ~~uh~~ step on a stool to reach to the… ~~n–~~ the cookies,
(16) and ~~u:m~~, and sh- he is going to fall ~~uh–~~ fall down, and the ~~uh~~, the, the sister was
(8) saying I wanted one- I want, one too…

LCM-RC- # of informative words (i-words): 19

(3) (the mother) is doing, di– (washing) (the dishes) and she- is thinking and
(4) and (she- ~~she~~ is not aware) (the water) (is flooded) (the floor) and
(1) ~~(the wo- ["woman"])~~ it is a nice day, (the window is open), an'
(2) (children ~~children)~~ (were trying to get) ~~(some cookies)~~ in the the higher the
(5) (on a upper. shelf) they, (the boy- ~~boy~~) (had to, step) (on a stool) (to reach)
(2) (to the… ~~the~~ cookies) and and (~~sh-~~ he is going to fall ~~fall~~ down), and
(2) (the ~~the the~~ sister) (was saying ~~I wanted one-~~ I want, one too)…

LCM-RC- # of minutes of narration: 1:28 = 1 + (28/60) = **1.47**

LCM-RC- # of grammatical morphemes in i-word units: 33

(8) (**the** mother) (wash/**ing**) (**the** dish/**es**) (**she** is **not** aware) (**the** water) (~~is~~ flood/**ed**)
(8) (**the** floor) (**the** window is open) (child/**ren**) (**were** try/**ing to** get) (**on a** upper shelf)
(8) (**the** boy) (had **to** step) (**on a** stool) (**to** reach) (**to the** cook/**ies**)
(9) (**he is** go/**ing to** fall down)(**the** sister) (**was** say/**ing I** want **one** too)

LCM-RC- # correctly used stem morphemes in i-word units: 0

(*0*) (**the** mother) (wash/**ing**) (**the** dish/**es**) (**she** *is* **not** aware) (**the** water) (~~is~~ flood/**ed**)
(*0*) (**the** floor) (**the** window *is open*) (child/**ren**) (**were** *try*/**ing to** get) (**on a** *upper* shelf)
(*0*) (**the** boy) (*had* **to** step) (**on a** stool) (**to** reach) (**to the** cook/**ies**)
(*0*) (**he is** go/**ing to** fall *down*)(**the** sister) (**was** say/**ing I** *want* **one** *too*)

LCM-RC- # of jargons, neologisms, phon. & sem. para. in i-word units: 3

(0) um the mother is doing, uh ~~di~~– washing the uh. dishes and uh she- is thinking and
(0) uh and she- uh she uh ~~i-i-~~is not aware the water is uh.~~f-~~flooded the floor and the
(1) **wo-** ["woman"] it is a nice day,.. the ~~win-win-~~window is open, an' children were. uh
(0) trying to um get some cookies uh in the. um the higher… the.. on a upper. Shelf and
(0) they, the boy- boy had to, uh:. uh step on a stool to reach to the… ~~n–~~ the cookies,
(1) and u:m, and **sh-** he is going to fall uh– fall down, and the uh, the, the sister was
(0) saying I wanted one- I want, one too…

LCM-RC- # of different word types in 70 words from narrative: 37

LCM-SS- total # of words: 94

(12) ~~um~~ the mother is doing, ~~uh~~ ~~di~~– washing the ~~uh~~. dishes and ~~uh~~ she- is thinking and
(14) ~~uh~~ and she- ~~uh~~ she ~~uh i-i-~~is not aware the water is ~~uh~~. ~~f-~~flooded the floor and the

(13) wo- ["woman"] it is a nice day,.. the ~~win-win-~~window is open, an' children were. ~~uh~~
(15) trying to ~~um~~ get some cookies ~~uh~~ in the. ~~um~~ the higher… the.. on a upper. Shelf and
(16) they, the boy- boy had to, ~~uh:.~~ ~~uh~~ step on a stool to reach to the… ~~n–~~ the cookies,
(16) and ~~u:m~~, and sh- he is going to fall ~~uh–~~ fall down, and the ~~uh~~, the, the sister was
(8) saying I wanted one- I want, one too…

LCM-SS- # of content units (CUs): 22

(4) (the mother) is doing, di– (washing) (the dishes) and (she- is thinking) and
(4) and (she- ~~she~~ is not aware) (the water) (is flooded) (the floor) and
(3) ~~(the wo- ["woman"])~~ (it is a nice day,) (the window) (is open), an'
(1) ~~(children children)~~ (were trying to get) ~~(some cookies)~~ in the the higher the
(5) (on a upper. shelf) they, (the boy- ~~boy~~) (had to, step) (on a stool) (to reach)
(2) (to the… ~~the~~ cookies) and and (~~sh-~~ he is going to fall ~~fall~~ down), and
(3) (the ~~the the~~ sister) (was saying) ~~(I wanted one)~~ (I want, one too)…

LCM-SS- # of minutes of narration: 1:28 = 1 + (28/60) = **1.47**

LCM-SS- # of correct bound & free gramm. morphemes in CUs: 37

(9) (**the** mother) (wash/**ing**) (**the** dish/**es**) (**she- is** think/**ing**) (**she** is **not** aware)
(6) (**the** water) (~~is~~ flood/**ed**) (**the** floor) (**it** is **a** nice day) (**the** window) (is open)
(9) (**were** try/**ing to** get) (**on a** upper shelf) (**the** boy) (had **to** step) (**on a** stool)
(11) (**to** reach) (**to the** cook/**ies**) (**he is** go/**ing to** fall down)(**the** sister) (**was** say/**ing**)
(2) (**I** want **one** too)

LCM-SS- # of morphosyntactic errors: 1

(0) um the mother is doing, uh di– washing the uh. dishes and uh she- is thinking and
(1) uh and she- uh she uh i-i-is not aware the water is/*has* uh. f-flooded the floor and the
(0) wo- ["woman"] it is a nice day,.. the win-win-window is open, an' children were. uh
(0) trying to um get some cookies uh in the. um the higher… the.. on a upper. Shelf and
(0) they, the boy- boy had to, uh:. uh step on a stool to reach to the… n– the cookies,
(0) and u:m, and sh- he is going to fall uh– fall down, and the uh, the, the sister was
(0) saying I wanted one- I want, one too…

LCM-SS- # of semantic errors: 2

(0) um the mother is doing, uh di– washing the uh. dishes and uh she- is thinking and
(1) uh and she- uh she uh i-i-is not aware the water is uh. f-flooded the floor and the
(0) wo- ["woman"] it is a nice day,.. the win-win-window is open, an' children were. uh
(0) trying to um get some cookies uh in/*on* the. um the higher… the.. on a upper. Shelf
(0) and they, the boy- boy had to, uh:. uh step on a stool to reach to the… n– the cookies,
(1) and u:m, and sh-/*he* he is going to fall uh– fall down, and the uh, the, the sister was
(0) saying I wanted one- I want, one too…

LCM-SS- # of sound errors: 3

(1) um the mother is doing, uh di– washing the uh. dishes and uh she- is thinking and
(0) uh and she- uh she uh i-i-is not aware the water is uh. f-flooded the floor and the
(1) wo- ["woman"] it is a nice day,.. the win-win-window is open, an' children were. uh
(0) trying to um get some cookies uh in the. um the higher… the.. on a upper. shelf and
(1) they, the boy- boy had to, uh:. uh step on a stool to reach to the… n– the cookies,
(0) and u:m, and sh- he is going to fall uh– fall down, and the uh, the, the sister was
(0) saying I wanted one- I want, one too…

LCM-SS- # of repetitions: 11

(0) um the mother is doing, uh di– washing the uh. dishes and uh she- is thinking and

(3) uh and she- uh she uh i-i-is not aware the water is uh. f-flooded the floor and the
(1) wo- ["woman"] it is a nice day,.. the win-win-window is open, an' children were. uh
(2) trying to um get some cookies uh in the. um the higher… the.. on a upper. Shelf and
(1) they, the boy- boy had to, uh:. uh step on a stool to reach to the… n– the cookies,
(3) and u:m, and sh- he is going to fall uh– fall down, and the uh, the, the sister was
(1) saying I wanted one- I want, one too…

F.iii. 3rd Transcription: 17 August 2005

LCM- total # of words: 80

(12) ~~um~~. the mother is ~~uh~~ doing the, ~~um~~.. dishes and she's thinking and then she, ~~th-uh~~
(10) the ~~uh~~ water was ~~uh.. uh.. um…~~ ~~uh.. uh… uh,~~ the water. is ~~um…~~ the faucet, she-she
(16) let the~~, f-~~fauceth. ~~um..~~ the sink, ~~f-~~full and it was spilling: down to the: floor. And the
(14) children were. ~~um~~, boy and a girl and the ~~uh,~~ the boy is ~~uh.. uh…~~ i:s getting the ~~co-~~
(15) cookies ~~a-~~and then he's gonna /duv/ ~~fa-~~ fall from the stool, and ~~um.~~ and the girl, his
(13) sister, ~~wa-~~wants to ~~uh..~~ to~~-uh-~~ ask him to-to get, get her a cookie

LCM- # of content units (CUs): 17

(4) (the mother) (is doing the dishes) and (she's thinking) and then she (the water was)
(3) the water is (the faucet) she-she let the-fauceth (the sink) (full) and
(4) (it was spilling down) (to the floor) And the children were (boy) and (a girl) and
(3) (the the boy is is getting) (the cookies) and then (he's gonna /duv/ fall)
(2) (from the stool) and and the girl, (his sister wants to to ask him)
(1) (to-to get, get her a cookie)

LCM- # of correct words in CUs: 48

(13) (the mother) (is doing the dishes) (she's thinking) (the water was) (the faucet)
(13) (the sink) (full) (it was spilling down) (to the floor) (boy) (a girl)
(11) (the ~~the~~ boy is is getting) (the cookies) (~~he's gonna~~ /~~duv~~/ (fall) (from the stool)
(11) (his sister wants to ~~to~~ ask him) (to-~~to~~ get, ~~get~~ her a cookie)

LCM- # of correct bound/contracted gramm. morphemes in CUs (endings): 8

(4) (the mother) (is do*/ing* the dish*/es*) (she*/'s* think*/ing*) (the water was) (the faucet)
(2) (the sink) (full) (it was spill*/ing* down) (to the floor) (boy) (a girl) (the boy is gett*/ing*)
(2) (the cook*/ies*) (fall) (from the stool) (his sister want*/s* to ask him) (to get her a cookie)

LCM-RC- total # of words: 80

(12) ~~um~~. the mother is ~~uh~~ doing the, ~~um..~~ dishes and she's thinking and then she, ~~th-uh~~
(10) the ~~uh~~ water was ~~uh.. uh.. um… uh.. uh… uh,~~ the water. is ~~um…~~ the faucet, she-she
(16) let the, ~~f-~~fauceth. ~~um~~.. the sink, ~~f-~~full and it was spilling: down to the: floor. And the
(14) children were. ~~um~~, boy and a girl and the ~~uh~~, the boy is ~~uh.. uh…~~ i:s getting the ~~co-~~
(15) cookies ~~a-~~and then he's gonna /duv/ ~~fa-~~ fall from the stool, and ~~um~~. and the girl, his
(13) sister, ~~wa-~~wants to ~~uh~~.. to ~~uh-~~ ask him to-to get, get her a cookie

LCM-RC- # of informative words (i-words): 17

(4) (the mother) (is doing) (the dishes) and (she's thinking) and then she
(3) (~~the water was~~ the water is) ~~(the faucet)~~ (she-she let the fauceth) (the sink full) and
(4) (it was spilling) (down to the floor) And (the children were) ~~(boy)~~ and (a girl) and
(4) (the the boy) (is is getting) (the cookies) and then (he's gonna /duv/ fall)
(1) (from the stool) and and ~~(the girl,) (his sister)~~
(1) (wants to to ask him to-to get, get her a cookie)

LCM-RC- # of minutes of narration: 1:28 = 1 + (28/60) = **1.47**

LCM-RC- # of grammatical morphemes in i-word units: 32
(9) (**the** mother) (**is** do/**ing**) (**the** dish/**es**) (**she/'s** think/**ing**) (**the** water is)
(8) (**she-**~~she~~ let **the** fauceth) (**the** sink full) (**it was** spill/**ing**) (down **to the** floor)
(8) (**the** child/**ren** were) (**a** girl) (**the** ~~the~~ boy) (**the** cook/**ies**) (**he/'s** gonna /~~duv~~/ fall)
(8) (**from the** stool) (want/**s to** ~~to~~ ask **him to-**~~to~~ get, ~~get~~ **her a** cookie)

LCM-RC- # correctly used stem morphemes in i-word units: 2
(*0*) (**the** mother) (**is** *do*/**ing**) (**the** dish/**es**) (**she/'s** think/**ing**) (**the** water *is*)
(*0*) (**she-**~~she~~ *let* **the** fauceth) (**the** sink *full*) (**it was** spill/**ing**) (*down* **to the** floor)
(*0*) (**the** child/**ren** *were*) (**a** girl) (**the** ~~the~~ boy) (**the** cook/**ies**) (**he/'s** *GONNA* /~~duv~~/ fall)
(*0*) (**from the** stool) (*want*/**s to** ~~to~~ ask **him to-**~~to~~ *get*, ~~get~~ **her a** *cookie*)

LCM-RC- # of jargons, neologisms, phon. & sem. para. in i-word units: 2
(0) the mother is doing the, dishes and she's thinking and then she, the water was the
(1) water. is the faucet, she-she let the, **fauceth**. the sink, full and it was spilling: down to
(0) the: floor. And the children were. boy and a girl and the the boy is i:s getting the
(1) cookies and then he's gonna **/duv/** fall from the stool, and and the girl, his sister,
(0) wants to to ask him to-to get, get her a cookie

LCM-RC- # of different word types in 70 words from narrative: 34

LCM-SS- total # of words: 80
(12) ~~um~~. the mother is ~~uh~~ doing the, ~~um..~~ dishes and she's thinking and then she, ~~th-uh~~
(10) the ~~uh~~ water was ~~uh.. uh.. um… uh.. uh… uh,~~ the water. is ~~um…~~ the faucet, she-she
(16) let the, ~~f-~~fauceth. ~~um~~.. the sink, ~~f-~~full and it was spilling: down to the: floor. And the
(14) children were. ~~um~~, boy and a girl and the ~~uh~~, the boy is ~~uh.. uh…~~ i:s getting the ~~co-~~
(15) cookies ~~a-~~and then he's gonna /duv/ ~~fa-~~ fall from the stool, and ~~um~~. and the girl, his
(13) sister, ~~wa-~~wants to ~~uh~~.. to ~~uh-~~ ask him to-to get, get her a cookie

LCM-SS- # of content units (CUs): 17
(3) (the mother) (is doing the dishes) and (she's thinking) and then she
(1) (~~the water was~~ the water is) ~~(the faucet)~~
(5) (she-she let the fauceth) (the sink) (full) and (it was spilling) (down to the floor)
(4) And ~~(the children were)(boy)~~ and (a girl) and (the the boy) (is is getting) (the cookies)
(2) and then (he's gonna /duv/ fall) (from the stool) and and
(2) ~~(the girl,) (his sister)~~ (wants to to ask him) (to-to get, get her) ~~(a cookie)~~

LCM-SS- # of minutes of narration: 1:28 = 1 + (28/60) = **1.47**

LCM-SS- # of correct bound & free gramm. morphemes in CUs: 30
(9) (**the** mother) (**is** do/**ing the** dish/**es**) (**she/'s** think/**ing**) (~~the water was~~ **the** water is)
(8) (**she-**~~she~~ let **the** fauceth) (**the** sink) (full) (**it was** spill/**ing**) (down **to the** floor)
(8) (**a** girl) (**the** ~~the~~ boy) (**the** cook/**ies**) (**he/'s** gonna /~~duv~~/ fall) (**from the** stool)
(5) (want/**s to** ~~to~~ ask **him**) (**to-**~~to~~ get, ~~get~~ **her**)

LCM-SS- # of morphosyntactic errors: 2
(0) um. the mother is uh doing the, um.. dishes and she's thinking and then she, th-uh
(0) the uh water was uh.. uh.. um… uh.. uh… uh, the water. is um… the faucet, she-she
(1) let the, f-fauceth. um.. the sink, xx/*is* f-full and it was spilling: down to the: floor. And
(1) the children were. um, x/*a* boy and a girl and the uh, the boy is uh.. uh… i:s getting
(0) the co-cookies a-and then he's gonna /duv/ fa- fall from the stool, and um. and the,
(0) girl his sister, wa-wants to uh.. to uh- ask him to-to get, get her a cookie

LCM-SS- # of semantic errors: 0
(0) um. the mother is uh doing the, um.. dishes and she's thinking and then she, th-uh

(0) the uh water was uh.. uh.. um… uh.. uh… uh, the water. is um… the faucet, she-she
(0) let the, f-fauceth. um.. the sink, f-full and it was spilling: down to the: floor. And the
(0) children were. um, boy and a girl and the uh, the boy is uh.. uh… iːs getting the co-
(0) cookies a-and then he's gonna /duv/ fa- fall from the stool, and um. and the girl, his
(0) sister, wa-wants to uh.. to uh- ask him to-to get, get her a cookie

LCM-SS- # of sound errors: 2

(1) um. the mother is uh doing the, um.. dishes and she's thinking and then she, th-uh
(0) the uh water was uh.. uh.. um… uh.. uh… uh, the water. is um… the faucet, she-she
(0) let the, f-fauceth. um.. the sink, f-full and it was spilling: down to the: floor. And the
(0) children were. um, boy and a girl and the uh, the boy is uh.. uh… iːs getting the co-
(1) cookies a-and then he's gonna /duv/ fa- fall from the stool, and um. and the girl, his
(0) sister, wa-wants to uh.. to uh- ask him to-to get, get her a cookie

LCM-SS- # of words with repetitions: 14

(0) um. the mother is uh doing the, um.. dishes and she's thinking and then she, th-uh
(3) the uh water was uh.. uh.. um… uh.. uh… uh, the water. is um… the faucet, she-she
(2) let the, f-fauceth. um.. the sink, f-full and it was spilling: down to the: floor. And the
(2) children were. um, boy and a girl and the uh, the boy is uh.. uh… iːs getting the
(3) co-cookies a-and then he's gonna /duv/ fa- fall from the stool, and um. and the girl,
(4) his sister, wa-wants to uh.. to uh- ask him to-to get, get her a cookie

F.iv. 4th Transcription: 19 December 2005

LCM- total # of words: 86

(13) ~~Um~~, mother is-is ~~um. uh.~~ washin. dishes. and she is thinking and ~~uh~~ and she have
(14) /eɪd/ the water.. flooded. And the children were-were ~~s-..~~ ~~um..~~ try to reach to the
(14) /kʊk taɪt/ cookie.. cookie jar, and the girl, the girl said brother give me
(13) /ʌnə/ ~~("another")~~ one, and he ~~/I-/~~ the ~~/I-/~~ the the stool is-is gonna ~~um:~~ fall down.
(9) The ~~um… mm..~~ skip? No. Trip? No. Anyway, ~~huh- /I/-/I/-/I/~~ he is going
(11) to fall down. The ~~w-w-~~win ~~("window")~~ ~~/I/-/I/-~~it's a ~~duh-~~ warm day the- one ~~win-~~
(12) window is ob^ ~~("open")~~ They have all ~~sh-~~short sleeves… and cups.. all done.

LCM- # of content units (CUs): 21

(5) (mother) (is-is washin) (dishes) and (she is thinking) andand (she have /eɪd/ the water)
(3) (flooded) And the children (were-were try to reach) (to the /kʊk taɪt/ cookie.. cookie)
(5) (jar) and (the girl the girl) (said) (brother) (give me /ʌnə/ ~~["another"]~~ one) and he
(2) (the the the stool) (is-is gonna fall down) The skip? No. Trip? No. Anyway he is
(3) going to fall down. (The ~~w-w-~~win ~~["window"])~~ (it's a warm day) (the- one window)
(3) (is ob^ ~~("open"))~~ (They have all short sleeves) and (cups.. all done)

LCM- # of correct words in CUs: 48

(10) (mother) (~~is-~~is washin) (dishes) (she is thinking) (~~she have~~ ~~/eɪd/~~ the water) (flooded)
(10) (~~were-~~were try to reach) (to the ~~/kʊk taɪt/ cookie..~~ cookie) (jar) (~~the girl~~ the girl)
(6) (said) (brother) (give me ~~/ʌnə/~~ ~~["another"]~~ ~~one~~) (~~the the~~ the stool)
(10) (is-~~is-~~gonna fall down) (The ~~w-w-~~win ~~["window"])~~ (it's a warm day)
(12) (the- one window) (is ob^ ~~["open"]~~) (They have ~~all~~ short sleeves) (cups.. all done)

LCM- # of correct bound/contracted gramm. morphemes in CUs (endings): 7

(4) (mother) (is wash*/in*) (dish*/es*) (she is think*/ing*) (the water) (flood*/ed*)
(0) (were try to reach) (to the cookie) (jar) (the girl) (said) (brother) (give me)
(1) (the stool)(is gonna fall down) (The win ~~["window"])~~ (it*/'s* a warm day)

(2) (the one window) (is ob^ ~~["open"])~~ (They have all short sleev/*es*) (cup/*s*.. all done)

LCM-RC- total # of words: 86

(13) ~~Um,~~ mother is-is ~~um. uh.~~ washin. dishes. and she is thinking and ~~uh~~ and she have
(14) /eɪd/ the water.. flooded. And the children were-were ~~s-.. um..~~ try to reach to the
(14) /kʊk taɪt/ cookie.. cookie jar, and the girl, the girl said brother give me
(13) /ʌnə/ ("another") one, and he ~~/I-/~~ the ~~/I-/~~ the the stool is-is gonna ~~um~~: fall down.
(9) The ~~um… mm..~~ skip? No. Trip? No. Anyway~~, huh- /I/-/I/-/I/~~ he is going
(11) to fall down. The ~~w-w-~~win ("window") ~~/I/-/I/-~~it's a ~~duh-~~ warm day the- one ~~win-~~
(12) window is ob^ ("open") They have all ~~sh-~~short sleeves… and cups.. all done.

LCM-RC- # of informative words (i-words): 16

(5) (mother) (is-is washin) (dishes) and (she is thinking) andand (she have /eɪd/ the water)
(4) (flooded) And (the children) (were-were try to reach) (to the /kʊk taɪt/ cookie cookie)
(3) (jar) and (the girl, the girl) (said brother give me /ʌnə/ ["another"] one) and he
(1) (the the the stool) ~~(is-is gonna fall down)~~ The skip? No. Trip? No. Anyway
(1) (he is going to fall down) ~~(The win ["window"])~~ it's a warm day
(2) (the- one window is ob^ ["open"]) They have all short sleeves and (cups.. all done)

LCM-RC- # of minutes of narration: 1:25 = 1 + (25/60) = **1.42**

LCM-RC- # of grammatical morphemes in i-word units: 25

(8) (mother) (**is**~~-is~~ wash/**in**) (dish/**es**) (**she is** think/**ing**) (**she** have ~~/eɪd/~~ **the** water)
(6) (flood/**ed**) (**the** children) (**were**~~-were~~ try **to** reach) (**to the** ~~/kʊk taɪt~~/ cookie ~~cookie~~)
(5) (jar) (**the** girl~~, the girl~~) (sa/**id** brother give **me** /ʌnə/ ["another"] **one**)(**the** ~~the the~~ stool)
(6) (**he is** go/**ing to** fall down) (**the-** one window is ob^ ["open"]) (cup/**s**.. all done)

LCM-RC- # of correctly used stem morphemes in i-word units: 0

(*0*) (mother) (**is** wash/**in**) (dish/**es**) (**she is** think/**ing**) (**she** *have* **the** water) (flood/**ed**)
(*0*) (**the** children) (**were** *try* **to** reach) (**to the** cookie) (jar) (**the** girl)
(*0*) (sa/**id** *brother give* **me** */ʌnə/* ["another"] **one**) (**the** stool) (**he is** *go/***ing to** fall *down*)
(*0*) (**the** *one* window *is ob^* ["open"]) (cup/**s**.. *all done*)

LCM-RC- # of jargons, neologisms, phon. & sem. para. in i-word units: 7

(0) mother is-is washin. dishes. and she is thinking and and she have /eɪd/ the water..
(2) flooded. And the children were-were ~~s-..~~ try to reach to the **/kʊk taɪt/** cookie.. cookie
(1) jar, and the girl, the girl said brother give me **/ʌnə/** ("another") one, and he the the the
(2) stool is-is gonna fall down. The **skip**? No. **Trip**? No. Anyway, he is going to fall
(2) down. The **win** ("window") it's a warm day the- one window is **ob^** ("open") They
(0) have all short sleeves… and cups.. all done.

LCM-RC- # of different word types in 70 words from narrative: 42

LCM-SS- total # of words: 86

(13) ~~Um,~~ mother is-is ~~um. uh.~~ washin. dishes. and she is thinking and ~~uh~~ and she have
(14) /eɪd/ the water.. flooded. And the children were-were ~~s-.. um..~~ try to reach to the
(14) /kʊk taɪt/ cookie.. cookie jar, and the girl, the girl said brother give me
(13) /ʌnə/ ("another") one, and he ~~/I-/~~ the ~~/I-/~~ the the stool is-is gonna ~~um~~: fall down.
(9) The ~~um… mm..~~ skip? No. Trip? No. Anyway~~, huh- /I/-/I/-/I/~~ he is going
(11) to fall down. The ~~w-w-~~win ("window") ~~/I/-/I/-~~it's a ~~duh-~~ warm day the- one ~~win-~~
(12) window is ob^ ("open") They have all ~~sh-~~short sleeves… and cups.. all done.

LCM-SS- # of content units (CUs): 21

(5) (mother) (is-is washin) (dishes) and (she is thinking) andand (she have /eɪd/ the water)
(3) (flooded) And ~~(the children)~~ (were-were try to reach) (to the /kʊk taɪt/ cookie cookie)

(5) (jar) and (the girl, the girl) (said) (brother) (give me /ʌnə/ ["another"] one) and he
(1) (the the the stool) ~~(is-is gonna fall down)~~ The skip? No. Trip? No. Anyway
(2) (he is going to fall down) ~~(The win ["window"])~~ (it's a warm day)
(4) (the- one window) (is ob^ ["open"]) (They have all short sleeves) and (cups.. all done)

LCM-SS- # of minutes of narration: 1:25 = 1 + (25/60) = **1.42**

LCM-SS- # of correct bound & free gramm. morphemes in CUs: 28

(8) (mother) (**is**-~~is~~ wash/**in**) (dish/**es**) (**she is** think/**ing**) (**she** have ~~/eɪd/~~ **the** water)
(5) (flood/**ed**) (**were**-~~were~~ try **to** reach) (**to the** ~~/kʊk taɪt~~/ cookie ~~cookie~~) (jar)
(4) (**the** girl~~, the girl~~) (sa/**id**) (brother) (give **me** /ʌnə/ ["another"] **one**)
(7) (**the** ~~the the~~ stool) (**he is** go/**ing to** fall down) (**it**/'s **a** warm day)
(4) (**the-** one window) (is ob^ ["open"]) (**They** have ~~all~~ short sleev/**es**) (cup/**s**.. all done)

LCM-SS- # of morphosyntactic errors: 6

(1) Um, mother is-is um. uh. washin. dishes. and she is thinking and uh and she have/*has*
(2) /eɪd/ the water.. xxx/*has* flooded. And the children were-were s-.. um.. tryxxx/*ing* to
(0) reach to the /kʊk taɪt/ cookie.. cookie jar, and the girl, the girl said brother give me
(0) /ʌnə/ ("another") one, and he /I-/ the /I-/ the the stool is-is gonna um: fall down.
(0) The um… mm.. skip? No. Trip? No. Anyway, huh- /I/-/I/-/I/ he is going to fall down.
(0) The w-w-win ("window") /I/-/I/-it's a duh- warm day the- one win-window is ob^
(3) ('open') They have all/*all have* sh-short sleeves… xx/*on* and cups.. xxx/*are* all done.

LCM-SS- # of semantic errors: 2

(0) Um, mother is-is um. uh. washin. dishes. and she is thinking and uh and she have
(0) /eɪd/ the water.. flooded. And the children were-were s-.. um.. try to reach to the
(0) /kʊk taɪt/ cookie.. cookie jar, and the girl, the girl said brother give me
(0) /ʌnə/ ("another") one, and he /I-/ the /I-/ the the stool is-is gonna um: fall down.
(2) The um… mm.. skip? No. Trip? No. Anyway, huh- /I/-/I/-/I/ he is going
(0) to fall down. The w-w-win ("window") /I/-/I/-it's a duh- warm day the- one win-
(0) window is ob^ ("open") They have all sh-short sleeves… and cups.. all done.

LCM-SS- # of sound errors: 11

(0) Um, mother is-is um. uh. washin. dishes. and she is thinking and uh and she have
(2) /eɪd/ the water.. flooded. And the children were-were s-.. um.. try to reach to the
(2) /kʊk taɪt/ cookie.. cookie jar, and the girl, the girl said brother give me
(3) /ʌnə/ ("another") one, and he /I-/ the /I-/ the the stool is-is gonna um: fall down.
(1) The um… mm.. skip? No. Trip? No. Anyway, huh- /I/-/I/-/I/ he is going
(2) to fall down. The w-w-win ("window") /I/-/I/-it's a duh- warm day the- one win-
(1) window is ob^ ("open") They have all sh-short sleeves… and cups.. all done.

LCM-SS- # of words with repetitions: 13

(2) Um, mother is-is um. uh. washin. dishes. and she is thinking and uh and she have
(1) /eɪd/ the water.. flooded. And the children were-were s-.. um.. try to reach to the
(2) /kʊk taɪt/ cookie.. cookie jar, and the girl, the girl said brother give me
(3) /ʌnə/ ("another") one, and he /I-/ the /I-/ the the stool is-is gonna um: fall down.
(1) The um… mm.. skip? No. Trip? No. Anyway, huh- /I/-/I/-/I/ he is going
(2) to fall down. The w-w-win ("window") /I/-/I/-it's a duh- warm day the- one
(2) win-window is ob^ ("open") They have all sh-short sleeves… and cups.. all done.

F.v. 5th Transcription: 22 April 2006

LCM- total # of words: 85

(12) ~~Aaahm…~~ the ~~g-~~ the the mother is doing.. doing.. w-washing dish-ishes and she is
(12) ~~uh..~~ is ~~uh…~~ dreaming and the the the w-w-w-wa-water was was (~8 sec) the the sink
(11) is over (5 sec) She should-d-d turn-turned off the-the (~5 sec) the /waər/ ("water")
(13) And the w- w-w- w-w- window is o-o- is o-over ~~uh~~ open and the boy is-is getting-
(13) getting cookies from the she-shelf and-and the- ~~buh-~~ ~~uh-~~ his sister wants a-a
(13) /k^ki/ ("cookie") also, An' then she- he was-as going to f-fall. fall-all down, because
(11) the the stool is-is.. is ~~uh um..~~ is going to fall down.

LCM- # of content units (CUs): 19

(3) the g- (the the mother) is doing.. doing.. (w-washing) (dish-ishes) and
(2) (she is is dreaming) and (the the the w-w-w-wa-water) was was [~8 sec]
(3) (the the sink) (is over) [5 sec] (She should-d-d turn-turned off) the-the [~5 sec] the
(3) /waər/ And (the w- w-w- w-w- window) (is o-o- is o-over open) and (the boy)
(4) (is-is getting- getting) (cookies) (from the she-shelf) and-and the- buh- (his sister)
(2) (wants a-a /k^ki/ ["cookie"] also) An' then (she- he was-as going to f-fall. fall-all down)
(2) because (the the stool) (is-is.. is is going to fall down)

LCM- # of correct words in CUs: 48

(7) (~~the~~ the mother) (~~w-~~washing) (dish~~-ish~~es) (she is ~~is~~ dreaming)
(10) (~~the the~~ the ~~w-w-w-wa-~~water) (~~the~~ the sink) (is over)(She should-~~d-d~~ ~~turn-~~turned off)
(8) (the ~~w- w-w- w-w-~~ window) (~~is~~ ~~o-o-~~ is ~~o-over~~ open) (the boy) (~~is-~~is ~~getting-~~ getting)
(10) (cookies) (from the ~~she-~~shelf) (his sister) (wants ~~a-~~a /k^ki/ ["cookie"] also)
(8) (~~she-~~ he was~~-as~~ going to ~~f-fall~~ fall~~-all~~ down) (~~the~~ the stool)
(5) (~~is-is.. is~~ is going to fall down)

LCM- # of correct bound/contracted gramm. morphemes in CUs (endings): 9

(3) (the mother) (wash*/ing*) (dish*/es*) (she is dream*/ing*) (the water) (the sink) (is over)
(3) (She should turn*/ed* off) (the window) (is open) (the boy) (is gett*/ing*) (cook*/ies*)
(1) (from the shelf) (his sister) (want*/s* a /k^ki/ ["cookie"] also)
(2) (he was go*/ing* to fall down) (the stool) (is go*/ing* to fall down)

LCM-RC- total # of words: 85

(12) ~~Aaahm…~~ the ~~g-~~ the the mother is doing.. doing.. ~~w-~~washing d~~ish-~~ishes and she is
(12) ~~uh..~~ is ~~uh…~~ dreaming and the the the ~~w-w-w-wa-~~water was was [~8 sec] the the sink
(11) is over [5 sec] She should~~-d-d~~ turn-turned off the-the [~5 sec] the /waər/ ["water"]
(13) And the ~~w- w-w- w-w-~~ window is ~~o-o-~~ is ~~o~~-over ~~uh~~ open and the boy is-is getting-
(13) getting cookies from the ~~she-~~shelf and-and the- ~~buh- uh-~~ his sister wants a-a
(13) /k^ki/ ["cookie"] also, An' then she- he was~~-as~~ going to ~~f~~-fall. fall-~~all~~ down, because
(11) the the stool is-is.. is ~~uh um..~~ is going to fall down.

LCM-RC- # of informative words (i-words): 17

(4) (the the the mother) is doing.. doing.. (washing) (dishes) and (she is is dreaming)
(3) and (the the the water) was was (the the sink) (is over) She should turn-turned off
(2) ~~(the [~5 sec] the /waər/ ["water"])~~ And (the window is is over open) and (the boy)
(4) (is-is getting- getting) (cookies) (from the shelf) and- and the- buh (his sister)
(2) (wants a-a /k^ki/ ["cookie"] also), An' then (she- he was going to fall fall down)
(2) because (the the stool) (is-is is is going to fall down)

LCM-RC- # of minutes of narration: 1:41 = 1 + (41/60) = **1.68**

LCM-RC- # of grammatical morphemes in i-word units: 27

(7) (**the** ~~the the~~ mother) (wash/**ing**) (dish/**es**) (**she is** ~~is~~ dream/**ing**) (**the** ~~the the~~ water)
(6) (**the** ~~the~~ sink) (**is** over) (**the** window is ~~is over~~ open) (**the** boy) (**is**-~~is~~ gett/**ing**- ~~getting~~)
(6) (cook/**ies**) (**from the** shelf) (**his** sister) (want/**s** **a**-~~a~~ /k^ki/ ["cookie"] also)
(8) (~~she~~- **he was** go/**ing to** fall ~~fall~~ down) (**the** ~~the~~ stool) (**is**-~~is is is~~ go/**ing to** fall down)

LCM-RC- # of correctly used stem morphemes in i-word units: 0

(*0*) (**the** mother) (wash/**ing**) (dish/**es**) (**she is** dream/**ing**) (**the** water) (**the** sink) (**is** over)
(*0*) (**She should** turn/**ed** *off*) (**the** window) (*is* open) (**the** boy) (**is** gett/**ing**)
(*0*) (*from* **the** shelf) (**his** sister) (want/**s**) (**a**-~~a~~ /k^ki/ ["cookie"] *also*)
(*0*) (**he was** *go/***ing to** fall *down*) (**the** stool) (**is** *go/***ing to** fall *down*)

LCM-RC- # of jargons, neologisms, phon. & sem. para. in i-word units: 4

(0) the ~~g-~~ the the mother is doing.. doing.. washing d~~ish-~~ishes and she is is dreaming and
(0) the the the water was was the the sink is over She should turn-turned off the-the the
(2) **/waər/** ["water"] And the window is is **over** open and the boy is-is getting- getting
(2) cookies from the shelf and-and the- **buh**- his sister wants a-a **/k^ki/** ["cookie"] also,
(0) An' then she- he was going to fall. fall down, because the the stool is-is.. is is going to
(0) fall down.

LCM-RC- # of different word types in 70 words from narrative: 31

LCM-SS- total # of words: 85

(12) ~~Aaahm…~~ the ~~g-~~ the the mother is doing.. doing.. ~~w-~~washing d~~ish-~~ishes and she is
(12) ~~uh..~~ is ~~uh…~~ dreaming and the the the ~~w-w-w-wa-~~water was was [~8 sec] the the sink
(11) is over [5 sec] She should~~-d-d~~ turn-turned off the-the [~5 sec] the /waər/ ["water"]
(13) And the ~~w- w-w- w-w-~~ window is ~~o-o-~~ is ~~o~~-over ~~uh~~ open and the boy is-is getting-
(13) getting cookies from the ~~she-~~shelf and-and the- ~~buh- uh-~~ his sister wants a-a
(13) /k^ki/ ["cookie"] also, An' then she- he was-~~as~~ going to ~~f~~-fall. fall-~~all~~ down, because
(11) the the stool is-is.. is ~~uh um…~~ is going to fall down.

LCM-SS- # of content units (CUs): 19

(4) (the the the mother) is doing.. doing.. (washing) (dishes) and (she is is dreaming)
(3) and (the the the water) was was [~8 sec] (the the sink) (is over) [5 sec]
(2) (She should turn-turned off) ~~(the [~5 sec] the /waər/ ["water"])~~ And (the window)
(4) (is is over open) and (the boy) (is-is getting- getting) ~~(cookies)~~ (from the shelf) and-
(3) and the- buh (his sister) (wants) (a-a /k^ki/ ["cookie"] also), An' then
(2) (she- he was going to fall fall down) because (the the stool)
(1) (is-is is is going to fall down)

LCM-SS- # of minutes of narration: 1:41 = 1 + (41/60) = **1.68**

LCM-SS- # of correct bound & free gramm. morphemes in CUs: 28

(7) (**the** ~~the the~~ mother) (wash/**ing**) (dish/**es**) (**she is** ~~is~~ dream/**ing**) (**the** ~~the the~~ water)
(6) (**the** ~~the~~ sink) (**is** over) (**She should** turn/**ed** off) (**the** window) (is ~~is over~~ open)
(6) (**the** boy) (**is**-~~is~~ gett/**ing**- ~~getting~~) (from **the** shelf) (~~the~~- **his** sister) (want/**s**)
(6) (**a**-~~a~~ /k^ki/ ["cookie"] also) (~~she~~- **he was** go/**ing to** fall ~~fall~~ down) (**the** ~~the~~ stool)
(3) (**is**-~~is is is~~ go/**ing to** fall down)

LCM-SS- # of morphosyntactic errors: 1

(0) Aaahm… the g- the the mother is doing.. doing.. w-washing dish-ishes and she is
(0) uh.. is uh… dreaming and the the the w-w-w-wa-water was was [~8 sec] the the sink
(1) is over [5 sec] She should-d-d xxxx/*have* turn-turned off the-the [~5 sec] the /waər/
(0) ["water"] And the w- w-w- w-w- window is o-o- is o-over uh open and the boy is-is
(0) getting-getting cookies from the she-shelf and-and the- buh- uh- his sister wants a-a

(0) /k^ki/ ["cookie"] also, An' then she- he was-as going to f-fall. fall-all down, because
(0) the the stool is-is.. is uh um... is going to fall down.

LCM-SS- # of semantic errors: 3

(0) Aaahm… the g- the the mother is doing.. doing.. w-washing dish-ishes and she is
(1) uh.. is uh… dreaming and the the the w-w-w-wa-water was was [~8 sec] the the sink
(0) is over [5 sec] She should-d-d turn-turned off the-the [~5 sec] the /waər/ ["water"]
(1) And the w- w-w- w-w- window is o-o- is o-over uh open and the boy is-is getting-
(0) getting cookies from the she-shelf and-and the- buh- uh- his sister wants a-a
(1) /k^ki/ ["cookie"] also, An' then she- he was-as going to f-fall. fall-all down, because
(0) the the stool is-is.. is uh um... is going to fall down.

LCM-SS- # of sound errors: 8

(1) Aaahm… the g- the the mother is doing.. doing.. w-washing dish-ishes and she is
(0) uh.. is uh… dreaming and the the the w-w-w-wa-water was was [~8 sec] the the sink
(3) is over [5 sec] She should-d-d turn-turned off the-the [~5 sec] the /waər/ ["water"]
(1) And the w- w-w- w-w- window is o-o- is o-over uh open and the boy is-is getting-
(2) getting cookies from the she-shelf and-and the- buh- uh- his sister wants a-a
(1) /k^ki/ ["cookie"] also, An' then she- he was-as going to f-fall. fall-all down, because
(0) the the stool is-is.. is uh um... is going to fall down.

LCM-SS- # of words with repetitions: 24

(4) Aaahm… the g- the the mother is doing.. doing.. w-washing dish-ishes and she is
(4) uh.. is uh… dreaming and the the the w-w-w-wa-water was was [~8 sec] the the sink
(3) is over [5 sec] She should-d-d turn-turned off the-the [~5 sec] the /waər/ ["water"]
(3) And the w- w-w- w-w- window is o-o- is o-over uh open and the boy is-is getting-
(3) getting cookies from the she-shelf and-and the- buh- uh- his sister wants a-a
(3) /k^ki/ ["cookie"] also, An' then she- he was-as going to f-fall. fall-all down, because
(4) the the stool is-is.. is uh um... is going to fall down.

F.vi. 6th Transcription: 30 September 2006

LCM- total # of words: 78

(11) ~~/ɹ ɹ/~~-it's a ~~nə~~-nice. day. warm. /thæ-/ the ~~w-wi~~-winda is open and ~~uh. uh. s-~~
(12) the mother is-is. ~~uh.~~ thy bishin. ~~w-~~washing ~~dish~~-dishes and ~~uh- s-~~ an' she is
(7) ~~s-sə-sith-thi~~-think ~~sə~~-something-~~thing~~ because of the water-~~r /ə/- /ə/-~~/ɔ/ ["all"?] ~~um~~.
(15) ~~fl~~-flow over the to the ~~uh~~ the. ~~uh, uh. /fwə/-~~ floors an' she didn't even see it and the
(13) childrens went ~~uh~~… ~~t-tr-ch-.~~ try to get th:e cookies and the- the. the ~~um~~ the the
(15) /bo/ ["boy"]- is going to fall down from the stool and ~~uh~~. the sister want to say
(5) heluh- also. ~~uh~~- also /wəwə/- [want?] ~~duh.. uh /k^p-kok-ko-/ /kʊ-/~~ cookies

LCM- # of content units (CUs): 18

(4) (it's a nice day) warm. /thæ-/ (the winda) (is open) and (the mother)
(3) (is-is. thy bishin washing) (dishes) and an' (she is think something) because of
(4) (the water) /ɔ/ ["all"?] (flow over the) (to the the floors) an' (she didn't even see it)
(3) and the childrens went (try to get) (the cookies) and (the the the the the /bo/ ["boy"])
(4) (is going to fall down) (from the stool) and (the sister) (want to say heluh) also also
(0) /wəwə/ [want?] cookies

LCM- # of correct words in CUs: 49

(12) (it's a nice day) (the winda) (is open) (the mother) (~~is-is thy~~ ~~bishin~~ washing) (dishes)
(12) (she is think something) (the water) (flow over the) (to ~~the~~ the floors)

(12) (she didn't even see it) (try to get) (the cookies) (~~the the the the~~ the /bo/ ["boy"])
(13) (is going to fall down) (from the stool) (the sister) (want to say ~~heluh~~)

LCM- # of correct bound/contracted gramm. morphemes in CUs (endings): 6

(3) (it*/'s* a nice day) (the winda) (is open) (the mother) (is wash*/ing*) (dish*/es*)
(0) (she is think something) (the water) (flow over the) (to the floor~~/s~~)
(2) (she did*/n't* even see it) (try to get) (the cook*/ies*) (the /bo/ ["boy"])
(1) (is go*/ing* to fall down) (from the stool) (the sister) (want to say)

LCM-RC- total # of words: 78

(11) ~~/ɪ-ɪ/-~~it's a ~~nə-~~nice. day. warm. /thæ-/ the ~~w-wi-~~winda is open and ~~uh. uh. s-~~
(12) the mother is-is. ~~uh.~~. thy bishin. ~~w-~~washing ~~dish-d~~ishes and ~~uh- s-~~ an' she is
(7) ~~s-sə-sith-thi-~~think~~-sə-~~something~~-thing~~ because of the water-~~r/ə/-/ə/-~~/ɔ/ ["all"?] ~~um~~.
(15) ~~fl-~~flow over the to the ~~uh~~ the. ~~uh, uh. /fwə/-~~ floors an' she didn't even see it and the
(13) childrens went ~~uh… t-tr-ch-.~~ try to get th:e cookies and the- the. the ~~um~~ the the
(15) /bo/ ["boy"]- is going to fall down from the stool and ~~uh~~. the sister want to say
(5) heluh- also. ~~uh-~~ also /wəwə/- [want?] ~~duh.~~. ~~uh~~ ~~/k^p-kok-ko-/ /kʊ-/~~ cookies

LCM-RC- # of informative words (i-words): 16

(2) it's a nice day warm /thæ-/ (the <u>winda</u> is open) and (the <u>mother</u> is-is) thy bishin.
(4) (<u>washing</u>) (<u>dishes</u>) and an' (she is <u>think</u> something) because of (the <u>water)</u> /ɔ/ ["all"?]
(3) (<u>flow</u> over the) (to the the <u>floors</u>) an' she didn't even see it and (the <u>childrens</u>) went
(4) (try to <u>get)</u> (the <u>cookies</u>) and (the- the the the the /<u>bo</u>/ ["boy"]) (is going to <u>fall</u> down)
(3) (from the <u>stool</u>) and (the <u>sister)</u> want to say ~~heluh-~~ (also ~~also~~ /<u>wəwə</u>/[want?] cookies)

LCM-RC- # of minutes of narration: 1:30 = 1 + (30/60) = **1.50**

LCM-RC- # of grammatical morphemes in i-word units: 25

(7) (**the** <u>winda</u> is open) (**the** <u>mother</u> **is**~~-is~~) (<u>wash</u>/**ing**) (<u>dish</u>/**es**) (**she is** <u>think</u> something)
(8) (**the** <u>water)</u> (<u>flow</u> **over the**) (**to the** ~~the~~ <u>floor~~/s~~</u>) (**the** <u>children</u>/**s**) (try **to** <u>get)</u>
(6) (**the** <u>cook</u>/**ies**) (**the**~~-the the the the~~ /<u>bo</u>/ ["boy"]) (**is** go/**ing to** <u>fall</u> down)
(4) (**from the** <u>stool</u>) (**the** <u>sister</u>) (also /<u>wəwə</u>/[want?] cook/**ies**)

LCM-RC- # of correctly used stem morphemes in i-word units: 2

(*2*) (**the** <u>winda</u> is *open*) (**the** <u>mother</u> **is**~~-is~~) (<u>wash</u>/**ing**) (<u>dish</u>/**es**) (**she is** <u>think</u> *SOMETHING*)
(*0*) (**the** <u>water)</u> (<u>flow</u> **over the**) (**to the** ~~the~~ <u>floor~~/s~~</u>) (**the** <u>children</u>/**s**) (*try* **to** <u>get)</u>
(*0*) (**the** <u>cook</u>/**ies**) (**the**~~-the the the the~~ /<u>bo</u>/ ["boy"]) (**is** go/**ing to** <u>fall</u> *down*)
(*0*) (**from the** <u>stool</u>) (**the** <u>sister</u>) (*also* /<u>wəwə</u>/[want?] cook/**ies**)

LCM-RC- # of jargons, neologisms, phon. & sem. para. in i-word units: 7

(3) it's a nice. day. warm. /**<u>thæ</u>**-/ the **<u>winda</u>** is open and the mother is-is. thy **<u>bishin</u>**.
(1) washing dishes and an' she is think-something because of the water **<u>/ɔ/</u>** ["all"?] flow
(0) over the to the the floors an' she didn't even see it and the childrens went try to get
(1) th:e cookies and the- the. the the the **<u>/bo/</u>** ["boy"]- is going to fall down from the stool
(2) and the sister want to say **<u>heluh</u>**- also also /**<u>wəwə</u>**/- [want?] cookies

LCM-RC- # of different word types in 70 words from narrative: 40

LCM-SS- total # of words: 78

(11) ~~/ɪ-ɪ/-~~it's a ~~nə-~~nice. day. warm. /thæ-/ the ~~w-wi-~~winda is open and ~~uh. uh. s-~~
(12) the mother is-is. ~~uh.~~. thy bishin. ~~w-~~washing ~~dish-d~~ishes and ~~uh- s-~~ an' she is
(7) ~~s-sə-sith-thi-~~think~~-sə-~~something~~-thing~~ because of the water-~~r/ə/-/ə/-~~/ɔ/ ["all"?] ~~um~~.
(15) ~~fl-~~flow over the to the ~~uh~~ the. ~~uh, uh. /fwə/-~~ floors an' she didn't even see it and the (13)
childrens went ~~uh… t-tr-ch-.~~ try to get th:e cookies and the- the. the ~~um~~ the the
(15) /bo/ ["boy"]- is going to fall down from the stool and ~~uh~~. the sister want to say

(5) heluh- also. ~~uh-~~ also /wəwə/- [want?] ~~duh.~~. ~~uh /k^p-kok-ko-/ /kʊ-/~~ cookies

LCM-SS- # of content units (CUs): 18

(4) (it's a nice day) warm /thæ-/ (the winda) (is open) and (the mother is-is) thy bishin.
(4) (washing) (dishes) and an' (she is think something) because of (the water) /ɔ/ ["all"?]
(3) (flow over the) (to the the floors) an' (she didn't even see it) and ~~(the childrens went)~~
(4) (try to get) (the cookies) and (the- the the the the /bo/ ["boy"]) (is going to fall down)
(3) (from the stool) and (the sister want) (to say ~~heluh-~~ also)~~(also /wəwə/[want?] cookies)~~

LCM-SS- # of minutes of narration: 1:30 = 1 + (30/60) = **1.50**

LCM-SS- # of correct bound & free gramm. morphemes in CUs: 27

(7) (**it**/'s **a** nice day) (**the** winda) (is open) (**the** mother **is**~~-is~~) (wash/**ing**) (dish/**es**)
(6) (**she is** think something) (**the** water) (flow over **the**) (**to the** ~~the~~ floor~~/s~~)
(7) (**she** did/**n't** even see **it**) (try **to** get) (**the** cook/**ies**) (**the**~~-the the the the~~ /bo/ ["boy"])
(7) (**is** go/**ing to** fall down) (**from the** stool) (**the** sister want) (**to** say ~~heluh-~~ also)

LCM-SS- # of morphosyntactic errors: 5

(0) /ɪ-ɪ/-it's a nə-nice. day. warm. /thæ-/ the w-wi-winda is open and uh. uh. s-
(0) the mother is-is. uh.. thy bishin. w-washing dish-dishes and uh- s- an' she is
(1) s-sə-sith-thi-thinkxxx*/ing* sə-something-thing because of the water-r /ɔ/- /ɔ/-/ɔ/
(1) ["all"?] um. fl-flow over the to the uh the. uh, uh. /fwɔ/- floors*/x* an' she didn't even
(2) see it and the childrens*/x* went uh… t-tr-ch-. tryxxx*/ing* to get th:e cookies and the-
(0) the. the um the the /bo/ ["boy"]- is going to fall down from the stool and uh. the sister
(1) want*x/s* to say heluh- also uh- also /wəwə/- duh.. uh /k^p-kok-ko-/ /kʊ-/ cookies

LCM-SS- # of semantic errors: 2

(0) /ɪ-ɪ/-it's a nə-nice. day. warm. /thæ-/ the w-wi-winda is open and uh. uh. s-
(0) the mother is-is. uh.. thy bishin. w-washing dish-dishes and uh- s- an' she is
(1) s-sə-sith-thi-think sə-something-thing because of the water-r /ɔ/- /ɔ/-/ɔ/ ["all"?] um.
(0) fl-flow over the to the uh the. uh, uh. /fwɔ/- floors an' she didn't even see it and the
(0) childrens went uh… t-tr-ch-. try to get th:e cookies and the- the. the um the the
(0) /bo/ ["boy"]- is going to fall down from the stool and uh. the sister want to say
(1) heluh- also. uh- also /wəwə/- [want?] duh.. uh /k^p-kok-ko-/ /kʊ-/ cookies

LCM-SS- # of sound errors: 12

(3) /ɪ-ɪ/-it's a nə-nice. day. warm. /thæ-/ the w-wi-winda is open and uh. uh. s-
(2) the mother is-is. uh.. thy bishin. w-washing dish-dishes and uh- s- an' she is
(2) s-sə-sith-thi-think sə-something-thing because of the water-r /ɔ/- /ɔ/-/ɔ/ ["all"?] um.
(1) fl-flow over the to the uh the. uh, uh. /fwɔ/- floors an' she didn't even see it and the
(0) childrens went uh… t-tr-ch-. try to get th:e cookies and the- the. the um the the
(1) /bo/ ["boy"]- is going to fall down from the stool and uh. the sister want to say
(3) heluh- also. uh- also /wəwə/- [want?] duh.. uh /k^p-kok-ko-/ /kʊ-/ cookies

LCM-SS- # of words with repetitions: 19

(3) /ɪ-ɪ/-it's a nə-nice. day. warm. /thæ-/ the w-wi-winda is open and uh. uh. s-
(3) the mother is-is. uh.. thy bishin. w-washing dish-dishes and uh- s- an' she is
(4) s-sə-sith-thi-think sə-something-thing because of the water-r /ɔ/- /ɔ/-/ɔ/ ["all"?] um.
(2) fl-flow over the to the uh the. uh, uh. /fwɔ/- floors an' she didn't even see it and the
(5) childrens went uh… t-tr-ch-. try to get th:e cookies and the- the. the um the the
(0) /bo/ ["boy"]- is going to fall down from the stool and uh. the sister want to say
(2) heluh- also. uh- also /wəwə/- [want?] duh.. uh /k^p-kok-ko-/ /kʊ-/ cookies

D.vii. 7th Transcription: 4 March 2007

LCM- total # of words: 94

(13) mama is-is pa-pa.. ~~sh-~~ ~~wa-~~ washin ~~d-.~~ dis-is an-u-tus.. water the-the… is-is ~~st-~~ fili-.
(11) ~~s:-sli-~~ ~~uh~~. the-the.. ~~uh.~~ the windows is ~~o-.~~ open. and it's ni-. days. ~~ousi-si-si~~ outside,..
(14) the children have, a boy and-and a. gir- ~~ther-~~there's ~~um~~ girls and ~~uh~~.. the guh-,
(14) the boy is a-a a ~~cook-~~cook jar-~~ar-ar~~, all- ~~ga-a-a-a~~ again-~~s-s-… o-a-a~~ the-the-the. lid
(16) and-and he-he is ~~uh-~~get he is… getting the ~~goo-coo-~~cookie ~~uh~~ to-to the. sister,.. and
(12) ~~uh~~ the- he ~~i-~~is-is. ~~go. go-~~going to.. fall-lo-~~lo~~ ["fall off"?] from the ~~uh~~ stoo-, and
(14) the hallo-of wofe,. ~~uh.. wa-~~ water is-is-is is-is ~~uh. o-~~over the-the-the ~~fu-fu-~~floor

LCM- # of content units (CUs): 16

(4) (mama) (is-is pa-pa.. washin) (dis-is) an-u-tus (water) the-the is-is fili-
(4) (the-the the windows) (is open) and (it's ni- days outside) the children have, (a boy)
(3) and-and (a gir-) there's girls and the guh the boy is (a-a a cook) (jar) all again
(2) (the-the-the lid) and-and (he-he is get he is getting) the cookie to-to the sister and the-
(2) (he is-is going to fall-lo ["fall off"?]) (from the stoo-) and the hallo-of wofe
(1) water is-is-is is-is (over the-the-the floor)

LCM- # of correct words in CUs: 36

(8) (mama) (~~is-is~~ ~~pa-pa.~~ washin) (dis-is) (water) (~~the-the~~ the windows) (is open)
(13) (it's ni- days outside) (a boy) (a gir-) (~~a-a~~ a cook) (jar) (~~the-the-~~the lid)
(12) (~~he-he is get~~ he is getting) (he is-~~is-~~going to fall-lo ["fall off"?]) (from the stoo-)
(3) (over ~~the-the-~~the floor)

LCM- # of correct bound/contracted gramm. morphemes in CUs (endings): 5

(3) (mama) (wash*/in*) (dis-*/is*) (water) (the window~~/s~~) (is open) (it*/'s* ni- day~~/s~~ outside)
(2) (a boy) (a gir-) (a cook) (jar) (the lid) (he is gett*/ing*) (he is go*/ing* to fall-lo)
(0) (from the stoo-) (over the floor)

LCM-RC- total # of words: 94

(13) mama is-is pa-pa.. ~~sh-~~ ~~wa-~~ washin ~~d-.~~ dis-is an-u-tus.. water the-the… is-is ~~st-~~ fili-.
(11) ~~s:-sli-uh~~. the-the.. ~~uh~~.. the windows is ~~o-.~~ open. and it's ni-. days. ~~ousi-si-si~~ outside,..
(14) the children have, a boy and-and a. gir- ~~ther-~~there's ~~um~~ girls and ~~uh~~.. the guh-,
(14) the boy is a-a a cook-~~cook~~ jar-~~ar-ar~~, all- ~~ga-a-a-a~~ again-~~s-s-… o-a-a~~ the-the-the. lid
(16) and-and he-he is ~~uh-~~get he is… getting the ~~goo-coo-~~cookie ~~uh~~ to-to the. sister,.. and
(12) uh the- he ~~i-is-~~is. ~~go. go-~~going to.. fall-lo-~~lo~~ ("fall off"?) from the ~~uh~~ stoo-, and
(14) the hallo-of wofe,. ~~uh~~.. ~~wa-~~ water is-is-is is-is ~~uh~~. ~~o-~~over the-the-the ~~fu-fu-~~floor

LCM-RC- # of informative words (i-words): 14

(3) (mama is-is) *pa-pa*.. (washin) (dis-is) *an-u-tus*.. (~~water~~) the-the… is-is fili-.
(2) (the-the.. the windows is open.) and it's ni-. days. outside,. (the children) have,
(2) (~~a boy~~) and-and (~~a. gir-~~) there's girls and (~~the guh-~~,) (the boy is) (~~a-a a cook~~) (jar)
(2) all- again the-the-the. lid and-and (he-he is get he is… getting) (the cookie)
(3) (to-to the. sister,..) and uh the- (he is. going to.. fall-*lo* ["fall off"?]) (from the stoo-,)
(2) and (the *hallo-of* wofe,. water) (is-is-is is-is over the-the-the floor)

LCM-RC- # of minutes of narration: 1:56 = 1 + (56/60) = **1.93**

LCM-RC- # correctly used grammatical morphemes in i-word units: 22

(6) (mama **is**-~~is~~) (wash/**in**) (dis-/**is**) (**the**-~~the.. the~~ window~~/s~~ is open.) (**the** child/**ren**)
(7) (**the** boy is) (jar) (~~he-he is get~~ **he is…** gett/**ing**) (**the** cookie) (**to**-~~to~~ **the**. sister,..)
(7) (**he is**. go/**ing to**.. fall-lo ["fall off"?]) (**from the** stoo-,) (**the** ~~*hallo-of* wofe~~,. water)
(2) (is-~~is-is is-is~~ **over the**-~~the-the~~ floor)

LCM-RC- # correctly used stem morphemes in i-word units: 0

(*0*) (mama **is**) (wash/**in**) (dis-/**is**) (**the** window/~~s~~ *is open*) (**the** child/**ren**) (**the** boy *is*) (jar)
(*0*) (**he is** gett/**ing**) (**the** cookie) (**to the** sister) (**he is**. go/**ing to**.. fall-lo ["fall off"?])
(*0*) (**from the** stoo-) (**the** water) (is **over the** floor)

LCM-RC- # of jargons, neologisms, phon. & sem. para. in i-word units: 13

(3) mama is-is **pa-pa**.. washin **dis-is** **an-u-tus**.. water the-the is-is fili- ~~s:-sli-~~ the-the the
(2) windows is open and it's **ni**- days outside, the children have, a boy and-and a **gir**-
(3) there's girls and the **guh**-, the boy is a-a a **cook** jar all- **ga-a a-a** again the-the-the lid
(1) and-and he-he is get he is **getting** the cookie to-to the sister and uh the he is going to
(4) fall-**lo** ("fall off"?) from the **stoo**-, and the **hallo-of** **wofe** water is-is-is is-is over the-
(0) the-the floor

LCM-RC- # of different word types in 70 words from narrative: 31

LCM-SS- total # of words: 94

(13) mama is-is pa-pa.. ~~sh-~~ ~~wa-~~ washin ~~d-.~~ dis-is an-u-tus.. water the-the… is-is ~~st-~~ fili-.
(11) ~~s:-sli-uh~~. the-the.. ~~uh~~.. the windows is ~~o-.~~ open. and it's ni-. days. ~~ousi-si-si~~ outside,..
(14) the children have, a boy and-and a. gir- ~~ther~~-there's ~~um~~ girls and ~~uh~~.. the guh-,
(14) the boy is a-a a cook-~~cook~~ jar~~-ar-ar~~, all- ~~ga-a a-a~~ again~~-s-s-… o-a-a~~ the-the-the. lid
(16) and-and he-he is ~~uh~~-get he is… getting the ~~goo-coo~~-cookie ~~uh~~ to-to the. sister,.. and
(12) uh the- he ~~i-is~~-is. ~~go. go~~-going to.. fall-lo~~-lo~~ ("fall off"?) from the ~~uh~~ stoo-, and
(14) the hallo-of wofe,. ~~uh~~.. ~~wa~~- water is-is-is is-is ~~uh~~. ~~o-~~over the-the-the ~~fu-fu~~-floor

LCM-SS- # of content units (CUs): 16

(3) (mama is-is) *pa-pa*.. (washin) (dis-is) *an-u-tus*.. (~~water~~) the-the… is-is fili-.
(3) (the-the.. the windows) (is open.) and (it's ni-. days. outside,.) (~~the children~~) have,
(2) (~~a boy~~) and-and (~~a. gir~~-) there's girls and (~~the guh~~-,) (the boy is) (~~a-a a cook~~) (jar)
(3) all- again (the-the-the. lid) and-and (he-he is get he is… getting) (the cookie)
(3) (to-to the. sister,..) and uh the- (he is. going to.. fall-*lo* ["fall off"?]) (from the stoo-,)
(2) and (the *hallo-of* wofe,. water) (is-is-is is-is over the-the-the floor)

LCM-SS- # of minutes of narration: 1:56 = 1 + (56/60) = **1.93**

LCM-SS- # of correct bound & free gramm. morphemes in CUs: 22

(5) (mama **is**~~-is~~) (wash/**in**) (dis-/**is**) (**the**~~-the.. the~~ window/~~s~~) (is open.) (**it**/'s ni-. day/~~s~~. outside,.)
(6) (**the** boy is) (jar) (**the**~~-the-the.~~ lid) (~~he-he is get~~ **he is…** gett/**ing**) (**the** cookie)
(8) (**to**~~-to~~ **the**. sister,..) (**he is**. go/**ing to**.. fall-lo ["fall off"?]) (**from the** stoo-,)
(3) (**the** ~~*hallo-of* wofe~~,. water) (is~~-is-is-is-is~~ **over the**~~-the-the~~ floor)

LCM-SS- # of morphosyntactic errors: 6

(0) mama is-is pa-pa.. sh- wa- washin d-.. dis-is an-u-tus.. water the-the… is-is st- fili-.
(3) s:-sli- uh. the-the.. uh.. the windows is/*are* o-. open. and it's x/*a* ni-. days/*x*. ousi-si-si
(2) outside,.. the children have, a boy and-and a. gir- ther-there's um x/*a* girls/*x* and uh..
(0) the guh-, the boy is a-a a cook-cook jar-ar-ar, all- ga-a a-a again-s-s-… o-a-a the-the-
(1) the. lid and-and he-he is uh-getxxx/*ing* he is… getting the goo-coo-cookie uh to-to
(0) the. sister,.. and uh the- he i-is-is. go. go-going to.. fall-lo-lo ("fall off"?) from the uh
(0) stoo- and the hallo-of wofe uh wa- water is-is-is is-is uh o-over the-the-the fu-fu-floor

LCM-SS- # of semantic errors: 3

(0) mama is-is pa-pa.. sh- wa- washin d-.. dis-is an-u-tus.. water the-the… is-is st- fili-.
(0) s:-sli- uh. the-the.. uh.. the windows is o-. open. and it's ni-. days. ousi-si-si outside,..
(1) the children have, a boy and-and a. gir- ther-there's um girls and uh.. the guh-,
(0) the boy is a-a a cook-cook jar-ar-ar, all- ga-a a-a again-s-s-… o-a-a the-the-the. lid

(1) and-and he-he is uh-get he is… getting the goo-coo-cookie uh to-to the. sister,.. and
(0) uh the- he i-is-is. go. go-going to.. fall-lo-lo ("fall off"?) from the uh stoo-, and
(1) the hallo-of wofe,. uh.. wa- water is-is-is is-is uh. o-over the-the-the fu-fu-floor

LCM-SS- # of sound errors: 21

(6) mama is-is pa-pa.. sh- wa- washin d-.. dis-is an-u-tus.. water the-the… is-is st- fili-.
(2) s:-sli- uh. the-the.. uh.. the windows is o-. open. and it's ni-. days. ousi-si-si outside,..
(2) the children have, a boy and-and a. gir- ther-there's um girls and uh.. the guh-,
(5) the boy is a-a a cook-cook jar-ar-ar, all- ga-a a-a again-s-s-… o-a-a the-the-the. lid
(1) and-and he-he is uh-get he is… getting the goo-coo-cookie uh to-to the. sister,.. and
(2) uh the- he i-is-is. go. go-going to.. fall-lo-lo ("fall off"?) from the uh stoo-, and
(3) the hallo-of wofe,. uh.. wa- water is-is-is is-is uh. o-over the-the-the fu-fu-floor

LCM-SS- # of words with repetitions: 35

(5) mama is-is pa-pa.. sh- wa- washin d-.. dis-is an-u-tus.. water the-the… is-is st- fili-.
(4) s:-sli- uh. the-the.. uh.. the windows is o-. open. and it's ni-. days. ousi-si-si outside,..
(2) the children have, a boy and-and a. gir- ther-there's um girls and uh.. the guh-,
(6) the boy is a-a a cook-cook jar-ar-ar, all- ga-a a-a again-s-s-… o-a-a the-the-the. lid
(5) and-and he-he is uh-get he is… getting the goo-coo-cookie uh to-to the. sister,.. and
(4) uh the- he i-is-is. go. go-going to.. fall-lo-lo ("fall off"?) from the uh stoo-, and
(9) the hallo-of wofe,. uh.. wa- water is-is-is is-is uh. o-over the-the-the fu-fu-floor

APPENDIX G: COUNT AND INDEX RESULTS FOR INTRA-CODER RELIABILITY

LCM-SS 1st implementation	Jan-05	Mar-05	Aug-05	Dec-05	Apr-06	Sep-06	Mar-07
TW	93	94	80	86	85	78	94
CU	18	22	17	21	19	18	16
GM	29	37	30	28	28	27	22
ME	5	1	2	6	1	5	6
SemE	3	2	0	2	3	2	3
SouE	4	3	2	11	8	12	21
Rep	12	11	14	13	24	19	35
Min	1.17	1.47	1.47	1.42	1.68	1.5	1.93
Index of Lexical Efficiency (ILE)	5.17	4.27	4.71	4.10	4.47	4.33	5.88
Index of Communicative Efficiency (ICE)	15.38	14.97	11.56	14.79	11.31	12.00	8.29
Index of Grammatical Support (IGS)	1.61	1.68	1.76	1.33	1.47	1.50	1.38
Index of Grammatical Errors (IGE)	0.05	0.01	0.03	0.07	0.01	0.06	0.06
Index of Semantic Errors (ISemE)	0.03	0.02	0.00	0.02	0.04	0.03	0.03
Index of Sound Errors (ISouE)	0.17	0.15	0.20	0.28	0.38	0.40	0.60

LCM-SS 2nd implementation	Jan-05	Mar-05	Aug-05	Dec-05	Apr-06	Sep-06	Mar-07
TW	93	94	81	86	84	77	95
CU	18	22	14	19	18	18	17
GM	30	40	30	29	31	29	23
ME	4	2	2	4	1	6	3
SemE	2	1	0	2	3	1	2
SouE	4	1	2	6	2	11	15
Rep	9	12	14	11	28	19	33
Min	1.17	1.47	1.47	1.42	1.68	1.5	1.93
Index of Lexical Efficiency (ILE)	5.17	4.27	5.79	4.53	4.67	4.28	5.59
Index of Communicative Efficiency (ICE)	15.38	14.97	9.52	13.38	10.71	12.00	8.81
Index of Grammatical Support (IGS)	1.67	1.82	2.14	1.53	1.72	1.61	1.35
Index of Grammatical Errors (IGE)	0.04	0.02	0.02	0.05	0.01	0.08	0.03
Index of Semantic Errors (ISemE)	0.02	0.01	0.00	0.02	0.04	0.01	0.02
Index of Sound Errors (ISouE)	0.14	0.14	0.20	0.20	0.36	0.39	0.51