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Formal Thought Disorder in Schizophrenia through the Lens of Chinese

Ruoyang Shi

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FORMAL THOUGHT DISORDER IN SCHIZOPHRENIA THROUGH THE LENS OF CHINESE

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A Doctoral Dissertation Submitted in Partial Fulfillment of the
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Abstract

This thesis examines a hitherto uninvestigated aspect of formal thought disorder (FTD), a core symptom of schizophrenia that manifests itself as speech which is difficult to follow often to the point of complete unintelligibility. Linguistic studies have found evidence of both lexico-semantic and grammatical within-sentence abnormalities in the expressed speech of schizophrenic patients with FTD, with some studies arguing that the former is critical. An influential study by Rochester and Martin (1979) also identified a discourse-level factor contributing to FTD: unclear reference, manifested in a failure to use pronouns and definite articles correctly to link utterances. Rochester and Martin (1979) additionally found some evidence for another abnormality in the speech of FTD patients, overuse of lexical cohesion. The Rochester and Martin study, like almost all studies in the field, examined FTD in speech samples from patients who spoke Standard Average European (SAE) languages. In Chinese, the absence of articles and the preference for ellipsis (i.e., silent phonology) instead of pronouns for reference tracking purposes make it possible to further examine the evidence they found for a possible a lexical contribution to FTD.

With the goal of further investigating whether lexical as opposed to grammatical abnormality characterizes the speech of schizophrenic patients with FTD, two experiments were designed and run on Chinese-speaking schizophrenic patients, who either showed (N= 9) or did not show (N= 10) FTD. Healthy controls (N= 19) were also examined. Both experiments involved the use of Chinese classifiers (CL), which span a continuum from a lexical to a grammatical end. Experiment 1 tested the use of CLs at the level of phrases and experiment 2 at the level of sentences.

Experiment 1 consisted of two tasks. Both consisted of a fill-in-the-blank test

which required the patients to select the proper CL for the CL phrase. The first aimed to examine the participants' linguistic knowledge of CLs. The second task tested whether the schizophrenic patients' performance (if impaired) could be improved through provision of additional information in the form of pictures. Task 1 gave statistically significant results, distinguishing FTD from both non FTD patients and healthy controls, with the FTD patients making more inaccurate, wrong choices in lexico-semantic CLs. As for the CL *ge*, the most grammatical one, no significant differences in use were detected between the three groups. In task 2, the significant difference between the two patient groups in the correct use of semantic CLs disappeared.

In experiment 2, the participants were prompted to use the existential *you* (Engl. *there is*) construction, in which each occurring nominal phrase must include a proper CL. Consistent with results of experiment 1, the results in experiment 2 indicated that the FTD patients made significantly more errors in the accuracy of their choice of semantic CLs than non FTD patients, although there was no significant difference in the number of semantic CLs used; no significant difference was found between non FTD patients and healthy controls. Also in agreement with the results of experiment 1, no significant difference was found between FTD, non FTD patients and healthy controls in their use of the CL *ge*. With respect to the number of omitted CLs (both grammatical and semantic), there was no significant difference between the patients with and without FTD. However, both patient groups showed significantly more CL omission than healthy controls. Otherwise, experiment 2 found that the FTD patients showed evidence of further grammatical or syntactic problems, which in some cases affected the grammatical head, i.e. *you*, of the presentational/existential construction.

The findings of experiment 1 suggest that the lexical knowledge related to semantic CLs is impaired, while the grammatical CL *ge* is relatively spared in FTD

patients. In experiment 2, the intact use of *ge* and number of semantic CLs, as well as the non-distinguishing rate of overall CL omission, might suggest that any impairment in the use of grammar in respect to CL is a feature of schizophrenia rather than specifically of FTD.

Taken together, the results of both experiments support the view that there is a significant lexical contribution to the linguistic abnormality seen in FTD. This finding is in accordance with those of some existing linguistic studies of FTD, although it is not a universally accepted interpretation of the literature. The findings of this thesis are also in line with the overuse of lexical cohesion found by Rochester and Martin (1979) in FTD. The lexical aspect of classifier abnormality, however, was seen in association with some evidence of grammatical abnormality as well. Under the assumption that lexicon and grammar form a continuum, these results indicate that in the complex task of building a sentence a lexical impairment may affect grammar in a correlational manner.

Resum

Aquesta tesi examina un aspecte fins ara no investigat del trastorn formal del pensament (FTD, Formal Thought Disorder), un símptoma central de l'esquizofrènia que es manifesta com a parla que és difícil de seguir, fins al punt que pot arribar a ser completament intel·ligible. Estudis lingüístics han trobat proves d'anomalies tant lèxico-semàntiques com gramaticals a nivell de frase en la parla dels pacients esquizofrènics amb FTD; amb un èmfasi en les primeres segons alguns. Un estudi influent de Rochester i Martin (1979) va identificar un factor que contribueix al FTD a nivell de discurs: la referència poc clara, manifesta en pronoms i articles definits que impedeixen lligar correctament els enunciats. Rochester i Martin (1979) van trobar, a més, proves d'una altra anomalia en la parla dels pacients amb FTD, l'excés de cohesió lèxica. L'estudi en qüestió, com gairebé tots els estudis en el camp de l'esquizofrènia, va examinar el FTD en mostres discursives de parlants de llengües europees prototípiques (SAE, Standard Average European). En xinès, l'absència d'articles i la preferència per l'el·lipsi (i.e., per una fonologia silenciosa) en lloc dels pronoms per reprendre la referència a entitats ja introduïdes en el discurs va fer possible posar a prova la possible contribució lèxica al FTD.

Amb la finalitat d'investigar si anomalies més aviat lèxiques que gramaticals caracteritzen la parla dels pacients esquizofrènics amb FTD, es van dissenyar dos experiments per realitzar amb pacients esquizofrènics de parla xinesa, amb FTD (N=9) o sense (N=10); i a controls sans (N=19). Tots dos experiments exigien usar classificadors xinesos (CL) que cobreixen un contínuum que va d'un extrem lèxic a un extrem gramatical. L'experiment 1 va testar l'ús dels CL a nivell de sintagma i l'experiment 2, a nivell de frase.

L'experiment 1 va consistir en dues tasques. Ambdues eren del tipus d'emplenar un buit amb el CL adient. La primera tenia com a objectiu examinar el coneixement dels CL per part dels participants. La segona provava si l'actuació dels participants esquizofrènics millorava (en cas d'anomalia prèvia) amb la disponibilitat d'informació addicional per mitjà d'imatges. En la tasca 1 es van obtenir resultats significatius estadísticament que distingien els participants amb FTD tant dels pacients sense FTD com dels controls: els pacients amb FTD van fer més tries descurades, incorrectes de CL lèxico-semàntics. Respecte del classificador *ge*, el més gramatical de tots, no va sortir cap diferència significativa. En la tasca 2, va desaparèixer la diferència significativa entre els dos grups de pacients en l'ús dels CL. En l'experiment 2, els participants eren induïts a fer servir la construcció existencial *you* (cat. haver-hi) en què cada sintagma nominal que hi ocorri ha de portar el CL pertinent. D'acord amb els resultats de l'experiment 1, els de l'experiment 2 van mostrar que els pacients amb FTD van fer més errors en la selecció adient dels CL semàntics que els pacients sense FTD tot i que no hi va haver cap diferència significativa pel que fa al nombre dels CL semàntics emprats. També d'acord amb els resultats de l'experiment 1, no es va trobar cap diferència entre els pacients amb FTD, sense FTD i els controls sans pel que respecta a l'ús del CL *ge*. Quant al nombre de CL omesos (tant gramaticals com semàntics), no hi va haver cap diferència significativa entre els pacient amb FTD i sense. Tots dos grups de pacients, però, van mostrar més omissió de CL que els controls sans. Addicionalment, més enllà dels CL, l'experiment 2 va trobar que els pacients amb FTD presentaven més problemes gramaticals o sintàctics que, en algun cas, afectaven *you*, el nucli gramatical de la construcció existencial.

Els resultats de l'experiment 1 suggereixen que en els pacients amb FTD el coneixement lèxic relacionat amb els CL semàntics està malmès mentre que no així el

relacionat amb el CL gramatical *ge*. En l'experiment 2, l'ús intacte de *ge*, el nombre de CL semàntics així com la proporció d'omissió de CL de tot tipus podria indicar que els dèficits gramaticals (que no lèxics) relacionats amb els CL són un tret de l'esquizofrènia més que no pas del FTD específicament.

En conjunt, els resultats de tots dos experiments donen suport a la visió que hi ha un factor lèxic significatiu que contribueix a les anomalies lingüístiques presents en el FTD. Aquest descobriment està d'acord amb alguns estudis existents sobre el FTD tot i que la incidència d'aquest factor lèxic no és una interpretació universalment acceptada en la bibliografia. Les troballes d'aquesta tesi, d'altra banda, estan en consonància amb l'ús excessiu de la cohesió lèxica detectat per Rochester i Martin (1979) en el FTD. L'aspecte lèxic de les anomalies amb els CL s'ha vist acompanyat de certes anomalies gramaticals també. Assumint que el lèxic i la gramàtica formen un contínuum, aquests resultats indiquen que en la complexa tasca de construir una frase, un dèficit lèxic pot afectar la gramàtica de manera correlativa.

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Dedication

I dedicate this thesis to my grandparents, Shi Deming (时德明) and Song Huizhen (宋惠珍).

List of abbreviations

CL	Classifier
DSM	The Diagnostic and Statistical Manual of Mental Disorders
FTD	Formal thought disorder
ICD	The International Classification of Diseases
SAE	Standard average European [language]
TLC	The Thought, Language and Communication Scale

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Chapter 1. General introduction

As one of the most severe and debilitating mental disorders, schizophrenia causes the most severe long-term disability (Kircher et al. 2018). Based on the information from World Health Organization, the disorder is the third leading contributor to the global burden of mental, neurological and substance use disorders, and the fifth among high-income countries (Collins et al., 2011).

The aetiology of schizophrenia and its various symptoms is largely unknown. One of these symptoms is formal thought disorder (FTD), which refers to a disorder seen in patients whose speech is difficult to follow, sometimes to the point of complete incomprehensibility. Research concerning FTD has not been a completely fruitful enterprise, and despite a substantial literature on this topic, a consensus has not yet been reached (Kircher et al. 2018).

This dissertation on one hand is intended as a contribution to the debate on the nature of FTD which presents a novel feature: the criterion of crosslinguistic validity in the characterization of the deficits underlying the speech of those patients with formal thought disorder (FTD). By crosslinguistic validity it is meant that the linguistic characterization ensuing from the present study must cover FTD as manifested linguistically in both Mandarin Chinese and Standard Average European (SAE) languages. On the other hand, based on the results of the two studies reported in it, and also by taking into account of the lessons from comparative biology, neurocognitive and evolutionary studies, this dissertation will present a general discussion on how linguistic theory can contribute to understanding the mechanisms of FTD. But let us first provide some historical background of schizophrenia.

1.1 Background of schizophrenia

Psychiatry was first established as a subject for academic study in the early 19th century in Germany. However, it was not until the end of that century and the beginning of the 20th century that what would be the modern classification of mental illnesses was developed. The diagnosis of schizophrenia first appeared in the 4th edition of Kraepelin's influential *Lehrbuch der Psychiatrie* (1896). In this, he described a new disorder, dementia praecox, characterized by the development of psychotic symptoms such as delusions, hallucinations, incoherence of speech and also catatonic symptoms, followed by a general deterioration in behaviour, which was often severe. As implied by his use of the term dementia, Kraepelin considered that the disorder was a degenerative disease affecting the brain.

Based on Kraepelin's ideas, Bleuler (1911) published an important work, *Dementia Praecox or the Group of Schizophrenias*, in which he coined the term schizophrenia, which means split or fragmented mind. Bleuler (1911) considered that speech and thought disturbances, i.e. FTD, were fundamental to schizophrenia ('present in every case and at every period of the illness even though, as with any other disease symptom, they must have attained a certain degree of intensity before they can be recognized with certainty'). As will be seen below, this view has not survived and FTD is now (DSM-IV) considered just to be another class of symptom along with delusions and hallucinations.

Throughout the world, the prevalence of schizophrenia is between 0.3 and 2%, with an average of 0.7-1% (Jablensky, 2010). Usually, the illness develops between the ages of 15 and 45 years (Tandon, 2008), most commonly in late adolescence or early adulthood (DeLisi, 2008). Men and women are approximately equally affected, although the onset tends to be later in women, who also tend to have a better course and

outcome (Jones, 2013). Females also show a second peak later in life, after the menopause (Stilo, 2010; McKenna, 2007).

1.2 Symptoms of schizophrenia

From the clinical perspective, schizophrenia is characterized by a remarkable diversity of symptoms. For the purpose of classifying patients into more homogeneous groups, Kraepelin, Bleuler and later authors proposed subtypes of the disorder, including paranoid schizophrenia (clinical picture characterized predominantly by delusions and hallucinations), hebephrenic schizophrenia (a presentation dominated by formal thought disorder and emotional abnormality), catatonic schizophrenia (where there is marked motor abnormality, especially periods of stupor and excitement) and simple schizophrenia (where there are no active psychotic symptoms, only deterioration). However, it is accepted that the subtypes often do not occur in pure form, and that individual patients sometimes change from one subtype to another over time (e.g. see McKenna, 2007).

Another means of subclassifying the heterogeneous clinical presentation of schizophrenia is according to symptoms. Crow (1980) argued that there were two broad groupings of symptoms, each of which occurred independently of the other. Positive symptoms are those dysfunctions that are characterized by an excess or distortion of normal function. They include delusions, hallucinations and formal thought disorder. Negative symptoms, on the other hand, take the form of absence of a normal function, for example poverty of speech, flattening of affect (dulling of emotional responses) and lack of volition or apathy. While the terms positive and negative continue to be widely used, Liddle (1987) later found, using factor analysis, evidence that the division is really three-way: reality distortion (delusions and hallucinations) forms one constellation of

tightly correlated symptoms; another is disorganisation (formal thought disorder and inappropriate affect and also disorganized behaviour) and the clinical poverty syndrome (his term for negative symptoms). This tripartite division has been amply supported by further factor analytic studies (Andreasen et al., 1995; Brekke et al., 1994; Grube et al., 1998).

1.2.1 Positive symptoms/reality distortion

Positive symptoms consist of two main types of symptoms: delusions and Hallucinations. The details are provided in the following two paragraphs.

Delusions: schizophrenic patients can show any of several types of delusions. One is persecutory delusions, which refers to beliefs where there is a conspiracy to harm the patient. A second type is grandiose delusions, where patients believe that they have special powers and abilities that are close to God or they are famous or related to someone famous. The third one is somatic delusions, which refers to that the patients describe bizarre changes in their bodies and corporal functioning. Finally, there are referential delusions, where the patients believe the neutral events in the environment have special significance for them.

Hallucinations: these are referred to as perceptions without the existence of an object that causes them that are considered real by the person experiencing them. The most common type of hallucination is verbal hallucinations ('hearing voices'). These can occur in the 2nd and 3rd person and can include voices commenting on their actions and giving them orders. Hallucinations can also occur in all other sensory modalities, i.e. of visual, olfactory, gustatory and tactile.

Delusions and hallucinations are often the first symptoms to appear in schizophrenia and they tend to characterize acute episodes, even when the illness is established. In particular, positive symptoms are often intermittent, worsening with relapses of illness and improving or disappearing between episodes. As the illness evolves into the chronic stage they sometimes but not always fade into the background or may even disappear altogether.

1.2.2 Negative symptoms/the clinical poverty syndrome

Negative symptoms are usually thought to consist of three main types of symptoms; lack of volition (reduced motivation sometimes amounting to complete apathy), poverty of speech or alogia (lack of spontaneity of speech output), and affective flattening (reduced emotional responsiveness). Unlike positive symptoms, which usually come and go or at least vary in intensity, they are relatively enduring; they also tend to develop slowly after the onset of illness rather than characterizing it from the outset.

1.2.3 Formal thought disorder/the disorganization syndrome

As noted above, this refers to the production of speech which is difficult to follow. The term encompasses a number of quite different abnormalities, which may be seen in more or less pure form or more usually in combination. Andreasen (1986) proposed a set of 18 recognizably different abnormalities. Formal thought disorder is discussed in detail in section 2.2.1.

1.2.4 Other symptoms of schizophrenia

1.2.4.1 Catatonic symptoms

These symptoms do not fall very well into the concept of positive and negative symptoms or Liddle's three-way classification. Catatonic symptoms consist of motor and behavioural alterations, ranging from meaningless repetitions of movements, hesitancy of motor actions, or more intangible disorders of cooperation such as negativism or excessive compliance. Such symptoms also commonly occur against a background of stupor (a marked reduction in all motor activity) or excitement (a high level of disorganized and often destructive activity). Speech can also be affected: catatonic symptoms here include aprosodia (speech that shows marked lack of normal inflection, or strange sing-song or robot-like inflections), echolalia (repeating words spoken to the patient by an interviewer) and mutism (where the patient hardly speaks at all, sometimes for prolonged periods).

1.2.4.2 Lack of insight into illness

Many schizophrenic patients do not believe that they are ill and reject the treatment. Instead, they minimize the effect of the illness and attribute the symptoms to other causes (Mintz et al., 2003; David, 1992). This symptom is very common in schizophrenia (McKenna, 2007)

1.2.4.3 Cognitive impairment

Although schizophrenia was for many years regarded as a 'functional' psychosis (i.e. one that does not impair cognitive function, in contrast to the 'organic' psychoses of delirium and dementia), over the last thirty years cognitive impairment has become

recognized as an important feature of the disorder. It is now accepted that schizophrenic patients typically show some degree of general intellectual impairment, as well specific neuropsychological deficits affecting many different domains of function. It is important to note that not all patients show impairment and the degree varies greatly.

Heinrichs and Zakzanis (1998) carried out a meta-analysis of different neuropsychological test impairments in schizophrenia. They found that schizophrenic patients show impairment in all areas of cognitive function, including memory, motor skills, attention, visual and visuospatial function, executive function, language and tactile perception. They also made the point that it varies considerably in degree, from a mild impairment similar to that seen in many healthy individuals, to a severe dysfunction found in patients with central nervous system disorders.

Various indirect lines of evidence suggest that cognitive impairment in schizophrenia is not due to antipsychotic drug treatment (King, 1990; Mortimer, 1997) and is well documented in drug-free and never-treated patients (Saykin et al., 1991; Braff et al., 1991; Saykin et al., 1994). Nor can it be easily attributed to poor motivation and co-operation, although the relevant studies are sparse (see McKenna, Ornstein and Baddeley, 2002). In a minority of patients with severe and chronic illness, severe degrees of general intellectual impairment have been reported, and some of these have shown a picture indistinguishable from dementia (Owens et al., 1980; Liddle and Crow, 1984; De Vries et al., 2001).

1.3 Diagnosis

There is no diagnostic test for schizophrenia. Instead, diagnosis depends on the presence of certain combinations of symptoms and the absence of symptoms typical of other disorders, especially mania or depression.

Two sets of criteria for diagnosing schizophrenia are widely used. These are the Diagnostic and Statistical Manual of Mental Disorders, currently in its 5th edition (DSM-5), produced by the American Psychiatric Association and the International Classification of Diseases, 10th version (ICD-10), developed by the World Health Organization. These both require the presence of characteristic symptoms, including delusions, hallucinations and formal thought disorder, plus evidence of deterioration from usual levels of functioning. The similarities between these two diagnostic manuals outnumber the differences: if a person is diagnosed with schizophrenia in one of the two he/she will almost certainly meet the criteria from the other one.

1.4 Aetiological factors in schizophrenia

The cause or causes of schizophrenia is still largely unknown (Macher, 2010). For much of the 20th century, psychological factors, ranging from Freudian concepts of repression and regression to the role of family psychodynamics were considered important. However, these theories had little or no scientific basis and have now largely been abandoned. Instead, schizophrenia is believed to be a largely biologically determined disorder. There is a consensus about the importance of a number of different aetiological factors, both genetics and environmental, and also neurodevelopmental mechanisms.

1.4.1 Genetics

It is well established that one of the risk factors of schizophrenia is genetic basis. The heritability of schizophrenia is high (some estimates are as high as 70%). By pooling data from studies carried out between 1920 and 1987, Gottesman (1991) found that the

risk of schizophrenia in relatives increases with the closeness of the genetic relationship, as shown in a well-known figure from Gottesman (1991) illustrated below (see Figure 1).

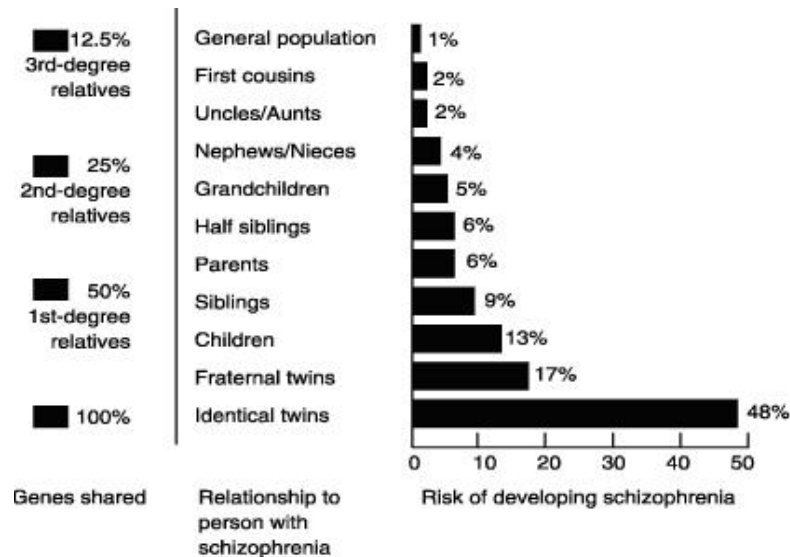


Figure 1: Risk of developing schizophrenia in the relatives of schizophrenic patients

(Gottesman, 1991)

As this figure indicates having a monozygotic twin with schizophrenia confers a risk of about 50%. When both parents have the illness, the level of risk is similar. On the other hand, siblings, children of one affected parent and dizygotic twins have around a 10% chance of becoming ill. The lack of 100% concordance in monozygotic twins, combined with statistical modelling of the rest of the pattern of risk, establish with near-certainty that schizophrenia follows a non-mendelian mode of transmission. In fact, its pattern of inheritance aligns it closely with disorders like diabetes mellitus, disseminated sclerosis, and pernicious anaemia, where liability is a complex trait, determined by genes, environment, and their co-action or interaction (Riley and McGuffin, 2000).

Using a strict statistical threshold, a large (36989 patients and 113075 controls) genome-wide association study (GWAS) discovered 108 genetic loci that were related with schizophrenia [Schizophrenia Working Group of the Psychiatric Genomics Consortium] (Ripke et al., 2014). This study showed that schizophrenia is a polygenic disorder, which could be due to the cumulative effects of hundreds or possibly thousands of genes. Hence, the 108 identified in this study each with small effect sizes are only the tip of the statistical iceberg.

Findings in this study have the potential to provide new insights into the etiology of schizophrenia. For example, dopamine receptor D2 (DRD2) gene and several genes are showed to be involved in voltage-gated calcium channels and glutamatergic neurotransmission with known and potential therapeutic relevance to schizophrenia. Further they are consistent with leading pathophysiological hypotheses. Independent of genes expressed in the brain, correlations were shown to be enriched among genes expressed in organs that play essential roles in immunity, indicating that the immune system may play a role in schizophrenia.

In addition to common variants, a small number rare genetic mutations been identified in schizophrenia (International Schizophrenia Consortium, 2008). Although these mutations are the greatest individual risk factors known to date, they do not explain much of the genetic heredity of schizophrenia since they are so uncommon and often occur de novo.

1.4.2 Neurochemical factors

The proposal that neurochemical factors are important in schizophrenia grew out of the finding that the group of drugs effective in treating schizophrenia, the neuroleptics or antipsychotics, all cause a functional reduction in brain dopamine function (specifically

they block the D2-family of post synaptic dopamine receptors) (Howes et al., 2009). Also relevant was the observation that stimulant drugs such as amphetamine, which increase brain dopamine, can cause a psychotic state indistinguishable from schizophrenia.

Accordingly, a major neurochemical theory of schizophrenia over many years has been that there is a functional dopamine excess in the disorder (Howes and Kapur, 2009). Although the above indirect evidence is convergent, the hypothesis still has not been fully confirmed in studies directly examining different aspects of dopamine function in patients with schizophrenia. In particular, the initial proposed mechanism of increased dopamine D2 receptors has not been confirmed in living patients who have never been exposed to antipsychotic drug treatment (Weinberger and Laruelle, 2001; McKenna, 2007). (Drug naivety is important because antipsychotic drug treatment itself is known to induce increases in post-synaptic D₂ receptor numbers).

More recent studies, on the contrary, have found evidence for increased synaptic release of dopamine in antipsychotic-free (and in some cases antipsychotic naïve) patients with schizophrenia using a neurochemical imaging paradigm involving stimulation of dopamine release by a single dose of amphetamine (Laruelle et al., 1996 ; Abi-Dargham et al., 1998; Breier et al., 1997). Other studies have found evidence for increased dopamine synthesis in individuals with prodromal symptoms of schizophrenia, who have never received treatment (Howes et al., 2009; Egerton et al., 2013). In both cases, however, the number of studies is so far small and the positive findings have not always been replicated (see Jauhar et al., 2022).

The glutamate hypothesis is the major alternative neurochemical theory of schizophrenia. It developed from the recognition that an anaesthetic drug, phencyclidine, which went on to become a drug of abuse, could produce symptoms similar to

symptoms of schizophrenia (Javitt and Zukin, 1991). Phencyclidine's main pharmacological action is to block N-methyl-D-aspartate receptor (NMDA) receptors, one of the two main classes of glutamatergic post-synaptic receptor, leading to the concept of a functional glutamate deficiency in schizophrenia.

Post-mortem studies have not found consistent evidence of alterations in NMDA receptor numbers in schizophrenia, with the possible exception of a single region, the dorsolateral prefrontal cortex (Catts et al., 2016). Support for the glutamate hypothesis instead comes chiefly from studies that have administered the phencyclidine-like drug, ketamine, to healthy volunteers. This reliably results in increases on rating scales for both positive and negative symptoms (Beck et al., 2020), and also produces cognitive impairment with a pattern that appears on the basis of limited evidence to be not dissimilar to that seen in schizophrenia (Gilmour et al., 2012).

1.4.3 The neurodevelopmental hypothesis of schizophrenia

This proposal states that brain damage before birth or in the early postnatal period might, in some way, encourage the later development of schizophrenia. Before then, however, the effects of the damage are not entirely silent but show themselves as subtle abnormalities in behaviour and development.

The neurodevelopmental hypothesis receives very strong support from a series of so-called birth cohort studies, a series of nationwide follow-ups of babies (e.g., all those born in a single week of one year) that began to be undertaken from the 1940s onwards (Wadsworth, 2005). The children in such studies are typically assessed on a wide range of physical and psychological measures at regular intervals, with assessments then often continuing into adult life. In these studies, children who later develop schizophrenia

have been found to have a lower IQ than those who do not (Done et al., 1994; Jones, 1994). They also show more anxiety in childhood (Done et al., 1994; Jones et al., 1994), more frequent speech problems (Jones et al., 1994), more presence of motor disorders (Rosso et al., 2000). A further finding is the increased presence of minor psychotic symptoms at the age of 11 (Poulton et al., 2000).

1.5 Brain structure in schizophrenia

The first structural imaging study on schizophrenic patients was carried out in 1976 and used CT in a small sample of chronically hospitalized patients with the disorder (Johnstone et al., 1976). It found evidence of enlargement of the lateral ventricles, an abnormality was originally considered to reflect a degenerative or atrophic process (as in patients with dementia). The finding was confirmed in many more studies (Andreasen et al., 1990). However, these studies did not support an atrophic process, instead finding that the abnormality was present at the time of first onset of illness and did not progress (Steen et al., 2006).

With the development of the more recent and sensitive technique of MRI (Wright et al., 2000; Haijma et al., 2012), the following structural changes in schizophrenia are now accepted. The enlargement of lateral ventricular is around 25%, and is coupled with a 2% reduction in whole brain volume. Volumes of basal ganglia structures were also higher. There is evidence that somewhat more marked reductions in the frontal lobe (5%), hippocampus (5-6%), thalamus (4%) and amygdala (9%).

1.5.1 Brain function in schizophrenia

Another important source of knowledge on brain abnormality in schizophrenia is functional neuroimaging, which includes the techniques of Positron Emission Tomography (PET), Single Photon Emission Computed Tomography (SPECT) and functional magnetic resonance imaging (fMRI). The first two techniques measure regional brain activity at rest or during performance of tasks designed to activate parts of the brain such as the prefrontal cortex. fMRI, in contrast, can only measure activity during performance of tasks; this is because it is a 'relative' technique which can only measure changes in activity, eg between rest and task performance.

Functional imaging studies of schizophrenia began in 1974 with a study by (Ingvar and Franzen, 1974). This found that resting global blood flow was not significantly different from the controls in the schizophrenic patients, but that there was a changed regional pattern of flow in both groups of schizophrenic patients, with 'hypofrontality' a reversal of the normal pattern of greater flow in anterior as compared to posterior regions. Subsequent studies which examined the brain at rest had conflicting findings concerning hypofrontality, but the finding has been supported by meta-analysis (Hill et al., 2004).

Weinberger et al. (1986) proposed that hypofrontality might be more consistently present in schizophrenia when cognitive demands were made on the prefrontal cortex. In their study they examined schizophrenic patients and healthy controls both at rest and during performance of a frontal or executive task, Wisconsin Card Sorting Test (WCST). In this study the schizophrenic patients did not show hypofrontality at rest, but it was present during task performance. This finding has also been supported by meta-analysis (Hill et al., 2004; Minzenberg et al., 2009).

Currently, many further avenues of functional imaging abnormality are being explored in schizophrenia using fMRI (now the predominant functional imaging technique). A 2010 meta-analysis of 13 studies of facial emotion processing in schizophrenic patients (Li et al., 2010) found reduced activation in the amygdala among other regions. A later meta-analysis of 56 studies of brain activations (Dong et al., 2018) again found evidence for reduced activation in this subcortical structure. The hippocampus has also been a focus of interest from the functional imaging point of view, partly because of the above finding that it is one of the regions largest volume reduction in structural imaging studies. To date, however, studies using various kinds of memory task and spatial navigation paradigms have not had consistent results.

1.5.2 Overlapping of neurological basis of language and schizophrenia

Some of the aforementioned brain structures implicated in schizophrenia are also found to be involved in language processing. Take basal ganglia for example, these subcortical nuclei are found to be involved in both the process of word generation (Crosson et al., 2003; Tao et al., 2020) and syntactic processing (Kotz et al., 2003). These shared neurological basis and corresponding functions provide clues for us in theorizing the linguistic ingredients of FTD.

1.6 Organization of the dissertation

The nature of FTD has been controversial in both clinical setting and academic research. The overarching goal of this dissertation is to provide a cross linguistically valid criterion of what constitutes FTD. As a first step, a review of various linguistic theories will be presented in chapter 2. The linguistic properties of Chinese and Chinese

Classifier (CL) will be presented in chapter 3. Chapter 4 includes two experiments which test how FTD patients fail in Chinese Classifiers (CLs) using tasks. In the last chapter, a general discussion concerning the results of experiments and their implications for future studies will be presented.

Chapter 2. Formal thought disorder (FTD): an overview

2.1 The phenomenon of FTD

As noted in Chapter 1, some patients with schizophrenia – estimates vary from “loosening of associations” to disorganization – show speech that is difficult to follow, amounting in some cases to complete incomprehensibility. Some examples are:

We’ve seen the downfall of the radium crown by the Roman Catholics, when you come to see the drinking side of the business, God saw that Noah, if he lost his reason, he got nobody there look after them.

(Wing et al, 1974)

[In answer to the question, Why does your body make a shadow?] ‘Because it hides the part of light that is used for full room capacity or area capacity which you intervene.’

(Cameron, 1938)

(1) A donkey was carrying salt/ (2) and he went through a river/ (3) and he decided to go for a swim/ (4) and his salt started dissolving off of him into the water/ (5) and it did/ (6) it left him hanging there/ (7) so he crawled out on the other side and became a mastodon/ (8) it gets unfrozen/ (9) it’s up in the Arctic right now/ (10) it’s a block of ice/ (11) and a block of ice gets planted in/ (12) it’s forced into a square right? (13) ever studied that sort of a formation, block of ice in the ground?/ (14) well, it fights the perma frost/ (15) it pushes it away/ (16) and lets things go up around it/ (17) you can see they’re like, they’re almost like a pattern with a flower/ (18) they start from the

middle/ (19) and it's like a submerged ice cube/(20) that got frozen into the soil afterwards/....

(Rochester and Martin, 1979)

In a month I've been upstairs, they've been taking my brains out a piece at a time or all together.

(Chaika, 1974)

[When asked to explain the saying 'Don't swap horses when crossing a stream'].
'That's wish-bell. Double vision. It's like walking across a person's eye and reflecting personality. It works on you, like dying and going to the spiritual world, but landing in the Vella world.'

(Harrow and Quinlan, 1985)

It is apparent from these examples that what makes speech difficult to follow seems to vary from patient to patient. The first extract is from a widely-used structured clinical interview designed to assess and quantify psychotic symptoms. The patient alludes to some distinctly unusual concepts (e.g. the radium crown) which are not expressed in a way that is possible to grasp. He also seems to have a reference problem, in that the word 'them' is used with no clear antecedent. The second patient's speech is characterized particularly by idiosyncratic word and phrase usage. According to Cameron, the author who described this phenomenon, the patient seems to have been referring to patterns of light and shade with the terms 'area capacity' and 'full room capacity'.

The third extract is from a well-known book by Rochester and Martin in which

they examined the proposal that some of what makes thought-disordered speech difficult is an inability to use cohesive ties correctly. In particular, like in the first extract, it shows the phenomenon of unclear reference: while in some of the patient's sentences such as (8) and (10) what the word 'it' refers to is clear, in others such as (14) and (15), it is not at all clear.

The fourth example is from a pioneering article arguing that there is linguistic abnormality in FTD. Like patient A, she seems to be referring in an unclear way to what are presumably delusions ('they've been taking my brains out a piece at a time,') but she also shows a grammatical error, using the word 'a' instead of 'the' in 'In a month I've been upstairs'.

Sometimes the disruption of speech is severe, as in the fifth example. Here the disturbance appears to affect individual sentences, which are semantically incomprehensible. When severe, thought-disordered schizophrenic speech also often features neologisms or invented words, in this case 'wish-bell' and 'vella'.

2.2 Clinical descriptions of FTD

Over the years there have been many attempts to conceptualize the abnormalities underlying FTD. Kraepelin (1913, cited by McKenna and Oh 2005: 3)), the 19th and early 20th century psychiatrist who first described schizophrenia, used the term derailment, a tendency for the line of thought to depart from the given idea and move in indistinct spheres of ideas. He also extended the concept of derailment to cover dysfunctional linguistic process: according to his argument, the process of finding appropriate words could derail, which give rise to use of inappropriate choices.

Bleuler (1911, cited by McKenna and Oh 2005: 3), who introduced the term schizophrenia, argued for the existence of two abnormal processes that gave rise to FTD.

One was loosening of associations, which referred to the patients' inability to operate with concepts and connect them to the main idea. The other was closely related, loss of the normal goal-directness of thinking. This meant that while thoughts continued to be subordinated to some general idea, they were not unified or directed to a central goal.

A later author who contributed to the development of views about FTD was Cameron. He proposed that there were three factors that he thought caused the patients' utterance difficult to follow, asyndetic thinking, metonymic distortion and interpenetration of themes. Asyndetic thinking was similar to Bleuler's loosening of associations and loss of goal; it referred to a lack of logical connection between speech elements, which gave rise to the impression that the utterances were 'too distant, too loose and too over-inclusive, a collection of fragments, a conglomerate not an integrate (McKenna and Oh, 2005: 7). Metonymic distortion referred to the use of word approximations - the substitution of a related term or phrase for a more precise word or phrase. He also described an abnormality he called interpenetration of themes, which broadly referred to an apparent inability to separate the topic of conversation at hand from the patient's own inner preoccupations, which became mingled together. (This last term did not stand the test of time).

Wing and co-workers (1974; see also McKenna and Oh, 2005) noted that while the speech of schizophrenic patients can show poverty of speech, that is speech that is reduced in quantity, some patients, in contrast showed speech that was normal in quantity, but was vague and little information was provided in spite of the manner of words used. This was despite there being an absence of more definite elements of FTD like derailment or loosening of associations. They termed this abnormality poverty of content of speech.

2.2.1 The work of Andreasen

The work of the above and other authors was reviewed and synthesized by Andreasen (1979a,b) in a step that gave birth in the modern classification of FTD, as a disorder that comprises a number of different elements which may appear either singly in combination. Her Thought Language and Communication (TLC) Scale forms the foundation for current research and remains the most comprehensive assessment method to date.

The TLC specifies 18 elements of FTD. these are summarized in the following paragraphs. Her examples of each type are also provided in Appendix A.

Poverty of speech (poverty of thought, laconic speech)

Restriction in the amount of spontaneous speech, so that replies to questions tend to be brief, concrete, and unelaborated. Unprompted additional information is rarely provided. Replies may be monosyllabic, and some questions may be left unanswered altogether. When confronted with this speech pattern, the interviewer may find himself frequently prompting the patient to encourage elaboration of replies.

Poverty of content of speech (poverty of thought, empty speech, alogia, verbigeration)

Although replies are long enough so that speech is adequate in amount, it conveys little information. Language tends to be vague, often over-abstract or over-concrete, repetitive, and stereotyped. The interviewer may recognise this finding by observing that the patient has spoken at some length but has not given adequate information to answer the question. Alternatively, the patient may provide enough information to answer the question, but require many words to do so, so that a lengthy reply can be summarized in a sentence or two. Sometimes the interviewer may characterise the

speech as ‘empty philosophizing.’

Pressure of speech

An increase in the amount of spontaneous speech as compared with what is considered ordinary or socially customary. The patient talks rapidly and is difficult to interrupt. Some sentences may be left uncompleted because of eagerness to get on to a new idea. Simple questions that could be answered in only a few words or sentences will be answered at great length, so that the answer takes minutes rather than seconds and indeed may not stop at all if the speaker is not interrupted. Even when interrupted, the speaker often continues to talk. Speech tends to be loud and emphatic. Sometimes speakers with severe pressure will talk without any social stimulation and talk even though no one is listening.

Distractible speech

During the course of a discussion or interview, the patient repeatedly stops talking in the middle of a sentence or idea and changes the subject in response to a nearby stimulus, such as an object on a desk, the interviewer’s clothing or appearance, etc.

Tangentiality

Replying to a question in an oblique, tangential, or even irrelevant manner. The reply may be related to the question in some distant way. Or the reply may be unrelated and seem totally irrelevant. In the past, tangentiality has been used as roughly equivalent to loose associations or derailment. The concept of tangentiality has been partially redefined so that it refers only to responses of questions and not to transitions in spontaneous speech.

Derailment (loose associations, flight of ideas)

A pattern of spontaneous speech in which the ideas slip off the track onto another one that is clearly but obliquely related, or onto one that is completely unrelated. Things may be said in juxtaposition that lack a meaningful relationship, or the patient may shift idiosyncratically from one frame of reference to another. At times, there may be a vague connection between the ideas; at others, none will be apparent. Perhaps the commonest manifestation of this disorder is a slow, steady slippage, with no single derailment being particularly severe, so that the speaker gets farther and farther off the track with each derailment without showing any awareness that his reply no longer has any connection with the question that was asked.

Incoherence (word salad, schizophasia, paragrammatism)

A pattern of speech that is essentially incomprehensible at times. The incoherence is due to several different mechanisms, which may sometimes all occur simultaneously. Sometimes the rules of grammar and syntax are ignored, and a series of words or phrases seem to be joined together arbitrarily and at random. Sometimes the disturbance appears to be at a semantic level, so that words are substituted in a phrase or sentence so that the meaning seems to be distorted or destroyed. Sometimes “cementing words” (conjunctions such as ‘and’ and ‘although’ and adjectival pronouns such as ‘the’, ‘a’ and ‘an’) are deleted. Sometimes portions of coherent sentences may be observed in the midst of a sentence that is incoherent as a whole.

Illogicality

A pattern of speech in which conclusions are reached that do not follow logically. This may take the form of non sequiturs, in which the patient makes a logical inference

between two clauses that is unwarranted or illogical. It may take the form of faulty inductive inferences. It may also take the form of reaching conclusions based on faulty premises without any actual delusional thinking.

Clanging

A pattern of speech in which sounds rather than meaningful relationships appear to govern word choice, so that the intelligibility of the speech is impaired and redundant words are introduced. In addition to rhyming relationships, this pattern of speech may also include punning associations, so that a word similar in sound brings in a new thought.

Neologisms

New word formations. A neologism is defined here as a completely new word or phrase whose derivation cannot be understood. Sometimes the term 'neologism' has also been used to mean a word that has been incorrectly built up but with origins that are understandable as due to a misuse of the accepted methods of word formation. For purposes of clarity, these should be referred to as word approximations.

Word approximations (paraphasia, metonyms)

Old words that are used in a new and unconventional way, or new words that are developed by conventional rules of word formation. Often the meaning will be evident even though the usage seems peculiar or bizarre (i.e., gloves referred to as 'handshoes,' a ballpoint pen referred to as a 'paperskate', etc). Sometimes the word approximations may be based on the use of stock words, so that the patient uses one or several words repeatedly in ways that give them a new meaning (i.e., a watch may be called a 'time

vessel', the stomach a 'food vessel', a television set a 'news vessel', etc).

Circumstantiality

A pattern of speech that is very indirect and delayed in reaching its goal idea. In the process of explaining something, the speaker brings in many tedious details and sometimes makes parenthetical remarks. Circumstantial replies or statements may last for many minutes if the speaker is not interrupted and urged to get to the point. Interviewers will often recognise circumstantiality on the basis of needing to interrupt the speaker to complete the process of history-taking within an allotted time.

Loss of goal

Failure to follow a chain of thought through to its natural conclusion. This is usually manifested in speech that begins with a particular subject, wanders away from the subject, and never returns to it. The patient may or may not be aware that he has lost his goal. This often occurs in association with derailment.

Perseveration

Persistent repetition of words, ideas, or subjects so that once a patient begins a particular subject or uses a particular word. He continually returns to it in the process of speaking.

Echolalia

A pattern of speech in which the patient echoes words or phrases of the interviewer. Typical echolalia tends to be repetitive and persistent. The echo is often uttered with a mocking, mumbling, or staccato intonation.

Blocking

Interruption of a train of speech before a thought or idea has been completed. After a period of silence lasting from a few seconds to minutes, the person indicates that he cannot recall what he had been saying or meant to say. Blocking should only be judged to be present if a person voluntarily describes losing his thought or if on questioning by the interviewer he indicates that that was his reason for pausing.

Stilted speech

Speech that has an excessively formal quality. It may seem rather quaint or outdated, or may appear pompous, distant, or overpolite. The stilted quality is usually achieved through use of particular word choices (multisyllabic when monosyllabic alternatives are available and equally appropriate), extremely polite phraseology ('Excuse me, madam, may I request a conference in your office at your convenience'), or stiff and formal syntax ('Whereas the attorney comported himself indecorously, the physician behaved as is customary for a born gentleman.').

Self-reference

A disorder in which the patient repeatedly refers the subject under discussion back to himself when someone else is talking and also refers apparently neutral subjects to himself when he himself is talking.

As can be seen from the above, Andreasen felt that there were both linguistic ('language') and non-linguistic ('thought') elements in FTD; however, there was no attempt at a linguistic or other mechanistic characterization. It should also be noted that some items in the TLC scale have fallen out of usage since the scale was introduced in 1979. Echolalia and blocking are usually regarded as catatonic symptoms (i.e. a motor

symptom affecting speech). Self-reference is uncommon and does not feature in current descriptions of FTD.

It is also worth noting that there is now a consensus, supported by factor analytic studies (see McKenna and Oh, 2005), that there are two dissociable clusters within the overall construct of FTD. One, referred to as 'positive FTD' or 'fluent disorganization' includes elements such as derailment, loss of goal and incoherence and is considered to be separate from poverty of speech, poverty of content of speech and perseveration, which are considered to represent 'negative FTD' or 'alogia'. The former group of symptoms is currently the focus of most research into FTD. Negative FTD or alogia is typically considered to be part of the group of negative symptoms of schizophrenia, along with lack of motivation and lack of emotional expression. An example of one of the main factor analytic studies of FTD, carried out by Peralta et al. (1992). It isolated seven factors as listed in the following table:

Table 1 : Factor analysis of the symptoms of FTD in Peralta et al. (1992)

Factor (Variance)	Items
1st Disorganization (22.4)	Derailment Loss of goal Tangentiality Illogicality Circumstantiality Incoherence
2nd Negative (12.0)	Poverty of content Poverty of speech Perseveration
3rd Idiosyncratic (8.6)	Stilted speech approximations
4th Semantic (8.1)	Neologisms Clanging
5th Attentional (7.8)	Blocking Distractible speech
6th Referential (6.5)	Self-reference Echolalia
7th Verbosity (5.8)	Pressure of speech

2.3 Linguistic abnormality in FTD

As noted, FTD is a descriptive construct used by clinicians to try capture the various aspects of a clinical phenomenon seen in patients with schizophrenia. Some of its features, however, suggest that linguistic mechanisms may be involved, for example the construct of word approximations and the apparent disruption of semantics and syntax within sentences as evident in Andreasen's (1986) definition of incoherence. As a result, there have been several attempts to explain FTD wholly or partly in linguistic terms.

2.3.1 Dysphasic abnormalities in FTD

One tradition has been that FTD is actually a form of fluent dysphasia. This view dates back to Kleist (1914, 1930) who believed that the symptoms of schizophrenia were essentially similar to those produced by focal brain lesions, and could ultimately be understood as dysfunction of particular regions. With respect to FTD, he argued that it was possible to identify paraphasias in thought-disordered schizophrenic speech, a classic dysphasic phenomenon, seen for example in Wernicke's aphasia, where there is substitution of a related (or sometimes unrelated) word for the intended word.

Kleist also noted the occurrence of what he called paragrammatism in FTD. He used this term in distinction to agrammatism as seen in non-fluent (i.e. Broca's) aphasia. While agrammatism was mainly concerned with omission of auxiliary words, word inflections, prefixes and suffixes, in paragrammatism these elements were present but used incorrectly. In other words, the individual words might be well formed, but the lexical strings violated grammatical rules. This term is still used in dysphasia research.

Finally, Kleist argued that the comprehension of speech was also impaired in FTD, as it typically is in Wernicke's dysphasia. This last proposal is no longer accepted and several studies, e.g. Oh et al. (2002), found no clear evidence of a comprehension deficit associated with FTD.

Kleist's views were initially not widely accepted. However, this changed in 1974 with the publication of a paper by Chaika, which was highly influential. The paper was titled 'A linguist looks at schizophrenic language', and it took the form of a linguistic analysis of the speech of a 37-year-old chronically hospitalized woman who had a clinical diagnosis of schizophrenia. She showed markedly disorganized speech with many features that were typical of FTD. Chaika noted that she also described aspects of the patient's speech that were reminiscent of dysphasia. These included the patient's use

neologisms and what Chaika called gibberish words. Examples included:

(21) [ðɪ sɔəndən sɔ tʰɜ̃č fɔ juəri]

(22) [dʌdn]

(23) He still had [fʊč] with [tʰekraʰmz] I'll be willing to betcha.

These gibberish words were produced as if they were meaningful speech. No pauses or stress were introduced before the patient uttered them, and they all conformed to the stress and phonemic rules of her own dialect.

In addition to gibberish and neologisms, Chaika argued for another phenomenon, in which the patient assigned wrong or insufficient semantic features to recognized words in the lexicon. She considered that this reflected a mismatching between phonological shapes and semantic features. In the following example, when the patient mentioned her mental illness, she used the word distemper.

(24) I have distemper just like cats do, 'cause that's what we all are, felines.

And further in the following speech sample, the patient connects the name Bill to the meaning 'making love' in the expression 'bill and coo'.

(25) a. My mother's name was Bill (pause)

b. (low pitch as in an aside, but with marked rising question intonation)and coo?

(strong, loud)

Finally, Chaika noted that, while in general, the syntax of the patients' speech was

relatively intact, occasional problems were seen. One example of syntactic error is shown in:

(26) In a month I've been upstairs, they've been taking my brains out a piece at a time or all together.

In this example, instead of using the article 'a', the article 'the' should have been used.

Interestingly, from the point of view of further research, Chaika also noted in passing an apparent lack of use of the discourse markers in connected speech necessary to show connections and orient listeners to her topic. An example in the speech of her patient (which she did not highlight) is:

(27) (declaiming) I believe in the spirit of the mountains. Right now, I'm thinking Pike's Peak for a rehaul of the Korean thing.

Here, 'the Korean thing' has no referent in the previous sentence. She argued that the above-described abnormalities of FTD were genuinely linguistic in nature and indicated disturbances of corresponding brain areas involved in language. However, she was ambivalent about treating FTD as a form of aphasia since the pattern of disturbances found in schizophrenic speech were different from those in aphasia, in particular being intermittent in many patients, unlike the case in neurological disease.

2.3.2 Further studies of dysphasic features in FTD

Several further studies have examined the question of whether there is dysphasia-like linguistic abnormality in patients with FTD. Faber et al. (1983) compared 14 schizophrenic patients with FTD and 13 patients with dysphasia (11 fluent and 2 non-fluent). They made transcripts of interviews with the patients, and after removing potential identifying information including age and references to psychiatric or neurological symptoms and treatment, presented them under blind condition to two psychiatrists, two neurologists and a speech and language pathologist. The results showed that the two neurologists were correct in only 18/27 cases, while the psychiatrists were correct in 20/27 and 22/27 cases. The speech pathologist performed better, being correct in 25/27 cases. The speech pathologist's success was based on clues that schizophrenic patients were fluent, showed relatively intact comprehension of questions and showed a tendency to use multisyllabic words, whereas the aphasic patients had comprehension deficits, word finding problems, impaired naming and used a reduced number of nouns.

Hoffman and Sledge (1984) investigated a 28-year-old male patient diagnosed with schizophrenia according to DSM-III (American Psychiatric Association, 1980) and Research Diagnostic Criteria (Spitzer, Endicott and Robins, 1978) who was considered to show prominent paragrammatism. During an interview that lasted approximately 30 minutes, the authors detected three sets of irregularities in this patient's production. The first set of problems occurred at the level of phrase. Some examples are as follows:

(28) a criminal a record of a criminal nature.

(29) a record of a criminal nature.

They argued that, compared with proposed correct phrase (29), the deviant example (28) was likely derived from the impairment in dealing with complex postnominal complements, within which ‘criminal’ is relocated to a condensed prenominal position.

The second set of problems were detected at the level of syntagm, a term they used to indicate phrases or clauses organized to express propositions. The following example occurred when the patient discussed the results of being left back in school.

(30) That’s why, you know, that fact that I did there was no stigmatism attached to that clearly explained in the record why you put back...

Another example was:

(31) it’s a long term investment, insurance being one of your soundest investments, which now even you know that’s what those brings you know retirement policies and things, that’ll pay you X amount of dollars

The authors argued that the structures of example (30) and (31) were similar, since both involved syntactic transformations. The two possible correct structures are illustrated in (32) and (33).

(32) It clearly explained in the record why you were put back/ that’s why, you know, there was no stigma attached to the fact that I was

(33) it’s a long term investment, insurance being one of your soundest investments, which even now [will] pay you X amount of dollars, you know, that’[s] what those

retirement policies and things bring

In example (30) the anaphoric element ‘that’ lacked a clause antecedent, which possibly could be ‘clearly explained in the record why you were put back’. While in (31) ‘[will] pay you X amount of dollars’ seems to be displaced across clause boundary and separated from anaphoric element ‘which’.

According to Hoffman and Sledge, these examples did not indicate primary problems in lexical or phonemic specification, but rather pointed to disrupted representations whose scope extended beyond the single word. They suggested that the patient’s linguistic pathology involved a malfunctioning combinatorial processes affecting multiple lexical items.

Chaika and Alexander (1986) compared the speech of 22 patients with thought disorder and 25 normal controls. The participants were shown a short video made up of several scenes. In the first scene, a girl is at a shopping centre, looking through the window of a Baskin Robbins store. In the second scene, a woman is setting a table, and the same girl walks into the room and asks, ‘Mommy, can I have some ice cream?’ The mother leans down and put an arm around her and says gently, ‘No, honey, it’s too close to supertime.’ Then her father walks into the house and she asks, ‘Daddy, can I have ice cream?’ The father then looks into the camera with a grin, and his hand moves towards his pants pocket. In the next scene, the child walks to the Baskin Robbins store, enters and leans against the counter as she waits fidgeting. Then a clerk asks whether he can help her. She responds inaudibly, but the clerk repeats clearly, ‘Double grape ice.’ The clerk gives her a double decker cone. The girl gives him the money and the man gives her the change and says, ‘thank you, Come again.’ The girl returns to the camera with a triumphant smile and leaves the store. The film ends there.

The participants were asked what happened in the story immediately afterwards. Chaika and Alexander described several linguistic abnormalities including the following:

Lexical choices: these took the form of unusual words which could be either overly emotional for the situation (one patient said the girl was ‘craving’ ice-cream, and another said she was ‘put down’ by her parents), or alternatively literary or poetic sounding (‘he gets her the coins’ or ‘The cash register man handled the financial matters’). They considered these literary or poetic using to be rare examples of a general difficulty in finding or using the correct word.

Narrative glitches: While both the patients and the healthy controls produced errors that interrupted the flow of the narrative, these appeared qualitatively different in the patients. For example, only the patients started a phrase, broke off to insert a comment and then never picked the phrase up again.

(34) He was blamed for and I didn’t think that was fair the way the way they did that

(35) What are the and uh there was a scene

(36) and asks if she can have then goes to the ice cream place

They also noted that as well as being exclusive to the patients, the sentences in which the glitches occurred were said as if nothing had been omitted; there was no break in the intonation or stress. They considered this to represent ‘a true break in syntactic ability, a genuine agrammatism.’

Additionally, both the patients and the controls made false starts, but in the patients only, these sometimes seemed unrelated to the ultimate choice of word:

(37) he ch- told where to go

Rhyming errors: The patients but not the controls produced utterances in which a word that rhymed with an apparent intended word was selected, with no apparent recognition of the slip:

(38) He twitched through the door

(39) That's all I can stew.

Use of neologisms/non-English words (Chaika and Alexander also used the term word salad): Here the patients produced a word or a string of words that were not words in English:

(40) she gets her ous ow after she . . .

This phenomenon was seen almost exclusively in the patients, although there was one example in a control ('so therefore she etuh she ed she listened').

In contrast to the above abnormalities, Chaika and Alexander found few syntactic errors, and both groups produced them, for example:

(41) He charged it for her

(42) it's too close *for dinnertime*. [control]

(43)...two three minutes for get waited on

(44) there was and when she got home there was too near supertime.' [patient]

In summary, Chaika and Alexander found that only psychotic patients produced syntactic gaps and rhyming slips. Their speech was also characterized by use of neologisms and false starts with elements that were not picked up later; such errors were rare or non-existent in the controls.

Oh et al. (2002) assessed 6 patients with FTD, 7 without FTD and 9 normal healthy controls. Five tasks were used to elicit speech samples and a minimum of 100 sentences were acquired. Speech was analyzed using Brief Syntactic Analysis (BSA; Thomas et al., 1996). BSA provides a measure of presence of syntactic and semantic abnormalities within sentences, as well as dysfluencies and sentence complexity. A sentence was judged as syntactically problematic when there was a violation of syntactic rules, omission of important syntactic structures or structural anomalies. For example:

(45) Patient: Then they come in again, and starts taking their coats off (verb disagreement)

(46) Patient: He goes fishing, and um... the ripples by the rock (missing clause)

A sentence was considered to be semantically deviant if unclear meaning was detected, or the meaning was bizarre based on its lexical content and syntactic structures. For instance:

(47) Patient: Seems to be like a white, like a white space deck... hand, which is white all over and coloured like a white sort of dome-type hand.

A sentence was also considered semantically deviant if it contained a word or words which were used in a semantically unacceptable fashion. For example:

(48) Patient: Oh, it [life in a hospital] was superb, you know the trains broke, and the pond fell in the front doorway.

In this sample, since the propositional features of a pond do not fit the action of falling in the front doorway, it was judged as semantically deviant. Further, semantic paraphasias was also considered as semantic error, for example:

(49) Patient: ‘Cause it’s [the boat] near the shore and somehow it wouldn’t drown.

‘Drown’ was a semantic paraphasia for sink.

In addition, the authors added another category of mistakes namely ‘semantic and syntactic deviance’. These sentences were not only semantically anomalous but also violated syntactic rules.

The main finding was that, whereas within-sentence syntactic abnormalities were found in both the patients with and without FTD at a higher rate than healthy controls, semantic abnormalities were virtually only seen in the patients with FTD. Thus, syntactic errors were seen in both FTD and non FTD patients’ speech at approximately the same frequency (FTD: mean syntactic errors 4.3%, range 3.0–8.3%; non FTD: mean syntactic errors 3.2%, range 0.5–7.2%). The frequency of syntactic errors was lower among the normal controls (mean 1.5%, range 0.4–2.7%). In contrast, while all the FTD patients produced semantically deviant sentences (mean 4.5%, range 2.5–7.8%), only three of the non FTD patients did so, and then only to a minimal degree (mean 0.4%, range 0–1.5%). None of the normal controls produced semantically deviant sentences.

It is important to note that the rate of both types of errors was low: semantically and/or syntactically abnormality was seen in less than 10% of the sentences overall.

Finally, Oh et al. (2002) noted that naming performance similar in the patients with and without FTD. They also found no clear evidence that a comprehension deficit characterized patients with FTD.

In summary, a small number of studies have indicated that linguistic abnormalities, that are similar in some respects to those seen in neurological patients with dysphasia, can be detected in schizophrenic patients with FTD. The study of Oh et al. (2002) also indicates is that such abnormalities are relatively infrequent and so cannot be the only explanation of what makes schizophrenic speech difficult to follow. In the following section, problems at the discourse level will be reviewed.

2.3.3 FTD as a discourse-level abnormality

Although Chaika, as described above, noted in passing problems at the level of discourse in FTD, this approach began formally with the work of Rochester and Martin (1979). They examined schizophrenic patients with and without FTD and 10 matched healthy controls matched for age, verbal IQ and educational background. There were three elements to their approach: cohesion, (non)phoric nominal groups and retrieval analysis.

2.3.3.1 Rochester and Martin's analysis of cohesion in relation to FTD

Rochester and Martin (1979) first applied Halliday and Hasan's (1976) analysis of discourse cohesion to FTD speech. Halliday and Hasan identified five cohesive ties ('means whereby elements that are structurally unrelated to one another are linked

together') in English: reference, substitution, ellipsis, conjunction and lexical cohesion. Rochester and Martin followed Halliday and Hasan's methodology, except that they did not consider collocations within the category of lexical cohesion, possibly because collocations were difficult to be assessed uniformly by different raters. Collocations complement the so-called reiterations within the lexical type of cohesive ties. The former include antonyms, or other words that are related as parts to wholes e.g., family-mother; house-door, while the latter include literal root repetitions, synonyms, hyperonyms and hypo-nyms, and general terms.

An illustration of the five major types of cohesive ties, with the corresponding subtypes analyzed by Rochester and Martin, is presented in Table 2.

Table 2: Examples of cohesive ties in Rochester and Martin (1979)

Category	Subcategory and Examples
Reference	<ol style="list-style-type: none"> 1. Pronominal: We met Joy Adamson and had dinner with her in Nairobi. 2. Demonstrative: We went to a hostel and oh that was a dreadful place. 3. Comparative: Six guys approach me. The last guy pulled a knife on me in the park.
Substitution	<ol style="list-style-type: none"> 1. Nominal: The oldest girl is 25 and the next one's 22. 2. Verbal: Eastern people take it seriously, at least some of them do. 3. Clausal: I'm making it worse for myself. I would think so.
Ellipsis	<ol style="list-style-type: none"> 1. Nominal: He's got energy too. He's got a lot more Ø than I do. 2. Verbal: I could go to university all my life, Ø keep going to school. 3. Clausal: Have you ever been to Israel? – No, my brother has Ø.
Conjunction	<ol style="list-style-type: none"> 1. Additive: I read a book in the past few days and I like it. 2. Adversative: They started out to England but got captured on the way. 3. Causal: It was a beautiful tree so I left it alone. 4. Temporal: My mother was in Ireland. Then she came over here. 5. Continuative: What kind of degree? –Well, in one of the professions.
Lexical	<ol style="list-style-type: none"> 1. Same root: Mother needed independence. She was always dependent on my father. 2. Synonym: I got angry at M. but I don't often get mad. 3. Superordinate: I love bass, but I love fish in general. 4. General item: The plane hit some air pockets and the bloody thing went up and down.

Their sample included 10 schizophrenic patients with FTD and 10 without FTD (N=10) were included; judgements were based on videotaped interviews of the patients assessed by two psychiatrists. All patients met an early set of diagnostic criteria for schizophrenia, the New Haven Schizophrenia Index (Astrachan et al., 1972). The controls were recruited from news paper advertisement. Over all the participants, the mean age was

26.7 years and the mean educational level was 13.3 years. Speech samples for the study were collected in three situations: an unstructured interview of about half an hour; a brief narrative, where a short story was read to the participants and they were required to retell it; and a cartoon description task.

Cohesion analysis was applied to speech samples obtained from the interviews and the narratives only; cartoon description was not used for this part of the study since it was short. In the interviews, 30 independent clauses were obtained from every participant. This amounted to 900 clauses for the whole sample of 30 subjects. In the case of the narratives, the full texts were analyzed which yielded a total of about 300 independent clauses. In total, 1200 clauses were obtained from both tasks. As each clause contained on average 2.6 cohesive links to other clauses, the overall database was 3100 observations in all three groups together.

The findings are summarized in Table 3. Because there were differences in the number of clauses produced by the three groups, and differences in the sample length differ in the narrative and the interview, the authors calculated both the total ties produced per speaker and per clause in the two tasks.

Table 3. Number of cohesive ties in schizophrenic patients with and without FTD and healthy controls in Rochester and Martin's (1979) study

Group (N = 10)	Total ties per speakers		Total ties per clause	
	Narrative	Interview	Narrative	Interview
FTD	24.7*	46.9	2.61*	2.04
NFTD	22.5	39.9	2.95	1.97
N	44.3	52.1	3.86	2.27

FTD: schizophrenic patients with formal thought disorder; NFTD: schizophrenic patients without formal thought disorder; N: normal controls.

It can be seen that the healthy controls used on average more cohesive ties than both schizophrenic groups in the narrative and interview sessions. In the narratives the difference between the controls and the patients was almost double and statistically significant (FTD: 24.7, NTD: 22.5, N: 44.3). In the interview the difference was less marked (FTD:46.9, NTD:39.9; N:52.1). On the other hand, there were no significant differences between the FTD and non FTD patients in the number of cohesive ties used in either condition. The pattern was the same when the number of cohesive ties per clause was used instead of total numbers of ties.

A breakdown of the results for the use of each of cohesive ties in each of the categories of reference, conjunction, lexical and ellipsis is shown in Table 3a and b (because only than 1% of substitution ties were found, this category was not analyzed). In the interview task, 46% of the ties used by patients with FTD were lexical ties, compared to 31% in the patients without FTD and 36% in the healthy controls. The difference between the two schizophrenic groups was significant, although neither

schizophrenic group differed significantly from the normal controls. This pattern was not seen in the narratives, however; here the controls used non-significantly more lexical cohesion than both patient groups.

Table 4a. Percentage of ties per category in narratives in Rochester and Martin's study

Group	Reference	Conjunction	Lexical	Ellipsis
FTD	52.0	21.7	24.9	0.7
NTD	49.9	24.1	22.8	3.2
N	46.5	21.1	30.3	2.0
Mean	49.5	22.3	26.0	2.0

Table 4b. Percentage of ties per category in interviews in Rochester and Martin's study

Group	Reference	Conjunction	Lexical	Ellipsis
FTD	28.6	20.2	45.8*	4.0
NTD	33.8	25.9	31.3	8.1
N	29.9	28.1	36.0	5.8
Mean	30.8	24.8	37.8	6.0

In summary, Rochester and Martin (1979) found some evidence for overuse of lexical cohesion in patients with thought disorder compared to those without. However, this result was complicated a) by the fact that it was seen only in interviews and b) that no significant differences were found between either patient group and the healthy controls.

2.3.3.2 Nonphoric nominal groups analysis in Rochester and Martin's study

The above cohesion analysis only captures reference at the between-sentence level. In order to supplement it, in chapters 5 and 6, Rochester and Martin (1979) further examined how new participants are introduced into discourse by patients with and without FTD. For this, they examined how the patients used nonphoric nominal groups, i.e. how new participants were introduced in discourse. Nonphoric nominal groups, unlike phoric ones, “do not depend on any prior identification of their participants”. Nonphoric nominal groups can be further divided into general nominal groups and specific nominal groups. In general nominal groups no particular participant needs to be identified, whereas in specific nominal groups, items refer to a particular participant or participants. General nominal groups rely either on generalized personal reference (e.g. ‘*One* never can tell about April days.’) or generic or kind reference (e.g. ‘*Linguists* are always picky.’). Generic reference includes a lot of lexical items, which White (1949) called ‘universal concepts’, for example ‘religion’, ‘the Chinese’ and ‘mankind’. Since these items do not refer to specific participants, they can be used again and again in the discourse and they don’t contribute to initiating any chain of reference although, importantly, by repeating themselves can contribute to lexical cohesion, although on its own this is never as integrative as referential chains. In the words of Rochester and Martin (1979): “Since they refer to no specific participant, they can be used again and again without initiating any chain of reference in the text. Consequently, they may

account for rather high proportions of lexical cohesion but contribute nothing to the referential cohesion within a text.” (Rochester and Martin, 1979: 120). This applies to generics irrespective of whether they are preceded by an article (*The Chinese*) or not (*linguists*). In this regard it is worth mentioning that in contrast with *the Chinese* in its generic interpretation, where a single cohesive tie is obtained (*Chinese*), a nominal group with the form *definite article + noun*, *the boys* for instance, where a previous nominal group like *some boys/the boys* is resumed (phoricity), there are two cohesive ties, one lexical (*boys*) and the other referential (*the*).

Rochester and Martin’s findings are shown in Table 4. Among the different types of nonphoric reference, the overuse of generics in the free interview task was the only statistically significant difference between the FTD and the non FTD patients. The FTD patients produced 13.1% of generics out of the total of nominal groups while the non FTD patients produced 4.2%.

Table 5: Percentage of generalized and generic in Rochester and Martin’s study

	Cartoon		
	FTD	NFTD	N
Generalized (e.g. One never knows*)	6.1	6.0	6.2
Generic (e.g. Tigers are fierce*)	4.6	4.2	5.4

	Narrative		
	FTD	NFTD	N
Generalized (e.g. One never knows*)	3.5	0.9	1.0
Generic (e.g. Tigers are fierce*)	3.2	2.8	7.3a

	Interview		
	FTD	NFTD	N
Generalized (e.g. One never knows*)	11.2	9.2	8.5
Generic (e.g. Tigers are fierce*)	13.1	4.2a	8.2

The difference between both groups increased if only simple generics (e.g. children, elephants, drugs) were considered (i.e. with the exclusion of partitive generics, e.g. a glass of water, a pinch of salt): the figures then became 9% in the FTD patients vs. 0.8% in the non FTD patients (Rochester and Martin, 1979: 124).

Nevertheless, once again the findings were not absolutely clear since a) the overabundance was found only in the interview task and not in the other two tasks, and b) there was a seeming overabundance of generics in the normal controls in the narrative task.

2.3.3.3 Retrieval analysis: how presumed elements are recovered in discourse.

Here, Rochester and Martin (1979) examined phoric nominal groups, i.e. those presuming a referent. Presumed referents can be recoverable from either a socioculturally shared pool of entities or from the context. They are always realized as definite NPs/nominal groups. In the former case, the referents are so prominent for a given sociocultural group as to be directly available to any of its members in ordinary communication. Such so prominent referents can be either homophoric, like *the moon*, *the government*, or unique, like *Mary*, *Trump*. Unique referents are usually conveyed by proper names. Both types of socioculturally based phoricity were negligible in Rochester and Martin's corpus in percentage terms.

In the latter case, that of presumed referents located in the context, they can be explicitly retrievable either in the verbal context (endophora) or in the nonverbal context (exophora). Yet there is a further case, namely when the presumed referent is not explicitly identifiable —nor prominent socioculturally. This occurs when the speaker has provided no specific referent. Then the listener's job is to infer an implicit or indirect referent supported by a close semantic item in the context providing sort of a bridge to reach the intended referent. If this inferential search fails an unclear referent is obtained. According to Rochester and Martin, the listener is compelled to add a new one by either creating or selecting it among those referents that have ambiguously been provided.

The four previous options for assigning a referent to a phoric, presuming element, were by far the predominant mode of reference in all speakers' productions and tasks in Rochester and Martin's study — about 60% to 80%. The typology illustrated with examples and completed with the retrieval strategy each type requires is summarized below.

Table 6: Retrieval categories for definite reference in Rochester and Martin (1979)

Retrieval category	Location of referent	Example
Endophoric	Direct verbal context	A donkey was loaded with salt and he went to cross a river.
Exophoric	Nonverbal context	You are reading this sentence now.*
Bridging	Indirect verbal context	There's a house with two people standing in the door.
Addition	Unclear	A donkey was crossing the other river. A commuter and a skier are on a lift and he looks very cold.

Table 7: Percentage of definite nominal groups in different retrieval categories in Rochester and Martin's study

Retrieval categories	Context								
	Cartoon			Narrative			Interview		
	FTD	NFTD	N	FTD	NFTD	N	FTD	NFTD	N
Endophoric (direct verbal context)	55*	73	74	69*	79	86	46	43	46
Exophoric (nonverbal context)	38*	21	18	5	3	1	42	50	43
Bridging (indirect verbal context)	4*	5	7	8	4	10	3	3	7
Addition (context unclear)	2*	1	—	17*	14	2	9	3	4

The main finding was of significantly less use of endophoric reference (immediate verbal context) in the FTD patients compared to the non FTD patients and controls, in two of the three conditions, cartoons and narratives, but not in the interview condition. Correspondingly, the FTD patients showed an increase in exophoric reference (immediate nonverbal context), although this was only evident in cartoons. Finally, and importantly, they found an apparent increase in the use of unclear references (addition subcategory) in the FTD patients. However, this was only seen in narratives. Moreover, the difference with the non FTD patients was minimal, with both groups showing many more instances than controls.

Rochester and Martin added a qualification to their finding of a high rate of unclear references in the narratives of schizophrenic patients, which as noted was only slightly

higher in those with FTD (17%) in comparison to non FTD (14%). This was that not all the cases annotated as unclear reference were actually unclear. Real cases of unclear reference were for instance *the elephant* and *the farmer* in examples like *The load was heavy because the elephant ...*, *The farmer was going across the river* because there was no elephant and no farmer in the original story. Untruthful cases of unclear reference, which nevertheless were annotated as if they were so, are *the donkey* and *the water* in an initial sentence like *The donkey was going into the water*; or *he* in *He tried to carry salt*. As Rochester and Martin argued, the latter cases were instead akin to those annotated as instances of exophora in the cartoons —non italicized (pro)nominals in the following examples: *The guy's looking at a bottle of whiskey or whatever it is*; *He has a mitt but he uses his bare hands*. Was thus the annotation wrong? In a way it was not. The annotators dealt with the patients' narrative as an independent, self-contextualizing text, which is the standard way to proceed. In other words, they were in the story-listening mood, namely as though they were not knowledgeable of the story at all — which is not the case. This strategy is fit and in correspondence with that of conventional tellers, who tell the story as though it was unknown to listeners. Schizophrenic patients are not, though, conventional retellers and seem to address the narrative task as if the story was shared with the listener.

In agreement with that and given the striking similarity between exophora in cartoons and untruthfully unclear reference in narratives, Rochester and Martin reanalyzed unclear reference in what they call analysis II. This analysis II distinguishes true unclear reference as explained above from untruthful cases that can be considered the abnormal extended exphora. The results show a striking reduction of unclear reference with the consequent increase in exophora.

In sum, the results of analyzing the retrieval strategies to locate referents in a

discourse are suggestive of a linguistic deficit in schizophrenic patients. Moreover, the analysis II strongly suggests that what is challenging for them, and specially for the thought disordered ones, is to rebuild a pre-established story in their minds and explain it appropriately, whether with visual support (cartoons) or without (retold story).

2.3.3.4 FTD from the viewpoint of cohesion and retrieval analyses: summary of findings.

Despite complexities, some trends in the above findings stand out. They concern endophoric verbal reference/anaphora, addition/unclear reference, exophora, and lexical cohesion. With respect to endophoric verbal reference/anaphora, it appears in both cohesion and retrieval analyses, it is less used in narratives by schizophrenic patients, both with or without FTD. The findings for unclear reference point to difficulty with the use of anaphoric devices in schizophrenia which is particularly pronounced in the case of patients with FTD. Anaphora is sensitive to task and shows up mainly in narratives across groups: while healthy controls use it profusely for an efficient retelling, schizophrenic patients do not and are prone to errors when they do, with the consequence that unclear reference appears. Exophora, or reference to the nonverbal context, is another distinctive marker of schizophrenic narratives. Although not directly pointing to a discourse deficiency in contrast with unclear reference, exophora has permeable borders with the latter and is likewise accented in those with FTD. It is then reasonable to associate it with the difficulties with anaphora in the narratives as well. In sum, the most solid results seem indissolubly related to the difficulties in establishing verbal reference or anaphora in narratives, which are the context where the anaphoric function is most needed. As for the differentiating role between FTD and non FTD schizophrenic patients that lexical cohesion accomplishes in interviews in Rochester

and Martin (1979), it can be concluded that it also holds albeit remaining under-researched.

2.3.4 The work of Docherty and co-workers on use of reference in schizophrenia.

Docherty and co-workers (Docherty et al., 1988; Docherty and Gordinier, 1999; Docherty et al., 2003) carried out a series of studies that were intended neither as retrieval or cohesion analyses, but as a referentiality analysis. For this they used their own measure, the Communication Disturbance Index (CDI) (Docherty and Hebert, 1997); some examples are shown in Table 8.

Table 8: Categories of communication failure measured by the communication disturbances index (Docherty and Hebert, 1997)

1. Vague references: Overinclusive words or phrases that obscure the meaning because of their lack of specificity	Being sick is, it's not bad. You can do things and plus you can make people afraid of you.
2. Confused references: Words or phrases that refer ambiguously to one of at least two clear-cut alternative references	Take the clock, for instance. You got ten, twelve on it, you got other numbers on it, you got a volume on it, it go up and down.
3. Missing information reference: References to information not previously presented and not known to the listener	I like to work all right. Some of those shops were filthy. I liked the bakeries, some of the shops are clean. (No prior mention of any shops or bakeries.)
4. Ambiguous word meanings: Instances in which a word or phrase could have a number of different meanings and the intended meaning is not obvious from the context	I had a chance to grow with him but I got a divorce because I couldn't.
5. Wrong word references: Use of an odd or apparently inappropriate word or expression in an otherwise clear utterance	I was trying to predict them people that I need, I need to get out of there.
6. Structural unclarities: Failures of meaning due to a breakdown or inadequacy of grammatical structure	I was socializing with friends. Girlfriends and friends the same as male.

Docherty and co-workers (Docherty et al., 1997) found reference abnormalities in the speech of her schizophrenic patients as a whole. They also found that presence of FTD was significantly correlated with all six classes of referential abnormalities identified in their scale (Docherty et al., 1988; Docherty and Gordinier, 1999; Docherty et al., 2003). For example, Docherty et al. (2003) examined 48 schizophrenic patients, and 28 control participants who roughly matched with the patients' age, gender and occupational level. The speech samples were three 10-minute conversations on topics like daily activities, routines hobbies and leisure activities. It was found that both the patient and control

group showed referential problems in all six types rated, but the level was higher in the patients on every type of the referential problems. Further, referential disturbances correlated with formal thought disorder, and they correlated highly in severe cases.

2.3.5. The work of Hinzen and co-workers: a discourse, referent retrieval approach in a grammatical framework

Referential problems like those detected in Docherty's studies were approached by Hinzen and co-workers at grammatical level. The authors attempted to explain the referential problems by proposing a specifically grammatical impairment which affected the use of pronouns, articles and demonstratives. According to Hinzen, the referential function of language depends mostly on grammar rather than on the lexicon, or equivalently on the more abstract part (specificity, singularity, etc.) rather than on the descriptive part of language. According to his illustration (Hinzen and Sheehan, 2013), *man* does not refer, but *this man* (*this*, deictic) or *the man* (*the*, definite article) do. In schizophrenia, therefore, they hypothesized that referential anomalies affecting NPs in general would be more present in patients with FTD than in those without FTD and that the same pattern would obtain for referential anomalies affecting definite NPs. Also differentiating FTD patients, an inferior number of definite NPs was predicted. Syntactic complexity and errors were predicted to be present to a similar extent in both groups of patients.

In an initial study to test this hypothesis, Çokal et al. (2018) examined schizophrenic patients with FTD (N=15), without FTD (N=15) and healthy controls (N=15) while they performed a cartoon narrative task (they also examined the first-degree relatives of patients with schizophrenia, but these results are not included here).

They annotated narrative transcripts for syntactic complexity, number of definite NPs (noun phrases), general NP reference anomalies and definite NP reference anomalies. Some examples of their findings were:

Vague-unclear references: ‘There is a man phoning a man and he is making an appointment to come and have dinner with him’—difficult to disambiguate *he/him*.

Third-person anaphor anomaly: ‘Resk saves the day. *They* come home’—the anaphoric pronoun *they* is used, but only one character ‘comes home’ (the other three never left).

Referential anomaly occurring in definite NP: ‘It is the two people from picture number four’—a more specific NP (e.g., ‘the couple’) is expected as these main story characters have been present throughout the story.

Referential anomaly occurring in indefinite NP: ‘Someone is crying’—the indefinite NP ‘someone’ is used where a definite NP (e.g., *she*) would be expected, since the referred character has been already introduced.”

The hypothesis of a reduced use of definite NPs in FTD compared to normal controls was supported. However, the hypothesized differences concerning the distinctive character of referential anomalies in (definite) NPs did not distinguish FTD from non FTD patients. Concerning syntactic complexity and abnormalities, no significant differences were found between both patient groups.

In a second study, Sevilla et al. (2018) carried out a similar analysis but this time using a task consisting of retelling a fairytale. Twenty patients with schizophrenia and FTD and 20 without TD were recruited; in this study the patients were Spanish speakers. All patients met DSM-IV criteria. There were also 14 healthy controls. The

variables that were examined this time were somewhat different: paraphasias were annotated and referential anomalies were not only assigned to definite and indefinite NPs but also to nominal vs. pronominal NPs. Syntax was assessed through syntactic complexity and integrity (errors). Also differently from Çokal et al. (2018), referential abnormalities in NPs were recorded, for example:

Pronoun: She walked in the forest [beginning of the fairy tale, where we don't know who is 'she']

Noun: The girl walked in the forest [beginning of the fairy tale, where we don't know who is 'the girl']

Definite: The girl walked in the forest [where 'a girl' would be expected]

Indefinite: The wolf chased the girl. Someone caught her.

It was found that abnormalities in pronouns and definite forms were significantly associated with FTD in contrast with abnormalities in nouns and indefinite forms. Paraphasia, it should be noted, also significantly distinguished FTD patients from both non FTD patients and controls.

2.4 Summary

The literature reviewed in this section indicates that the linguistic impairments of schizophrenic FTD can be broadly classified into two types: First there dysphasic-like problems such as clanging, neologism and syntactic related problems, which occur within sentences). Secondly, there appear to be problems in maintaining discourse as manifested particularly by reference abnormalities, and possibly also increased lexical cohesion. These latter mainly occur at the between-sentence level. Particularly

important here is the issue of reference abnormality; whether this results from deficits at lexical level or grammatical level is still a pending question.

Chapter 3. The Chinese language and the assessment of schizophrenic speech and FTD

In the last chapter it was noted that among the different linguistic abnormalities in FTD, considerable attention has been paid to reference tracking mechanisms. The studies reviewed focused prominently on pronounhood and definiteness and found that unclear reference often arises in schizophrenic speech and is more frequent in FTD patients. Distinctive of FTD might instead be an overuse of lexical cohesion in free interviews according to Rochester and Martin (1979), who also made the qualification that unclear reference and its increased occurrence in FTD occurs in narratives —and not in free interviews. All in all, looking at English and other SAE (Standard Average European) languages, it is uncertain whether FTD gravitates towards the functional (grammatical) or content (lexical) end of the lexis-grammar continuum. The former is suggested by the means through which unclear reference arises in those languages, namely pronouns and definite articles. The latter is hinted at by a seemingly excessive reliance on lexical cohesion, essentially repetitiousness of vocabulary.

Putting Chinese on stage further complicates the situation. In brief, FTD is found in Chinese speaking schizophrenia patients despite the virtual impossibility to locate its linguistic manifestation in unclear reference as defined for SAE. Does this mean that a cross linguistic perspective would per se make tilt the balance in favor of a lexical factor at the basis of FTD? Not at all, since as we will see next, grammar, including entity reference grammar, goes beyond the devices used in SAE as the system of Chinese classifiers (CL) shows.

Accordingly, with a Chinese perspective, in this chapter we first present some gross characteristics of this language centered on how the reference to entities, mainly to those that are presumed, is made. This amounts to explain what a Radical Argument Drop (RAD) language is. We comparatively illustrate that by showing the relevant differences between English and Chinese at the sentence and discourse levels. Through the illustration it will become explicit that in Chinese unclear reference cannot be identified in the same way as in SAE languages, if at all. After having demonstrated this, we present Chinese CLs, a prominent aspect of the language which is involved in referencing entities and that by embracing the whole grammar-lexis continuum seems to constitute an appropriate testing ground to assess the contribution of grammar and lexicon to the inception of FTD.

3.1 Chinese, a Radical Argument Drop language

Chinese is a RAD language. The term itself and its history in theoretical linguistics hint at the property in question. *Radical argument drop* has to be understood in comparison to *pro-drop*. In the so called *pro-drop* languages, exemplified by most of the Romance languages, *pro-drop* amounts to a pronominal verbal inflection able to make an independent pronoun dispensable. Thus in English we say *They came*, while in Spanish we usually find *Vinieron* (*come*-PAST.3PL), where inflectional *-on* contains the reference to a third-person plural —*Ellos*_(3PL.M) *vinieron* (Engl. *They came*) is also possible in some contexts. In Chinese, like in Spanish, the preverbal subject position can also be vacated. Unlike Spanish, however, there is no verbal inflection and therefore no overt morphology expressing the person and number identifying the missing argument. Moreover this property extends to objects (direct and indirect). That is the reason why

Chinese is considered a ‘*radical drop argument*’ language (Huang, 1984). The same rationale applies to a different and older term which used to say that Chinese is a discourse-oriented language. In a RAD or discourse-oriented language, ellipsis — silence or absence of audible linguistic form— is pervasive. Consequently, given the appropriate context or discourse, the range of possibilities for a simple Chinese sentence to be correct is larger than in SAE languages. The following contrast between English (50) and Chinese (51) makes this clear.

(50) English

- a. Tom loved Mary.
- b. He loved Mary.
- c. Tom loved her.
- d. He loved her.
- e. * ____ loved Mary.
- f. *Tom loved ____.
- g. *He loved ____.
- h. * ____ loved her.
- i. * ____ loved ____.

(51) Chinese

- a. 汤姆爱玛丽.
Tom love Mary
- b. 他爱玛丽.
he love Mary
- c. 汤姆爱她.

Tom love her

d. 他 爱 她.

he love her

e. ____ 爱 玛丽.

____ love Mary

f. 汤姆 爱 ____.

Tom love ____

g. 他 爱 ____.

He love ____

h. ____ 爱 她.

____ love her

i. ____ 爱 ____.

____ love ____

Dashes in the glosses represent the ellipsis.

The discourse-oriented character of the language also manifests itself in the lack of articles, a property of Chinese (Robertson 2000) which is relevant here. The following question-answer examples show that the indefinite-definite distinction collapses in the language: there is no grammatically/morphologically coded distinction in this regard, which essentially makes the old/new information status of participants depend on discourse or context.

(52) a. 餐厅 在 哪?

restaurant at where

Where is there a restaurant?

b. 餐厅 在 广场 上.

restaurant at square on

There is a restaurant in the square.

(53) a. 那个 餐厅 在 哪?

that restaurant at where

Where is that/the restaurant?

b. 餐厅 在 广场 上.

restaurant at square on

The restaurant is in the square.

As shown in (52) and (53), the answers in (52b) and (53b) are exactly the same at the surface, irrespective of the former providing an answer to an existential/indefinite question and the latter to a definite one where definiteness, in absence of articles, is conveyed by a demonstrative, *nage* —那个 at the beginning of (53a). It is notable that the interpretation in (52b) and (53b) is context-dependent and there is no open wellformedness *vs.* malformedness contrast, which overtly differs from what is found in English where the well- and malformedness are manifest. Thus, the only good answer to (54a) —corresponding to Chinese (52a)— is (54b), with (54b') as an infelicitous (#), answer in this context; and the only good answer to (55a) —corresponding to Chinese (53a)— is (55b), with (55b') as an infelicitous one.

(54) a. Where is there a restaurant?

b. There is a restaurant in the square.

b'. #The restaurant is in the square.

(55) a. Where is the restaurant?

b. The restaurant is in the square.

b'. #A restaurant is in the square.

The impact of the aforementioned Chinese linguistic properties can be better appreciated if shown beyond sentences (as in (50), (51)) or simple question-answer pairs, as above. Given our general goal, here we present a Chinese translation of the donkey story used in the narrative task in Rochester and Martin (1979). The donkey story is originally taken from Bleuler (1950; 84).

(56) A donkey loaded with bags of salt had to wade across a river. (57) He slipped and fell and remained lying comfortably in the cool water for a few moments. (58) Standing up, he noticed how much lighter his load had become because the salt had dissolved in the water. (59) The donkey noticed this advantage and decided to use it the following day when he was carrying a load of sponges across the same river. (60) This time, he fell deliberately but was badly disappointed. (61) The sponges had soaked up a great deal of water and were far heavier than before. (62) Indeed, the load was so heavy that it drowned him.

(56') 一头背着盐袋的驴不得不过一条河。

a CL load STATE salt bag of donkey have to cross a CL river

(57') 他滑倒了并且在凉爽的水中舒适地躺了一会儿。

He slip fall ASP and in cool water comfortably lie ASP for a while

(58') 他站起来, 由于盐溶解在水中,

stand up , because salt dissolve in water,

注意到负担减轻了多少。

_____notice load become lighter how much

(59') 注意到这个优势, 决定在第二天

notice this advantage, _____decide at the second day.

背着海绵过同一条河的时候用。

carry sponges cross same one CL river time use。

(60') 这一次, 故意摔倒, 却很失望。

this time, _____deliberately fall , but very disappointed.

(61') 海绵吸收了大量的水, 比以前重得多。

sponges soak up a great deal of water, than before much heavier .

(62') 的确, 担子太重了, 把他淹死了。

Indeed, load too heavy it drowned him.

Dashes in the glosses represent ellipsis.

As shown in (56')-(62'), there are many differences between how English and Chinese organize discourse. Focusing exclusively on those that are relevant for our purposes, it is of note that the absence of articles in the language eliminates the possibility of the

instance of unclear reference obtained in English if *the donkey* (definite) is used at the very beginning of the retelling, as it was the case in the retelling by schizophrenia patients in Rochester and Martin, 1979. Still concerning the noun *donkey*, it is also noteworthy that in English it occurs twice (first, definite; next, indefinite) while in Chinese only once. Still on articles, it can be seen that the first English occurrence of *sponges* is indefinite while the second one is definite —see (59) and (61). In Chinese instead there are two identical occurrences of this noun —see (59') and (61'). These two examples show that any unclear reference noticeable through the use of a wrong article in English cannot occur in Chinese.

As for the distribution of pronouns in both languages, the contrast is huge: there are only two sentences ((57), (57'); (62), (62')) where an English pronoun translates into a Chinese pronoun. The general pattern demonstrates that where English uses pronouns, Chinese preferentially opts for ellipsis. In sum, it has been demonstrated that the vehicles of unclear reference in SAE languages, i.e. mainly pronouns and articles, are scarce and non-existent, respectively, in Chinese. As a consequence, unclear reference as understood in the schizophrenia literature has no cross-linguistic validity.

The reliance on ellipsis for reference-tracking is also consequential in a different sense. It could be the case that interlocutors of Chinese-speaking patients with FTD overinterpret the referential intent of the patients because of the general underdeterminacy of the linguistic form in this regard. It has to be taken into account that a mentally healthy interlocutor, by virtue of the principle of charity, which requires the listeners to interpret the speaker's statement in the most rational way (Blackburn, 2016; 79), is supposed to try to make as much sense as possible of what the patient says. This could lead to an unconscious repair by the mentally healthy interlocutor of elliptical, silent forms with no guarantee that the inferred referents are

actually those intended by the patient, if any. In other words, in a conversational, naturalistic setting with a Chinese schizophrenic patient, it can go unnoticed if ellipsis with its entailed reference has gone astray. It is likely that the lack of reference problems in the nominal-pronominal interplay found by Hsu et al. (2013).

Hsu et al. (2013) shows that our assumptions are on the right track. The authors investigated the narrative ability of Mandarin-speaking patients. 22 patients and 20 normal controls were recruited for a storytelling task. Participants were required to narrate three picture-books and the results were evaluated by a Mandarin version of Narrative Assessment Profile (Tsou, Chang and Cheung, 2009), in which eight dimensions of narrative namely topic maintenance, event sequencing, reasonableness, referential skills, background information, evaluation, conjunctive cohesion, and the overall narrative pattern. Results showed that schizophrenic patients only had trend level impairment in event sequencing and referential skills, while other six dimensions were significantly worse than the controls. The results presented in this study contrast with those obtained from research conducted within SAE language speaking FTD patients, who show signs of referential problems. Hence, it can be interpreted that in Chinese speaking schizophrenic patients results from the scarcity of such an interplay due to the pervasiveness of ellipsis.

Be that as it may, we have shown that in Chinese the usual vehicles of unclear reference in SAE (pronouns and articles) are virtually useless as evidence of referential malfunctioning. Ellipsis goes with an inherent great underdeterminacy in terms of its referential intent because it consists of an absence of linguistic overt realization. Classifiers, instead, by being overt and embracing the whole grammar-lexis continuum, are more appropriate to explore a potential distinct contribution of the functional/grammatical vs. the content/lexical end to the emergence of FTD.

3.2 Chinese classifiers (CLs)

Classifiers (or CL for short) are a hallmark of Chinese grammar. In Chinese, the term CL is called *liàngcí* (量词), which literally means "measure word", but the most important function is to categorize nouns into different classes (Tai, 1994). Since a numeral cannot quantify a noun by itself in Chinese, this language relies on CLs in nominal phrase. The nominal classifier system is widely accepted as one of, if not, the most difficult grammatical dimension of the Chinese language. Even for a native speaker, CLs are one of the most challenging aspects of language acquisition. Mandarin Chinese is treated as a typical CL language for basically three reasons. First, in a numeral compound, which is composed of three elements: a numeral, a CL, and a noun, it is obligatory to use a CL (very few exceptions include idiomatic expressions). Second, the word order in the numeral compound is fixed. CL always follows the numeral and precedes the noun: 'numeral + CL + noun'. And no noun can combine with numeral directly. Third, no other functional elements can intervene within the three elements (Zhang, 2013: 1). The basic pattern is illustrated in the following two examples.

(63) a. yi ping shui.

one glass(CL) water

b. a glass of water

(64) san tiao yu

Three CL fish

Three fish

Examples (63) and (64) represent two kinds of CL. Adopting Cheng and Sybesma (1999)'s term, the CL in (63) is called 'mass-CL' and the one in example (64) is called 'count-CL'. In example (63), since built-in semantic partitioning does not come naturally from water, 'Mass-CL' creates a unit to make a mass like water to be countable. All languages have resources to quantize mass nouns that to some extent resemble Chinese CLs, for instance (63b) shows the counter example in English. The CL in (64) is the target of the experiments presented this paper. 'Count-CL' represents the natural units denoted by non-mass nouns and it does not appear with mass nouns.

On the one hand, CLs have grammatical functions (Chao (1948, 1968: 584), Ōta (2003: 146), Wiltschko (2005), Gerner (2010: 275) and Bowers (1991: 19). On the other hand, CLs must also satisfy semantic requirements related to sorting (Tai, 1994) and counting (Zhang, 2013). As Myers (2000: 104) noted 'learning how to choose classifiers is in principle as complex as the myriad cognitive factors that go into human categorization of entities in the real world' (see also Tai 1994).

As for the grammatical position, whether CLs are a functional category or belong to the lexical domain, what their functions are and how they are represented syntactically are still contentious issues. As Zhang (2013) noted, a classifier may belong to what Borer (2005: 100) calls 'twilight zone between the substantive and the functional'. On one hand, CLs are sensitive to the semantics of following nouns. As Cardinaletti and Giusti (2006) proposed, elements that are sensitive to lexical semantics should count as lexical themselves, rather than functional. On the other hand, CL has been proposed to have the properties of definite determiner (Cheng and Sybesma 1999), which is grammatical in nature.

3.2.2 Classifier *ge*

To make the separation of the function clear, we first introduce the most frequently used CL *ge*. It can be used with animals, body parts of human beings, plants, electric devices, locations, numerals, characters, words, abstract concepts. For example:

(65) a. *san ge laoshi.*

three CL teacher

‘three teachers’

b. *yi ge dianao.*

one CL computer

‘one computer’

CL *ge* is special. In many situations, when it occurs, it can be replaced with another CL. However, it is not always possible. It is generally recognized that when the semantic property is close between the CL and the noun, it is less likely that the CL can be replaced by *ge* (Ahrens 1994; Myers 2000). And such closeness between the CL and noun is captured by the degree of grammaticalization. CL *ge* emerged quite late in the historical development of CL system (Wang, 1989). The examples in (66) shows that certain CLs, for instance *wei*, *tai*, *zhang* and *dao* could alternate with *ge*.

(66) a. san ge/wei laoshi.

three CL/CL teacher

‘three teachers’

b. yi ge/tai dianao.

one CL/CL computer

‘one computer’

c. yi ge/zhang zhuozi.

yi CL/CL table

‘one table’

d. si ge/dao cai.

four CL/CL dish

‘four dishes’

As the grammaticalization proceeds, CL *ge* can occur with more and more nouns including ‘abstract nouns, nouns denoting new concepts, and nouns denoting the results of certain acts’ (Zhang, 2013:48). If a CL is at a low stage of grammaticalization, it cannot be replaced by CL *ge*. Thus, CL *ge* is proposed to have no semantic sorting function. Hence, it is also called the ‘general’ or ‘default’ CL (Myers and Tsay 2000) which seems to be free from the semantic selection requirement from the nouns.

3.2.3 Classifiers with semantic features (semantic CL for short)

Different from the default CL *ge*, which does not classify the semantic types of nouns (Myers 2000, among others) there is another kind of CL which have semantic contents (Allan 1977: 285; Tai and Wang 1990). When this kind of CL is chosen, the size, shape, or function of the noun that the CL combines with functions as a partial guide. Due to the close relation between the CL and the noun, it is proposed that it is less likely that CL *ge* is available as a replacement (Ahrens 1994; Myers 2000). Examples in (67) show that this type of CLs have stricter semantic selectional restrictions than CL *ge*.

(67) a. san pi {ma/*zhu}

three CL horse/*pig

‘three horses’

b. san sou {chuan/*feiji}

three CL ship/*plane

‘three ships’

Zhang (2013: 163)

c. san ke putao/*you/*zhi/*zheng-qi/*xue/*rou/*bu/*qian/*yanlei

three CL grape/oil/paper/steam-air/blood/meat/cloth/money/tear

Zhang (2013: 18)

In example (67), CL *pi* can only be used with *ma* ‘horse’ and *sou* can occur with *chuan* ‘ship’. And CL *ke* can only take *putao* ‘grape’ in (67c). These semantic correlations of

CLs mark the discrete individuals which have non-arbitrary shape, size or boundaries (Zhang 2013: 65).

There are some examples in which the CL bares semantic content, but still can be combined with different nouns. In (68), CL *tiao* can be used with different types nouns, for instance *shuzhi* ‘tree branch’ *huanggua* ‘cucumber’ and *shengzi* ‘rope’.

(68) a. yi tiao shuzhi

one CL tree branch

‘one tree branch’

b. liang tiao huanggua, san tiao shengzi

two CL cucumber three CL rope

‘two cucumbers’ ‘three ropes’

Wu (2006: 555)

CL *tiao* can be used to represent the shared semantic features (e.g., shape) of tree-branch, cucumber, rope. Hence, Zhang (2013) proposed that this type of CL seemed to sort or classify the semantic types of the nouns.

In another cases, the same nouns can be combined with different CLs. In example (69), (70) and (71), *qiang* ‘wall’, *yu* ‘fish’ and *shu* ‘book’ can be combined with different CLs.

(69) a. liang mian qiang

two CL wall

‘two walls (2-dimension perspective)’

b. liang du qiang

two CL wall

‘two walls (3-dimension perspective)’

(70) a. san tiao yu

three CL fish

‘three fish (focusing on body shape)’

b. san wei yu

three CL fish

‘three fish (focusing on the tails)’

(71) a. san ben shu

three CL book

‘three books (in regular shapes)’

b. san juan shu

three CL book

‘three books (in the ancient roll form)’

(Her 2012: 1217)

This phenomenon occurs because different foci of the properties or different perspectives of the same entity are captured by different CLs. Hence semantic content of the noun still guides the process of choosing appropriate CLs.

In sum, the two types of CLs, CL *ge* and the semantic CL, have different functions in Chinese. The CL *ge* is also called ‘general’ or ‘default’ CL (Myers and Tsay 2000). Due to the high degree of grammaticalization, CL *ge* can be combined various types of nouns, including persons, numerals, characters, words, abstract concepts and etc and it only serves a grammatical function or ‘place holder’. CLs with semantic content, in contrast, are more restricted since they abide by the content of the nominal they combined with. Hence, the Chinese CL system forms a lexis-grammar continuum and serves as a perfect probe to discern the linguistic nature of language abnormalities of schizophrenic patients with FTD.

3.3 Summary

In this chapter, on the one hand, we reviewed the main characteristics of the Chinese language that are of interest when addressing schizophrenic speech and should then be taken into account if cross linguistic validity in the characterization of schizophrenic speech is pursued. We saw that neither the deficits in the nominal-pronominal interplay nor definiteness, which are both at the basis of the phenomenon of unclear reference as seen in the speech of SAE speaking schizophrenia patients, can yield unclear reference in Chinese. This is due to two different reasons related both to reference tracking. The first reason is that ellipsis is the dominant device in Chinese instead of pronouns, which are in contrast the only choice in SAE languages. The second one is the nonexistence of articles —either definite or indefinite— in the Chinese language. On the other hand, we

showed that a different device working in nominals, the Chinese CL system, by having both a grammatical and a lexical dimension might serve as a potential probe to examine the linguistic abnormalities of Chinese schizophrenic patients with FTD. Though the Chinese CL system is more indirectly related to the function of reference tracking than ellipsis, pronouns and articles, it could reflect whether the language abnormalities in FTD are grammatical or lexical in nature. Based on the properties of CL reviewed in this chapter, two experiments revolving the usage pattern of Chinese schizophrenic patients will be presented in the next chapter.

Chapter 4. Two behavioral experiments on Chinese classifiers

4.1 Introduction

In this chapter, two experiments concerning the use of Chinese CL by Chinese speaking schizophrenic patients are presented. These two experiments were designed to examine whether the linguistic elements of FTD in schizophrenic patients are more grammatical or lexical in nature.

Based on the fact that increased rates of use of unclear reference in FTD patients in SAE speakers rely mainly on deficits in the use of devices like articles and personal pronouns which in Chinese either do not exist (articles) or are not a commonly used means of reference tracking (pronouns) because of the pervasiveness of ellipsis (i.e. no overt linguistic form), the CL system was chosen to examine the nature of the linguistic impairment in Chinese-speaking FTD patients. CLs, as seen in the previous chapter, are always overt and encompass a lexis-grammar spectrum that makes them an appropriate testing ground to figure out whether the impairment gravitates towards the former (lexis) or the latter (grammar) extreme of this spectrum.

Given that CLs extend across such a grammar-lexis spectrum, it comes as no surprise that Chinese CLs have already been explored in other pathological conditions known to differentially affect grammar. That is the case with aphasia. Tzeng et al. (1991) demonstrated that patients with Wernicke's and Broca's aphasia showed different pattern of mistakes when using classifiers. For example, the noun *che* (Engl. *car*) requires the CL *liang*. Wernicke's aphasia patients were found to use the CL *zhi*, which normally appears in association with animals rather than non-animate nouns. Patients with Broca's aphasia, on the other hand, tended to replace lexically proper CLs with *ge*.

In addition, the authors also found that Broca's aphasia patients showed higher rates of classifier omission.

CL abnormality found in aphasia may provide an approach to the study of use of CLs in FTD in schizophrenia. In fact, FTD has sometimes been considered to resemble Wernicke's aphasia in that it presents with problems also seen in Wernicke's, from a lack of awareness that patients have that what they are saying does not make sense, to the production of neologisms, paraphasias and paragrammatisms, and grammatical distortions which differ from the telegraphic signature of speech production in Broca's aphasia.

4.2 Demographics of subjects

Nineteen patients, age 18 through 74 years (9 females and 10 males), who met DSM-IV (American Psychiatric Association, 1994) diagnostic criteria for schizophrenia, were recruited from Tianjin Anding Hospital. The diagnoses were made by trained psychiatrists on the basis of a clinical interview. The patients were prospectively recruited on the basis that they either showed FTD (N=9) or did not show the symptom (N=10).

Since the TLC is not widely used in China, the distinction between schizophrenic patients with FTD (SZ+FTD) and schizophrenic patients without FTD (non FTD) group was assessed by the item P2 (conceptual disorganization) item of the Positive and Negative Syndrome Scale (PANSS, Kay et al., 1987), a rating scale that covers psychotic and mood symptoms seen in schizophrenia. P2 is designed to rate 'disruption of goal directed sequencing, e.g., circumstantiality, tangentiality, loose associations, non sequiturs, gross illogicality, or thought blocking'. Ratings are based on free speech and

replies to open-ended questions during the interview. Items in the PANSS are rated from 1 ('absent') to 7 ('extreme'). Patients included in the SZ+FTD group had P2 scores of ≥ 5 , ie 'moderately severe, severe and extreme', while the non FTD group had P2 scores of ≤ 3 , ie 'absent', 'minimal' or 'mild'. Both groups of patients were receiving antipsychotic treatment.

Nineteen Mandarin speaking healthy controls, aged 31 to 67 were recruited from the Chinese-speaking population in Tianjin and Barcelona (7 were non-medical staff in the Tianjin hospital and 12 participants were recruited via acquaintances in Barcelona). The three subject groups were matched (see Table 9) for age, sex and years of education.

Exclusion criteria in both groups included a history of learning disability, as assessed on the basis of schooling, history of alcohol or drug abuse, and history of head injury or disease that could affect brain function. All participants were native Mandarin speakers.

A written description of the study was provided to all participants and written consent to participate was obtained. All the procedures included in this study were approved by the local Ethical Committee in China on human experimentation and complied with the principles of the Helsinki Declaration.

Both experiments took the form of administration of CL tasks to the participants. This was done in a quiet room and there were no constraints on the time taken to respond to the questions, and participants could take a break if this was requested. The general format of the tasks involved presentation of stimuli on paper and eliciting of responses. Each experiment lasted approximately 15 minutes. During the two experiments, the participants gave answers verbally and these were recorded by the examiner. Responses in the second experiment, which involved picture description, were tape recorded by the examiner.

Table 9. Demographic characteristics of the groups

	FTD (N=9)	Non FTD (N=10)	Healthy control (N=19)	Comparison
Age	57.75(±6.04)	52.60(±13.11)	58.63±(10.37)	F=1.38,p=0.27
Sex (m/f)	4/5	6/4	5/5	Chi ² =0.48, p=0.79
Education	10.91±(3.40)	11.43±(3.91)	9.64±(1.32)	F=0.92, p=0.41

4.3 Experiment 1

In this experiment CLs were tested at the level of phrases. This experiment consisted of two tasks. The first aimed to examine the participants' use of CLs. The second task was employed in order to examine whether their performance (if impaired) could be improved through provision of additional information in the form of pictures.

4.3.1 Aims and hypotheses

The main hypothesis was that during performance of a linguistic task requiring selection of CLs, schizophrenic patients with FTD would show significantly more errors in use of CLs than those without FTD. In line with the overall expectation of a decreased performance with CLs sensitive to lexico-semantic content, it was also hypothesized that CL impairment would affect particularly semantic CLs, and that the grammatical CL *ge* would be spared. No hypothesis was made concerning differences between

patients without FTD and healthy controls, as it seems possible, based on the existing literature, that patients without FTD could either show more errors than healthy controls or no difference in error rates.

An additional hypothesis — for task 2; see below— was that the performance on semantic classifiers would improve with presentation of relevant pictorial information. This was based on the reasoning that the access to the semantic features that are crucial for the choice of the right CL would be facilitated or enhanced through the use of images. Hence, it was hypothesized that the difference concerning the mistakes of using semantic CL between schizophrenic patients with and without FTD would be reduced when relevant pictorial information was additionally provided.

4.3.2 Methods

Experiment 1 took the form of administration of two CL tasks to the participants. This experiment lasted approximately 15 minutes. During the two tasks, the participants gave answers verbally and these were recorded by the examiner. Responses in the second experiment, which involved picture description, were tape recorded by the examiner.

Experiment 1 consisted of two tasks. In the first task, participants were presented with 30 written phrases in the form of (yi__he) ‘one__river’ or (yi__tuzi) ‘one__rabbit’, where the blank indicated a missing CL that had to be provided orally by the patient. In the second task, the same set of CL phrases was presented in the same form. In addition, in order to assist the participants to select CLs, participants were presented with corresponding visual stimuli, a picture including the content of the classifier phrase. The patients were required to fill in the blanks orally with the appropriate classifiers.

An example of the stimuli used experiment 1 is presented in the following picture.

Other materials used in experiment 1 are summarized in Appendix B and C.

Task 1

一 ___ 兔子
yi ___ *tuzi*
'one ___ rabbit'

Task 2

一 ___ 兔子
yi ___ *tuzi*
'one ___ rabbit'



4.3.3 Results

Data were analysed using SPSS for Windows 19.0. Because the numerical data were not normally distributed – specifically there were ceiling effects in performance, that were more pronounced in the healthy controls but still evident in the two patient groups – nonparametric procedures were used. The Kruskal-Wallis test was used to compare the total scores of CL of all groups. Multiple pair-wise comparisons between the groups following an overall significant Kruskal-Wallis test were made with the Mann-Whitney

test. All P-values were two-tailed and considered significant when probabilities were less than 0.05.

Further statistical taken was undertaken compare a) differences in numbers of semantic CL errors in the three groups and b) and numbers of uses of the CL *ge*. Semantic CLs were allocated on the basis of clear use of an inappropriate classifier for the noun concerned (See appendix B and C). Uses of CL *ge* were based simply on counts. For this part of the analysis the Kolmogorov-Smirnov two sample test was employed, as the most appropriate method for comparing non-normally distributed groups where there are many zeros (i.e. correct responses). All P-values were again two-tailed and considered significant when probabilities were less than 0.05.

In task 1, a Kruskal-Wallis test showed that the FTD and non FTD patients and the healthy controls differed significantly in their numbers of acceptable responses in selection of classifiers (FTD median = 26.00, interquartile range = 20; non FTD median = 30.00, interquartile range = 1; HC median = 30.00, interquartile range = 0; $H(2)=14.51$, $P=0.001$). *Post hoc* pairwise Mann-Whitney tests revealed significant differences between the FTD group and the non FTD group ($p = 0.02$), and the FTD group and the healthy controls ($p = 0.001$). No significant difference was found between non FTD group and healthy controls ($p = 1.000$) (See Table 10a).

A Kolmogorov-Smirnov two sample test indicated that difference was significant for the number of errors in use of semantic CL between the FTD group and the non FTD group ($Z= 1.45$, $P= 0.03$). In the case of CL *ge*, no significant difference was found between the FTD group and the non FTD group ($Z= 0.65$, $P= 0.79$). Similarly, a significant difference was found between the FTD group and the healthy controls in the number of errors in use of semantic CL ($Z= 1.65$, $P= 0.009$). However, there was no significant difference between the FTD group and the healthy controls in the number of

CL *ge* ($Z= 0.55, P= 0.924$). No significant difference was found between the non FTD group and the healthy controls for semantic CL errors ($Z= 0.36, P= 0.999$) or the number of uses of CL *ge* ($Z= 0.75, P= 0.60$) (see Table 10b).

For the second task, a Kruskal-Wallis test showed that the FTD patients, the non FTD patients and the healthy controls significantly differed in total number acceptable responses (FTD median = 29.00, interquartile range = 3; non FTD median = 30.00, interquartile range = 0; HC median = 30.00, interquartile range = 0; $H(2)=9.12, P=0.01$). The results of pairwise comparisons showed only a significant difference between the FTD group and the healthy controls ($P=0.008$). There were no significant differences between the FTD group and the non FTD group ($p = 0.17$), and between the non FTD group and the healthy controls ($p = 1.000$) see Table 10a).

Results of a Kolmogorov-Smirnov two sample test showed that the difference was not significant for the number of errors in use of semantic CL ($Z=0.77, P= 0.59$) or the number of instances of CL *ge* ($Z=0.85, P= 0.47$) between FTD group and non FTD group. There was a trend-level difference between the FTD group and the healthy controls in the errors in use of semantic CL ($Z=1.24, P=0.09$) and in the number of CL *ge* ($Z= 1.27, P= 0.08$). No significant difference was found between non FTD group and the healthy controls in errors in use of semantic CL ($Z= 0.38, P= 0.99$) and the number of CL *ge* ($Z=0.50, P= 0.96$) (see Table 10b).

Table 10a. Total number of acceptable answers for FTD, non FTD and normal controls

Task 1	FTD (N=9)		Non FTD (N=10)		Controls (N=19)		p
	Med	Iqr	Med	Iqr	Med	Iqr	
Acceptable CL	26.00	20	30.00	1	30.00	0	a 0.001* b 0.019* c 0.001* d 1.000
Task 2	Med	Iqr	Med	Iqr	Med	Iqr	p
Acceptable CL	29.00	3	30.00	0	30.00	0	a 0.01* b 0.166 c 0.008* d 1.000

Med: medians; Iqr: interquartile ranges; a: P value is derived from Kruskal-Wallis tests; b: P value is derived from Mann-Whitney U test between FTD and non FTD. c: P value is derived from Mann-Whitney U test between FTD and week healthy controls d: P value is derived from Mann-Whitney U test between non FTD and healthy controls.(a, = $P \leq 0.05$); SD = standard deviation.

Table 10b: Number of errors in use of semantic CL, number of uses of the general classifier *ge* in the FTD and non FTD patients and the healthy controls

Task 1	FTD (N=9)		Non FTD (N=10)		Controls (N=19)		p
	Med	Iqr	Med	Iqr	Med	Iqr	
Semantic CL errors	3.00	4	0.00	1	0.00	0	a0.030* b0.009* c0.999
Ge	7.00	6	5.00	6	7.00	3	a0.787 b0.924 c0.602
Task 2	Med	Iqr	Med	Iqr	Med	Iqr	p
Semantic CL	1.00	3	0.00	0	0.00	0	a0.587 b0.091 c0.999
Ge	9.00	3	6.50	6	6.00	3	a0.846 b0.079 c0.965

Med: medians; Iqr: interquartile ranges; a: P value is derived from Kolmogorov-Smirnov two sample test between FTD and non FTD. b : P value is derived from Kolmogorov-Smirnov two sample test between FTD and week healthy controls c : P value is derived from Kolmogorov-Smirnov two sample test between non FTD and healthy controls.

4.3.4 Discussion

The results of Experiment 1 indicate that the ability to use classifiers correctly distinguishes patients with FTD from the non FTD group and healthy controls. This is in line with the hypothesis that the linguistic ability is more impaired in FTD patients. It was also found that this significantly lower rate of correct usage reflected errors only in use of semantic CL; use of the classifier *ge* among these three groups was

indistinguishable. Taking into account that *ge* is the CL occupying the grammatical end of the classifier spectrum, the results suggest that CL misuse in FTD reflects a lexico-semantic rather than grammatical impairment.

In task 2, as explained in the Methods section, the same task was performed with the added presence of pictures. The results indicate that the presence of pictures enhanced the performance of the FTD patients so that, while significant differences were found among the three groups, the FTD group no longer performed more poorly than the non FTD group, although they still performed significantly more poorly than the healthy controls. These findings are clearly indicative an ameliorative effect of visual (i.e. pictorial) support on the classifier impairment found in schizophrenic patients with FTD in task 1.

The reason why FTD patients performed better in task 2, within which a visual support was presented, does not seem to require an explanation tailored to FTD but must be more general as some facilitation induced by pictures in linguistic tasks that go beyond the ordinary use of language is a rather general phenomenon for which a thorough and in depth explanation is to our understanding still missing. In the meantime, and at risk of merely restating the facts, one might say that with image support the relevant lexico-semantic features that must be accessed for the right CL choice are made more accessible by the picture instead of depending on the internal workings of the mind entirely. Be that as it may, the results are in agreement with the claim that the differential factor between FTD and non FTD patients is lexico-semantic rather than grammatical.

4.4 Experiment 2

In the second experiment, given the finding in experiment 1 of a lexico-semantic deficit

in the use of CL at the phrase level in schizophrenic patients with FTD, the question of whether CL impairment is also seen at the sentence level was investigated. Specifically, the aim was to determine whether an impairment gravitating towards the lexical end of the lexis-grammar axis would also be seen at the level of the sentence.

There is a caveat here, in that the continuous quality of the lexis-grammar axis itself along with the inherently greater complexity of sentences in comparison to phrases raises the possibility that some grammatical impairment could also be found at the sentence level. In other words, as there is more potential for lexical impairment, more impact on grammatical aspects would also be seen. It is important to note, however, that such a grammatical impairment insofar it is predicted to be less marked than the lexical one, would nevertheless be consistent with the claim that the major linguistic deficit in FTD is lexical, i.e. semantic, rather than grammatical, syntactic.

In order to examine CLs at the sentence level, a picture description task was presented in such a way to the patient so as to prompt the use of the Chinese existential construction. The Chinese existential construction, which translates into English as There is an X ... (or There are X), has the template in (i) and is illustrated in (ii) and (iii). In (ii) the CL is the general *ge* while in (iii) is *wei*, which is sensitive to the lexico-semantic properties of the nominal (N) it modifies.

(i) you NUM CL N (PP/VP) ...

have NUM CL N (PP/VP)...

There is a N (PP/VP)...

where NUM stands for number; CL for classifier, N for noun phrase, PP for prepositional phrase and VP for verb phrase.

(ii) you yi ge ren zai xuexiao/ chi fan .

have a CL person at school/ eat food

'There is a person at school/eating food.'

(iii) you yi wei laoshi zai xuexiao/ chi fan .

have a CL teacher at school/ eat food

'There is a/the teacher at school/ eating food.'

The Chinese *you* (Engl. have), by denoting existence, has a grammatical meaning —i.e. it lacks descriptive content (Tsai 2003). Hence, errors concerning Chinese *you* cannot be lexical but instead grammatical, syntactic errors; the same applies to grammatical CL *ge* in (ii). By contrast, in the case of (iii), where N is *laoshi* (teacher), the most appropriate CL is *wei*, which goes with person with a senior position, and is therefore a choice determined by lexical rather than grammatical features.

In the below picture, taken from the sample used in the experiment, the person is asked to provide a description of its content would usually introduce three noun phrases —denoting the girl, the woman and the apple— with their corresponding classifiers.



The resulting existential structure will therefore include three CLs, as shown in (iii):

(iii) You yi ge nvren gei yi ge nvhai yi ge pingguo.

have a CL woman give a CL girl a CL apple

There is a women giving a girl an apple.

Similarly, when two entities are presented in the picture, two noun phrases with their CLs should correspondingly be used.

It is worth mentioning that when the noun is not accompanied by a CL, it is counted as a CL omission. For example, as illustrated in (iv), three CLs should be used. In other words, the three nouns should all be accompanied by a CL. However, if only two CLs are found, then it is counted as one omission. Omitting CLs is not the same as mistaking a CL for another but it shows an abnormally simplified linguistic form.

(iv) You yi (ge) nvren gei yi ge nvhai yi ge pingguo.

have a (CL) woman give a CL girl a CL apple

There is a woman giving a girl an apple.

The omission of *you* is, however, different. *You* is the head of the existential structure (Engl. have) whose omission undermines the whole existential construction. For that reason it is not counted with the rest of omissions but as a syntactic error.

(v) *(you) ¹yi ge ren zai xuexiao/ chi fan .

(have) a CL person at school/ eat food

'There is a person at school/eating food.'

In this way, the above examples shows that the existential construction elicited in the present experiment allows the examination of the interplay of grammar and lexis at the sentence level.

4.4.1 Aims and hypotheses

In line with experiment 1, it was hypothesized (a) that schizophrenic patients with FTD would show significantly more errors in the use of semantic CLs than patients without FTD and healthy controls. Also in line with Experiment 1, it was hypothesized (b) that, regarding the use of CL *ge*, there would be no significant difference between schizophrenic patients with FTD, schizophrenic patients without FTD and healthy controls.

In contrast with Experiment 1, however, here it is expected that non FTD patients will not perfectly align with controls first because of an increase in difficulty/complexity due to the sentential nature of the task along with the well known fact that some sort of linguistic deficit is present across schizophrenia, and second because of the aforementioned expectation of an increased syntactic deficit correlating with the size of the lexico-semantic impairment. Consequently, Experiment 2 is expected to show that non FTD patients will differentiate not only from the FTD ones —as in Experiment 1— but also from healthy controls. It is then hypothesized that (c)

¹ According to linguistic conventions, an asterisk preceding a parenthesis means that the element in parenthesis is compulsory.

schizophrenic patients with FTD will significantly omit more CLs (grammatical and semantic) than non FTD patients, while non FTD will significantly omit more CLs than healthy controls. In the same line, a further hypothesis is that (d) schizophrenic patients with FTD will significantly make more syntactic errors than non FTD patients, while non FTD will significantly make more syntactic mistakes than healthy controls.

Finally, in order to stress that the differential feature of FTD consists in making lexico-semantic mistakes—which falls under hypothesis (a)—rather than in avoiding verbal choices determined by lexico-semantic properties, it is hypothesized that (e) regarding the number of semantic CLs, there will be no significant difference between the FTD group and the non FTD group while both patient groups will have significant less number of semantic CL than the healthy controls.

All in all, the hypotheses presented for Experiment 2 can be summarized as follows—where HC stands for healthy controls:

- a) Errors in semantic CLs: FTD > non FTD and HC
- b) CL *ge*: the same across FTD, non FTD and HC
- c) Omission of CLs: FTD > non FTD > HC
- d) Syntactic errors: FTD > non FTD > HC
- e) Number of semantic CL: FTD and non FTD < HC

Where (a) and (b) are in conformity with Experiment 1; (c) and (d) are both motivated by the increased complexity of sentences (Experiment 2) *vs.* phrases (Experiment 1) and (d) differentially relies on the expectation of a correlation between the degree of the lexical and syntactic impairment with the latter driven by the former and, finally, (e) highlights the difference between the prominence of errors (i.e. (a)) and the avoidance of semantically driven choices where the former would be a unique hallmark of FTD.

4.4.2 Methods

Experiment 2 consisted in the description of scenes shown in a picture (27 in total). The picture stimuli were introduced with the following instructions: ‘I am going to show you some pictures, I would like you to tell me what you can see in this picture and what is this man/woman doing?’ In this way, the participants were encouraged to use existential sentence including CL. As in Experiment 1, testing took place in a quiet room and there were no constraints on the time taken to respond to the questions. The experiment lasted approximately 20 minutes. During the experiment, the participants gave answers verbally and these were tape-recorded by the examiner. Errors of semantic CL were allocated on the basis of clear use of an inappropriate classifier for the noun concerned, as in Experiment 1. The omission of classifiers was based on the omission of both semantic and grammatical CL.

4.4.3 Results

Since, like in Experiment 1, the numerical data in experiment 2 showed asymmetrical distributions nonparametric procedures were used for data analysis. Results of a Kolmogorov-Smirnov two sample test showed a significant difference in the number of errors in use of semantic CL between the FTD group and the non FTD group ($Z= 1.74$, $P= 0.005$). In the case of the number of CL *ge* used, no significant difference was found between the FTD group and the non FTD group ($Z=0.97$, $P= 0.31$). There was no significant difference between the FTD and non FTD groups in the number of omitted CL ($Z=0.60$, $P= 0.86$). A significant difference was found between FTD group and non-FTD in the errors of syntactic structures ($Z=1.45$, $P=0.030$).

Comparing the FTD patients and the healthy controls, a Kolmogorov-Smirnov two

sample test indicated that difference was significant in the number of errors of semantic CL ($Z=2.34$, $P<0.001$). As for the number of CL *ge*, no significant difference was found between the two groups ($Z= 0.82$, $P= 0.51$). A significant difference was found in the errors of syntactic structures ($Z= 2.47$, $P< 0.001$) and the number of omitted CL ($Z=2.34$, $P<0.001$).

Between the non FTD group and healthy controls, a Kolmogorov-Smirnov two sample revealed no significant difference in the number of errors of semantic CL ($Z= 0.38$, $P= 0.99$). There was no significant difference in the number of CL *ge*, between the two groups ($Z= 0.63$, $P= 0.82$). A significant difference was found in the errors of syntactic structures ($Z= 2.43$, $P<0.001$) and the number of omitted CL ($Z= 2.17$, $P< 0.001$). The results are summarized in Table 11.

Table 11: Errors of semantic CL, number of the general classifier *ge*, errors of syntactic structures, errors of omitted CL of FTD, non FTD and healthy controls

	FTD (N=9)		Non FTD (N=10)		Controls (N=19)		p
	Med	Iqr	Med	Iqr	Med	Iqr	
Errors of semantic CL	1.00	2	0.00	0	0.00	0	a0.005* b0.000* c0.999
Number of general classifier <i>ge</i>	10.00	11	8.00	6	9.00	3	a0.307 b0.506 c0.818
Number of omitted CL of FTD	28.00	21	25.00	21	12.00	7	a0.858 b0.000* c0.000*
Errors of syntactic structures	15.00	8	6.50	4	1.00	2	a0.030* b0.000* c0.000*

Med: medians; Iqr: interquartile ranges; a: P value is derived from Kolmogorov-Smirnov two sample test between FTD and non FTD. b : P value is derived from Kolmogorov-Smirnov two sample test between FTD and week healthy controls c : P value is derived from Kolmogorov-Smirnov two sample test between non FTD and healthy controls.

A Kruskal-Wallis test revealed that the FTD group, the non FTD group and the healthy controls differed significantly in the number of semantic CLs used (FTD median = 9.00, interquartile range = 11; non FTD median = 14.00, interquartile range = 16; HC median = 26.00, interquartile range =7; $H(2)=24.48$, $P < 0.001$). Using post-hoc Mann-Whitney tests, significant differences were found between the FTD group and healthy controls ($p < 0.001$) and the non FTD group and the healthy controls ($p = 0.001$). No significant difference was found between the FTD group and non FTD group ($p = 1.000$). The data are summarized in Table 12.

Table 12. Number of semantic CL

	FTD (N=9)		Non FTD (N=10)		Controls (N=19)		p
	Med	Iqr	Med	Iqr	Med	Iqr	
Number of Semantic CL	9.00	11	14.00	16	26.00	7	a 0.000* b 1.000 c 0.000* d 0.001*

Med: medians; Iqr: interquartile ranges; a: P value is derived from Kruskal-Wallis tests; b: P value is derived from Mann-Whitney U test between FTD and non FTD. c: P value is derived from Mann-Whitney U test between FTD and week healthy controls d: P value is derived from Mann-Whitney U test between non FTD and healthy controls. (a, = $P \leq 0.05$); SD = standard deviation.

4.4.4 Discussion

The results of experiment 2 are generally consistent with what we found in experiment 1. FTD patients have more mistakes of semantic CL than the non FTD patients and healthy controls, according to hypothesis *a* above.

Hypothesis *b* predicted that no significant differences will be detected as for the number of CL *ge* between the two groups of patients. The results accord with the hypothesis. The grammatical CL *ge* as a mere placeholder is confirmed as the easiest option for both FTD and non FTD patients despite not being always used as a last resort.

As for the omission of CL, no significant difference is found between FTD and non FTD group, which was not expected according to hypothesis *c* that stated that FTD patients would show a significant increased amount of omitted CLs in comparison to non FTD ones, which in turn would significantly omit more CLs than controls. The

omission of CL shows that the patients of either group are not always able to resort to the syntactic place holder CL *ge*, which can rescue a nominal construction in any event although not optimally if a more specific CL fits the nominal.

In addition to the abnormalities related to CLs, FTD patients show more syntactic problems than non FTD patients, which is expected according to hypothesis *d*. It is worth noting that the syntactic problems addressed in this hypothesis are additional to missing CLs, which is targeted in hypothesis *c*. Here it is not the mere absence of a grammatical element which is counted but wrong grammatical choices. To illustrate, it is found that instead of using existential construction *you yi ge ren* ‘there is a CL person’, the patients tended to use indefinite *yi ge* or *yi wei*, (see example (ii) for the details of this structure). In the former case (*yi ge*) a grammatical element, *you*, which is not a CL, is wrongly missing. In the latter, (*yi wei*), on top of the absent *you*, two of the FTD patients tended to substitute CL ‘*wei*’ by ‘*ge*’. The difference is that ‘*wei*’ always goes with the person who have a senior position, for example, *teacher*, professor or the leader, while ‘*ge*’ is a place holder and used to describe person and stuff in general. These mistakes are then double: on the one hand the grammatical role of CL *ge* in the existential construction is not fulfilled and, on the other hand, the semantic feature of the CL *wei* chosen by these patients does not match with the nominal it combines with. Our results then suggest that the quantitatively superior but also qualitatively distinct problems at syntactic level found in the FTD group might be derived from the accumulative deficits at lexical level.

As for the number of semantic CLs, no significant difference is found between FTD and non FTD. Both patients groups use fewer semantic CLs than healthy controls. The results are then in agreement with the hypothesis *e*, which highlights that the avoidance of semantic CLs is different from the accuracy in their use, which is where

FTD patients fail significantly more than non FTD ones, as the correctness of hypothesis a has shown.

Chapter 5. General discussion and conclusion

The studies reported in this thesis aimed to use Chinese CLs to explore the question of whether and to what extent linguistic abnormality in FTD in schizophrenia is lexical or grammatical in nature. Chinese CLs are grammatical devices that occur with nouns and they have both a grammatical and a lexical dimension, which can be represented as ranking along a spectrum. In particular, the more semantic features that are shared between the CL and the noun, the less likely that the default CL *ge* can be used. (Ahrens,1994; Myers,2000). CL *ge* is the only classifier that is located at the very grammatical end of the spectrum, whereas semantic CL such as *zhi* (which goes with small animal), *pi* (which goes with horse), and others are located towards the lexical end. Only the latter are sensitive to nominal selectional restrictions, i.e. to the semantic features of the noun they concur with. In the two experiments reported, it was examined whether semantic CL and grammatical CL *ge*, behaved differently in schizophrenic patients with FTD, which could shed further light on the question of whether the disorder is more lexical or grammatical.

The broad finding from both studies was of a predominance of lexical abnormality among errors in use of classifiers by schizophrenic patients with FTD. In this chapter, the implications of the findings of the two studies are first discussed. Secondly, further evidence bearing on the lexical view of FTD from the linguistic and neuropsychological literature will be considered. Finally, some limitations and suggestions for further research will be presented.

In experiment 1, the results from task 1 indicated that the ability to use classifiers that are sensitive to semantic content distinguishes schizophrenic patients with FTD from those without FTD and from healthy controls. However, these differences co-

occurred with an indistinguishable use of the classifier *ge* among the three groups. Putting both results together and taking into account that *ge* is the CL occupying the grammatical end of the classifier spectrum, the hypothesis that it is the lexicon rather than grammar that is impaired in FTD was supported.

In task 2 in experiment 1, it was found that showing pictures enhanced the performance of the FTD patients so that significant differences among the three groups were no longer seen, although the non FTD and healthy control group performed nonsignificantly better than the FTD group. As for the use of classifier *ge*, once again no difference across the three groups was found. The preservation of use of the default *ge* in task 2 coheres with the findings from task 1, and again suggests that grammar is relatively intact. As for the errors of semantic CL, the fact that previous significant differences between FTD and non FTD group disappeared when pictures were provided could be considered to point to the lexical nature of the original impairment, since the support pictures would provide is most obviously understandable in lexical terms. According to this interpretation, it is plausible to suppose that the enhancement in performance was due to lexical access being more demanding without pictures as it relied on the purely lexical associations, i.e. associations of meaning with sound, whereas with pictures part of the extended semantic relations that a lexical item maintains are accessible to assist lexical retrieval.

This may not be the correct or whole explanation of picture-supported improvement, however. It is worth noting that one of the patients in the study showed an extreme improvement when the picture was provided in task 2 of experiment 1. Before the picture was provided, instead of using a classifier (72a) *ge*, he used an adjective to fill the blanks, as showed in (72b):

(72)a. yi ge nanhai

one CL boy

‘one boy’

b. * yi hao nanhai

one good boy

‘one boy’

Or, omitted the numeral when producing the CL phrase, which is showed in (28), even though the numeral is already presented in the task:

(73)*hao laoshi

good teacher

‘good teacher’

Both the mistakes shown in (72) and (73) could be treated as the omission of the grammatical CL, the functional head of the CL compound. Hence, the possibility that there is a syntactic impairment in this patient cannot be excluded since instead of using a classifier, the patient modified the noun with an adjective. This yielded an Adjective+Noun combination, which is semantically simpler than CL+Noun.

In experiment 2, the patients and controls were required to produce complete sentences instead of noun phrases. This makes experiment 2 more complex than experiment 1. In general, the results were in line with those in experiment 1: the FTD

patients made more mistakes in the use of semantic CLs than non FTD patients, and no significant difference was found between the two patient groups in their use of CL *ge*. Going further than in experiment 1 where only errors were under consideration, experiment 2 looked at number of semantic CLs and omission of CLs (semantic and grammatical). As for the former, no significant difference was found, according to the expectation. As for the latter, instead, the unexpected occurred and, contrary to the prediction, the omission of CL (both grammatical and semantic) did not differentiate patients with and without FTD. Having into account the even results in both groups of patients for both CL *ge* and number of semantic CLs, their similar rate of CL omission when grammatical and semantic CLs are put together indicates that the non FTD patients did not use classifier *ge* as a last resort. The impoverished grammar reflected in the CL omission seems therefore to be related to schizophrenia in general rather than to FTD in particular.

Beyond CLs, however, experiment 2 showed that only FTD patients presented with further grammatical, syntactic problems. As a prominent example, it was found that the grammatical element heading the Chinese existential construction, i.e. *you*, was often wrongly missing. This result could be considered in line with certain findings in the literature on healthy subjects. There is mounting evidence from theoretical linguistics and psycholinguistics that a drastic divide between lexicon and grammar is incorrect (Bates and Goodman, 1997; also Construction Grammar (Goldberg, 2006), for instance), and even further that a lexicalized view of syntax is required to explain aphasia (Matchin and Hickok, 2020) and language in the brain (Fedorenko et al., 2020). Following this view of syntax, a correlation between lexical and syntactic deficits is expected. The fact that syntactic anomalies independent of CLs were able to distinguish

FTD from non FTD can thus be interpreted as a consequence of an increased lexical dysfunction in the former.

The findings concerning use of classifiers in Chinese patients with schizophrenia reported in this thesis can be summarized as indicating that there is a lexical dysfunction in FTD, but that in some circumstances — specifically when sentences need to be constructed — grammar can be affected as well. The question arises of how far this interpretation fits with the rest of the literature on FTD. In general, this literature points to evidence of both lexical and grammatical abnormality in patients with FTD. For example, at a descriptive level, Andreasen (1986) describe incoherence, i.e. severe FTD, as being characterized by the presence of both lexical and grammatical misuses:

The incoherence is due to several different mechanisms, which may sometimes all occur simultaneously. Sometimes the rules of grammar and syntax are ignored, and a series of words or phrases seem to be joined together arbitrarily and at random. Sometimes the disturbance appears to be at a semantic level, so that words are substituted in a phrase or sentence so that the meaning seems to be distorted or destroyed. Sometimes ‘cementing words’ (conjunctions such as ‘and’ and ‘although’ and adjectival pronouns such as ‘the’, ‘a’ and ‘an’) are deleted.

Most of the literature on FTD has been silent on the question of whether lexical abnormalities are more pronounced than grammatical ones. However, it is interesting to note that Chaika (1974) in her pioneering single case study, found only one incontrovertible example of a grammatical abnormality in speech that was otherwise littered with neologisms and erroneous word usage:

In a month I've been upstairs, they've been taking my brains out a piece at a time or all together.

On the other hand, in another case study, Herbert and Waltensperger (1980) described a schizophrenic patient who showed much more marked grammatical abnormality:

I'm was railroad.

Dr – turned in I'm understand the truth is the books to you.

[They] give me cholera without me know.

Similar grammatical omissions were also noted in the speech of a series of patients with FTD examined by Chaika and Alexander (1986). The authors found several instances of grammatically incorrect sentences that were produces as if nothing had been omitted (underlined parts).

What are the and uh there was a scene

and asks if she can have then goes to the ice cream place

Turning to group studies, Faber et al. (1983) found instances of neologisms, paraphasias, circumlocutions and idiosyncratic use of words in transcripts of speech from 14 schizophrenic patients with FTD, but recorded no instances of agrammatism or pronoun

word problems. In contrast, three studies (Morice and Ingram, 1982; Fraser et al., 1986; Hoffman and Sledge, 1988) scanned transcripts of schizophrenic patients and non-schizophrenic controls and found higher rates of both semantic and syntactic errors in the patients, with one of them (Hoffman and Sledge, 1988) finding a preponderance of the latter. It is important to note, however, that these three studies did not select their patients for presence of FTD.

A possible resolution of these conflicting findings is provided by the study of Oh et al. (2002), described in Chapter 2. They analyzed transcripts of speech from 6 patients with FTD and 7 without FTD; 9 healthy individuals were also examined. Both the patients with and without FTD showed evidence of within-sentence syntactic errors at a higher rate (on average slightly more than double) than the healthy controls. However, semantic errors were almost exclusively seen in the patients with FTD; only 3 of the 7 non FTD patients showed semantic errors, which were present at much lower rates than in the FTD patients; there were no semantic errors in the healthy controls.

One of the findings from Rochester and Martin's (1979) study, which examined FTD speech at the between-sentence level, might also be taken as providing support for the existence of greater lexical than grammatical abnormality. In particular, the authors found that out of the five types of the cohesive ties they examined (lexical cohesion, reference, ellipsis, conjunction, substitution), an overuse of lexical cohesion in free interviews was seen in the FTD as opposed to the non FTD patients. The amount of substitution being negligible in their interviews and ellipsis was prompted by the question-answer interplay (e.g., *–Where were you living then? – In Washington with ellipsis of I was living*). Out of the remaining three types, lexical cohesion occupies the lexical end of the lexis-grammar continuum whereas reference and conjunction are at

the grammatical end. Accordingly, Rochester and Martin's (1979) study found some evidence pointing to a lexically rather than grammatically weighted contribution to FTD.

The findings of the two studies reported in this thesis thus add to existing studies examining both within-sentence and between-sentence speech, to converge on the view that lexical abnormality particularly (but not exclusively) characterizes FTD in schizophrenia. This, however, is far from knowing what might be the ultimate nature of the lexical dysfunction that contributes to FTD. Here, however, there is a potential further source of knowledge in neuropsychological studies on semantic priming in schizophrenia (for reviews see Minzenberg et al., 2002; McKenna and Oh, 2005). The semantic priming paradigm is based on a widely accepted view of semantic memory which proposes that lexical items representing our semantic knowledge are organized in an associative network composed of conceptual 'nodes' and connected by 'links'. Activation of one node, eg by hearing a word, spreads to nearby nodes representing semantically related words, providing a mechanism whereby operations such as selection of utterances and sentence verification can be performed (Collins and Loftus, 1975). The semantic priming paradigm consists tests spreading activation through the semantic network by requiring subjects to identify briefly presented strings of letters as words or non-words. Responding is faster if the (real) word is preceded by presentation of a word that is semantically related to it, presumed to reflect spread of activation to the second word and reducing the activation needed for it to be identified as a real word.

In a meta-analysis of studies of semantic priming in schizophrenia, Pomarol-Clotet et al. (2008) found no evidence for increased or decreased priming in the disorder as a whole. However, there was some support for increased priming in patients with FTD, although this was not conclusive. Specifically, there was pooled evidence for increased semantic priming in patients with FTD in comparison with healthy controls and there

was no increase in patients without FTD compared to healthy controls. When patients with FTD were compared directly to patients without FTD, no increase in semantic priming was seen, although a trend level ($p=0.08$) increase appeared when studies with outlying findings were excluded. Such findings provide qualified support for an abnormality in lexical processing in schizophrenic patients with FTD, although it should be noted that they are silent on whether or not there is also a problem with grammatical processing.

Clearly, the findings concerning lexical vs grammatical abnormality in FTD in patients with schizophrenia are less than fully convergent, although they are consistent with the view that the former is present. This thesis on FTD in Chinese was in part driven by the absence of articles and the pervasive occurrence of phonetically null arguments/participants in this language, with the latter greatly outweighing that of pronouns. Definite articles and pronouns are main conveyors of unclear reference in SAE speaking FTD patients, a salient feature that has been considered a hallmark of FTD. Chinese CLs which distribute in a grammatical towards lexical gradient, were chosen as probes of the nature of FTD as manifested in Chinese. The use of CLs was tested in two experiments (Experiment 1, phrasal; Experiment 2, sentential). The results showed that the lexical dysfunction shown in linguistic studies of patients with FTD, and the overuse of lexical ties found by Rochester and Martin (1979) is paralleled by a statistically significant difference between FTD and non FTD patients in the accuracy of semantic CLs choice in our experiments. Though syntactic deficits are also detected in experiment 2, we suggest this may be derived from abnormalities arising at the lexical level. Further research is needed to clarify these points, which would in turn require to test the lexical dysfunction in a conversational setting with Chinese-speaking patients as interlocutors.

Be that as it may, it is hoped that this dissertation has added meaningfully to the debate. By working on Chinese-speaking patients with and without FTD, the scope of enquiry has at least been enlarged.

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Appendix A: Speech samples used in scale for the assessment of

Thought, Language, and Communication

1. Poverty of Speech (Laconic Speech, Poverty of Thought)

Example: Interviewer: "Do you think there's a lot of corruption in government?"

Patient: "Yeah, seem to be."

Interviewer: "Do you think Haldeman and Erlichman and Mitchell have been fairly treated?"

Patient: "I don't know."

Interviewer: "Were you working at all before you came to the hospital?"

Patient: "No."

Interviewer: "What kind of jobs have you had in the past?"

Patient: "Oh, some janitor jobs, painting."

Interviewer: "What kind of work do you do?"

Patient: "I don't. I don't like any kind of work. That's silly."

Interviewer: "How far did you go in school?"

Patient: "I'm still in the 11th grade."

Interviewer: "How old are you?"

Patient: "Eighteen."

2. Poverty of Content of Speech (Poverty of Thought, Alogia, Verbigeration, Negative Formal Thought Disorder)

Interviewer: "Ok. Why, why is it do you think that, people believe in God?"

Patient: "Well, first of all because, he uh ly, he are the person that, is their personal savior. He walks with me and talks with me. And, uh, the understanding that I have, um, a lot of peoples, they don't really, uh, know they own personal self. Because, uh, they

ain't, they all, just don't know they own personal self. They don't, know that he, uh, seemed like to me, a lot of 'em don't understand that he walks and talks with them. And, uh, show them their way to go. I understand also that every man and every lady, is just not pointed in the same direction. Some are pointed different. They goes in their different ways. The way that, uh, Jesus Christ wanted 'em to go. Me myself I am pointed in the ways of, uh, knowing right from wrong and doing it. I can't do no more, or no less, than that."

3. Distractible Speech

"Then I left San Francisco and moved to...Where did you get that tie? It looks like it's left over from the fifties. I like the warm weather in San Diego. Is that a conch shell on your desk? Have you ever gone scuba-diving?"

4. Tangentiality

Interviewer: "What city are you from?"

Patient: "Well, that's a hard question to answer because my parents I was born in Iowa, but I know that I'm white instead of black so apparently I came from the North somewhere and I don't know where, you know, I really don't know where my ancestors came from. So I don't know whether I'm Irish or French or Scandinavian or I don't, I don't believe I'm Polish but I think I'm, I think I might be German or Welsh. I'm not but that's all speculation and that, that's one thing that I would like to know and is my ancestors, you know, where did I originate. But I just never took the time to find out the answer to that question."

5. Derailment (Loose Associations, Flight of Ideas)

Interviewer: "Did you enjoy doing that?"

Patient: "Um-hm. Oh, hey, well, I, I, oh, I really enjoyed some communities I tried it, and the next day when I'd be going out, you know, um, I took control like, uh, I put, um,

bleach on my hair in, in California. My roommate was from Chicago and she was going to the junior college. And we lived in the Y.W.C.A. so she wanted to put it, um, peroxide on my hair, and she did, and I got up and looked at the mirror and tears came to my n eyes. Now do you understand, I was fully aware of what was going on but why couldn't I, why, why the tears? I can't understand that, can you?"

Interviewer: "No."

Patient: "Have you experienced anything like it?"

Interviewer: "You just must be an emotional person, that's all."

Patient: "Well, not very much I mean, what if I were dead? It's funeral age. Well, I, um? Now I had my toenails, uh, operated on. They're, uh, um, got infected and I wasn't able to do it but they wouldn't let me at my tools. Well."

6. Illogicality

"Parents are the people that raise you. Anything that raises you can be a parent. Parents can be anything, material, vegetable, or mineral, that has taught you something. Parents would be the world of things that are alive, that are there. Rocks, a person can look at a rock and learn something from it, so that would be a parent."

7. Clanging

"I'm not trying to make noise. I'm trying to make sense. If you can make sense out of nonsense, well, have fun." "I'm trying to make sense out of sense. I'm not making sense [cents] anymore. I have to make dollars."

8. Neologisms

"I got so angry I picked up a dish and threw it at the geshinker." "So I sort of bawked the whole thing up."

9. Word Approximations (Paraphasia, Metonyms)

"Southeast Asia, well, that's like Middle Asia now." "His boss was a seeover."

10. Perseveration

"I think I'll put on my hat, my hat, my hat, my hat."

Interviewer: "Tell me what you are like, what kind of person you are."

Patient: "I'm from Marshalltown, Iowa. That's 60 miles northwest, northeast of Des Moines, Iowa. And I'm married at the present time. I'm 36 years old. My wife is 35. She lives in Garwin, Iowa. That's 15 miles southeast of Marshalltown, Iowa. I'm getting a divorce at the present time. And I am at presently in a mental institution in Iowa City, Iowa, which is a hundred miles southeast of Marshalltown, Iowa."

11. Echolalia

The doctor says to the patient, "I'd like to talk with you for a few minutes."

The patient responds with a staccato intonation, "Talk with you for a few minutes."

12. Self-Reference

Interviewer: "What time is it?"

Patient: "Seven o'clock. That's my problem. I never know what time it is. Maybe I should try to keep better track of the time."

13. Paraphasia, Phonemic

"I sipped on the lice and broke my arm while running to catch the bus."

14. Paraphasia, Semantic

"I slipped on the coat, on the i-i-ice, I mean, and broke my book."

Appendix B: Materials used in task 1 of experiment 1

1. 一 ___ 兔子
yi ___ *tuzi*
'one ___ rabbit'
2. 一 ___ 老师
yi ___ *laoshi*
'one ___ teacher'
3. 一 ___ 女孩
yi ___ *nvhai*
'one ___ girl'
4. 一 ___ 椅子
yi ___ *yizi*
'one ___ chair'
5. 一 ___ 花
yi ___ *hua*
'one ___ flower'
6. 一 ___ 猪
yi ___ *zhu*
'one ___ pig'
7. 一 ___ 男孩
yi ___ *nanhai*
'one ___ boy'
8. 一 ___ 狗
yi ___ *gou*
'one ___ dog'
9. 一 ___ 书
yi ___ *shu*
'one ___ book'
10. 一 ___ 床
yi ___ *chuang*
'one ___ bed'
11. 一 ___ 人
yi ___ *ren*
'one ___ person'
12. 一 ___ 牛
yi ___ *niu*
'one ___ cow'

13. 一 ___ 大象
yi ___ *daxiang*
'one ___ elephant'

14. 一 ___ 小鸟
yi ___ *xiaoniao*
'one ___ bird'

15. 一 ___ 台灯
yi ___ *taideng*
'one ___ desk lamp'

16. 一 ___ 电视机
yi ___ *dianshiji*
'one ___ television'

17. 一 ___ 车
yi ___ *che*
'one ___ car'

18. 一 ___ 电话
yi ___ *dianhua*
'one ___ telephone'

19. 一 ___ 水
yi ___ *shui*
'one ___ water'

20. 一 ___ 茶
yi ___ *cha*
'one ___ tea'

21. 一 ___ 蛇
yi ___ *she*
'one ___ snake'

22. 一 ___ 马
yi ___ *ma*
'one ___ horse'

23. 一 ___ 鱼
yi ___ *yu*
'one ___ fish'

24. 一 ___ 桔子
yi ___ *juzi*
'one ___ orange'

25. 一 ___ 香蕉
yi ___ *xiangjiao*
'one ___ banana'

26. 一__鸡蛋
*yi*__*jidan*
'one__egg'
27. 一__衣服
*yi*__*yifu*
'one__cloth'
28. 一__鞋
*yi*__*xie*
'one__shoes'
29. 一__刀
*yi*__*dao*
'one__knife'
30. 一__河
*yi*__*he*
'one__river'

Appendix C: Materials used in task 2 of experiment 1

1. 一 ___ 兔子
yi ___ tuzi
'one ___ rabbit'



2. 一 ___ 老师
yi ___ laoshi
'one ___ teacher'



3. 一 ___ 女孩
yi ___ nvhai
'one ___ girl'



4. 一 ___ 椅子
yi ___ yizi
'one ___ chair'



5. 一 ___ 花
yi ___ hua
'one ___ flower'



6. 一 ___ 猪
yi ___ zhu
'one ___ pig'



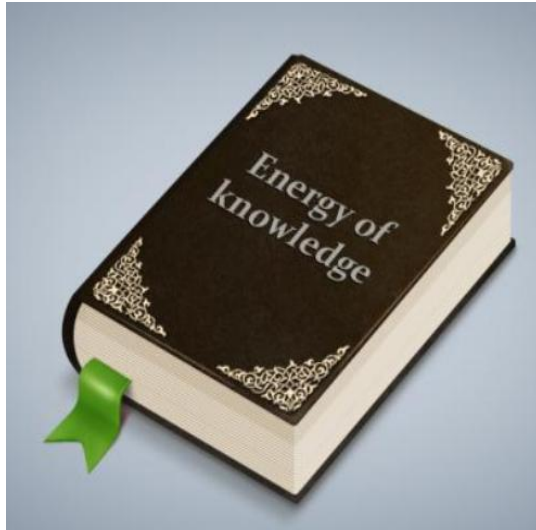
7. 一 ___ 男孩
yi ___ *nanhai*
'one ___ boy'



8. 一 ___ 狗
yi ___ *gou*
'one ___ dog'



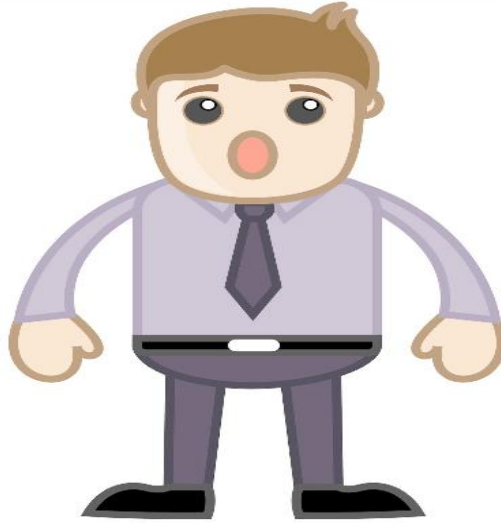
9. 一 ___ 书
yi ___ shu
'one ___ book'



10. 一 ___ 床
yi ___ chuang
'one ___ bed'



11. 一 ___ 人
yi ___ ren
'one ___ person'



12. 一 ___ 牛
yi ___ niu
'one ___ cow'



13. 一 ___ 大象
yi ___ *daxiang*
'one ___ elephant'



14. 一 ___ 小鸟
yi ___ *xiaoniao*
'one ___ bird'



15. 一 ___ 台灯
yi ___ *taideng*
'one ___ desk lamp'



16. 一 ___ 电视机
yi ___ *dianshiji*
'one ___ television'



17. 一__车
yi __che
'one __car'



18. 一__电话
yi __dianhua
'one __telephone'



19. 一 ___ 水
yi ___ shui
'one ___ water'



20. 一 ___ 茶
yi ___ cha
'one ___ tea'



21. 一 ___ 蛇
yi ___ she
'one ___ snake'



22. 一 ___ 马
yi ___ ma
'one ___ horse'



23. 一 ___ 鱼
yi ___ yu
'one ___ fish'



24. 一 ___ 桔子
yi ___ jvzi
'one ___ orange'



25. 一 ___ 香蕉
yi ___ xiangjiao
'one ___ banana'



26. 一 ___ 鸡蛋
yi ___ jidan
'one ___ egg'



27. 一 ____ 衣服
yi ____ yifu
'one ____ cloth'



28. 一 ____ 鞋
yi ____ xie
'one ____ shoes'



29. 一 ____ 刀
 yi ____ *dao*
 ‘one ____ knife’



30. 一 ____ 河
 yi ____ *he*
 ‘one ____ river’



Appendix D : Materials used in experiment 2

















