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Metalinguistic Filters Within the Bilingual Language Faculty: A Study of Young English-Chinese Bilinguals

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Abstract This study reports two metalinguistic parameters that constitute the schematic control of lateral inhibitory links between translation equivalents within the bilingual lexico-semantic system of Green's (Bilingualism: Language and Cognition 1:67–81, 1998a, Bilingualism: Language and Cognition 1:100–104, 1998b, The bilingualism reader, Routledge, London, 2007) inhibitory control (IC) model. Building on Green's postulation that the bilingual lexico-semantic system is controlled by a hierarchy of schemas under a supervisory attentional system, the bilingual unconsciously filters activated lemmas during fluent spontaneous codeswitching, such that lemmas that are semantico-syntactically versatile or morpho-syntactically transparent are likely to reach a threshold of activation first while other lemmas are inhibited. To investigate the issue, we collected code-paired naturalistic and elicited data with a focus on code-switched determiner phrases from 140 Mandarin-English simultaneous bilinguals who were post-secondary students in Singapore. We found that the semantico-syntactic and morpho-syntactic dissimilarities between Mandarin and English activated both filters. As most Mandarin determiners are economical vis-à-vis their English counterparts, their lemmas were selected frequently while English lemmas were largely inhibited. It was also found that our participants preferred English nouns in filling the lexical category for their interpretable feature of number, a feature that is normally absent in Mandarin nouns.

Keywords Codeswitching · Bilingual processing · Inhibitory control · Chinese · English · Speech production · Singapore

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Introduction

Several studies on how bilinguals process languages have been reported. The view that bilingualism enhances metalinguistic knowledge is supported by many linguists (e.g., [Bialystok 1988](#); [Cummins 2000](#)), although this depends on the proficiency level in both languages ([Ricciardelli 1992](#); [Kuo and Anderson 2007](#)). [Jay \(2003\)](#) attests that bilinguals are metalinguistically more developed than monolinguals owing to the former's dual means of conceptual thinking and structural knowledge. [Bialystok \(1988\)](#) and [Bialystok and Majumder \(1998\)](#) found that bilinguals with the added advantage of possessing another set of lexicon, develop greater syntactic awareness vis-à-vis monolinguals. Importantly, [Edwards and Gardner-Chloros \(2007\)](#) found code-switched evidence that metalinguistic knowledge determines the syntactic form of code-switched utterances. They further found that formal models of grammar such as [Myers-Scotton's \(2002\)](#) Matrix Language Framework Model (MLFM) and [MacSwan's \(2000\)](#) bilingual minimalist grammar are unable to account for all codeswitching (CS) norms and constraints.

To date, substantial research has been conducted to unearth the workings of a proposed executive control mechanism that governs linguistic activation in bilinguals. [Rodríguez-Fornells et al. \(2006\)](#) cited evidence from neuron-imaging studies that show a partial functional separation of bilingual lexicons in the brain, while pointing out the imperative of further research on the neural control mechanism that regulates language choices and use within the bilingual language faculty. [Grosjean \(2001\)](#) developed the language mode continuum that aimed to encompass all possible states of activation of the base language and a less frequently used language (or guest language), depending on whether the contact situation is with a monolingual or with a fellow bilingual. He added that bilinguals make largely unconscious language choices during spontaneous speech. [Rodríguez-Fornells et al. \(2006\)](#) went further by postulating two selection mechanisms in bilinguals, viz. a top-down mechanism interacting with a bottom-up mechanism governing the selection-suppression of different lexicons. Other than proposing that these mechanisms could be mediated by the prefrontal cortex, they were vague and uncertain as to how exactly these mechanisms work.

[Green \(1998a,b, 2007\)](#), based on empirical data from various studies on bilingual aphasics and normal bilinguals, establishes the inhibitory control (IC) model which explicates the workings of the bilingual lexico-semantic system controlled by the conceptualizer and the “specifier”—an executive system that controls language switches through inhibitory and excitatory processes. He proposes that there are three levels of activation that lead to a language output:

1. Selected: The selected language controls the speech output.
2. Active: The active language plays a role in ongoing processing, works parallel to the selected language and does the same things in fact, but has no access to the outgoing speech channel.
3. Dormant: a dormant language is stored in long-term memory, but does not play a role in ongoing processing.

(Green, 1986, as cited in [de Bot 2007](#), p. 395)

Consequently, fluent CS can be accounted for by parallel production of two languages alternating between selected and active levels of activation in Green's IC model. The IC model is in tandem with [Grosjean's \(2001\)](#) theory on language modes, stating that activating and deactivating languages allow bilinguals to switch to different language modes. Furthermore, [de Bot \(2007\)](#) found that research converge on a bilingual processing model similar to the IC model in terms of parallel activation of two lexicons and grammatical subsystems to

account for the fluency and structural well-formedness of codeswitched speech. According to Green (2007), speakers who spontaneously code-switch produce words whose lemmas first reach threshold of activation (selected) from either one of the languages, where lemmas from both languages are activated by conceptual representations within the conceptualizer. Green (1998a,b) asserts that the relationship between the word production schemas of both languages within the specifier during CS is cooperative rather than competitive. Importantly, he added that the cooperative relationship does not preclude inhibitory control, particularly when code-switches are triggered by semantic overlap of two lexicons (Trefflers-Daller 1998). Green (1998b) also stated that inhibitory and excitatory processes are selective and pointed out a need in bilingual research to demonstrate the selective inhibitory effects on lemmas and “specify their computational basis more fully” (p. 102). Similarly, Francis (2004) concludes that the challenge facing researchers is to specify the control workings of cross linguistic interfaces or lateral inhibitory links between two lexicons during spontaneous CS. The postulation of inhibitory control is supported by Pulvermüller (1999) who stated that any psychological processing model entails inhibitory activities. Recent neuroimaging evidence further supported Green’s hypothesis of inhibitory mechanisms by showing activated prefrontal basal ganglia circuits which are equipped with inhibitory interneurons when bilinguals accessed a given lexicon (Abutalebi and Green 2007, 2008). However, the precise function of these circuits remains elusively unknown. Research in describing inhibitory control during fluent CS is also lacking although the functional control circuits of translation schemas and word production schemas during translation tasks and elicited CS are explicated in the IC model. Our study fills this gap in bilingual research by investigating the workings of a natural CS schema in controlling lateral inhibitory links between translation equivalents within the bilingual lexico-semantic system based on the evidence of naturalistic codeswitched speech of Chinese Singaporean polytechnic students and their elicited perceptions of codeswitched determiner phrases in terms of naturalistic occurrences.

The focus of this study is on a predominant preference for a code-paired pattern of functional-lexical phrases, particularly determiner phrases (DP).¹ The functional lexicon is at the heart of grammatical CS studies in proposing universal grammatical rules for CS utterances. For example, Myers-Scotton’s MLFM postulates that in CS, all functional or system morphemes are from the matrix language while all lexical or content morphemes are from the embedded language. Furthermore, the determiner phrase is pointed out by Lu (1991) as a frequent hotspot of Chinese-English CS.

Tan (1988) reported that CS occurs within D + N phrase, such as in (1), where the Chinese determiner (Dem + Cl) “nà gè” is paired with the English noun “woodcutter”.

- (1) Okay, eh nà gè woodcutter.
 Okay, Prt that Cl woodcutter
 ‘Okay, that woodcutter’.
 (Tan 1988, p.85)

Evidence of such code-paired determiner phrases has been widely found in the naturalistic CS corpora of several prior studies on Mandarin-English CS, with a clear prevalent pattern of Mandarin D + English Noun. Table 1 below collates 68 code-switched determiner phrases extracted from several studies on CS speech of young Singaporean English-Mandarin bilinguals. Code-paired determiner phrases gathered from these CS studies showed a prevalent pattern of Mandarin D + English N. It is significant to find that there is no evidence of an

¹ A determiner phrase consists of the determiner as the head and its complement being the noun phrase (Bussman 1996).

Table 1 Collation of code-paired determiner phrases from prior local studies

| Code-paired DPs | | | | |
|---|--|----------------------------------|---------------------------------|--|
| Pron + Poss + N | Dem + (Num) + Cl + N | Num + Cl + N | Others | |
| tā men de parents (Tan 1988) | nà gè woodcutter (Tan 1988) | yí gè woodcutter (Tan 1988) | shén me hall (Lee 2003) | |
| tā de husband (Kamwangamalu and Lee 1991) | nà handbag (Kamwangamalu and Lee 1991) | yí gè project (Chen 1992) | shén me programme (Lee 2003) | |
| tā de estate (Kamwangamalu and Lee 1991) | zhè xiē cake (Chen 1992) | yì zhī pencil (Chen 1992) | sān bǎi kuài de gown (Lee 2003) | |
| tā de teacher (Kamwangamalu and Lee 1991) | zhè gè button (Chong 2001) | liǎng gè court (Chen 1992) | jǐ gè module (Lee 2003) | |
| tā de mother (Kamwangamalu and Lee 1991) | zhè gè bag (Chong 2001) | wú shí gè questions (Chong 2001) | | |
| tā de bag (Ng, 1997) | nà gè police headquarters (Chong 2001) | yì běn booklet (Chong 2001) | | |
| wǒ de pager (Chong 2001) | nà gè area licensing scheme (Chong 2001) | yí gè system (Lee 2003) | | |
| wǒ de entertainment fees (Chong 2001) | zhè gè ARS (Chong 2001) | yí gè sentence (Lee 2005) | | |
| zì jǐ de interest (Chong 2001) | zhè gè semester (Lee 2003) | yí gè plan (Lee 2005) | | |
| wǒ de friend (Chong 2001) | zhè sǎn zhāng notes (Lee 2003) | gè plan (Lee 2005) | | |
| wǒ friend (Lee 2003) | zhè gè rose mail (Lee 2003) | | | |
| wǒ de hotmail (Lee 2003) | nà gè password (Lee 2003) | | | |
| nǐ de hotmail (Lee 2003) | nà gè bottlecap (Tan 2004) | | | |
| wǒ Hugo Boss suit (Lee 2003) | zhè gè bat (Tan 2004) | | | |
| wǒ de office (Lee 2003) | zhè gè bag (Tan 2004) | | | |
| nǐ de email (Lee 2003) | nà xiē large lorries (Lee 2005) | | | |
| tā men makeup (Lee 2003) | zhè gè point (Lee 2005) | | | |
| wǒ men de remedial (Tan 2004) | zhè gè blab blah blah (Lee 2005) | | | |
| wǒ men de form teacher (Tan 2004) | zhè gè attached plan (Lee 2005) | | | |
| tā de secretary (Lee 2005) | nà gè memo (Lee 2005) | | | |
| nǐ de imagination (Lee 2005) | zhè gè attachment plan (Lee 2005) | | | |
| | nà gè plan (Lee 2005) | | | |
| | zhè gè manager (Lee 2005) | | | |
| | nà gè staff (Lee 2005) | | | |

Table 1 continued

| Code-paired DPs | | | |
|-----------------|--------------------------------|--------------|--------|
| Pron + Poss + N | Dem + (Num) + Cl + N | Num + Cl + N | Others |
| | nà gè blue label (Lee 2005) | | |
| | zhè gè plan (Lee 2005) | | |
| | zhè gè review (Lee 2005) | | |
| | nà gè question (Lee 2005) | | |
| | nà gè gas (Lee 2005) | | |
| | nà gè air-con (Lee 2005) | | |
| | nà gè water turbine (Lee 2005) | | |
| | nà gè methane (Lee 2005) | | |
| | nà gè volcano (Lee 2005) | | |

English D + Mandarin N phrasal pattern in the CS data reported by these studies. Interestingly, the Mandarin D + English N pattern holds in predominantly Mandarin verbatim transcripts (Kamwangamalu and Lee 1991; Chen 1992; Chong 2001; Lee 2003; Tan 2004), as well as in predominantly English verbatim transcripts (Lee 2005). An example of a Mandarin D + English Noun (zhè sān zhāng notes) which occurred in Mandarin as a base language (or the predominant language in terms of lexical density) and is spoken by a university undergraduate majoring in Chinese during an informal conversation with fellow Chinese students, is detailed in (2) below.

- (2) Nǐ bǎ zhè sān zhāng notes pass gěi X, jīn tiān zǎoshàng lòu le.
 You hold this three sheets give today morning left Prt
 ‘You pass these three sheets of notes to X, I left them out this morning.’
 (Lee 2003, p.163)

Similarly, Lee (2005) found an example of an Mandarin D + English N phrase (zhè gè review), in English as a base language and uttered by a polytechnic student during an English communication skills class, which is shown in (3) below.

- (3) Da jiang zhè gè review, there is a customer feedback form?
 It said this Cl
 ‘It mentioned that this review, is there a customer feedback form?’
 (Lee 2005, p.141)

Importantly, codeswitched DPs that are collated from different studies show semantic congruence between the words of the base language and their guest language counterparts. Similarly, Wei (2002) found that there is adequate cross linguistic congruence in Chinese-English codeswitching such that English language items are interchangeable with their Chinese language counterparts.

Furthermore, this pattern is found across different pragmatic motivations, such as changing a conversational topic, clarifying, emphasizing and reducing negative effects (Lee 2003, 2005). This suggests that the pattern is impervious to differing external input and is likely a function of internal control within the language faculty. Also, the pattern is observed in CS data taken from studies of primary school children (Tan 2004), polytechnic students (Lee 2005), and university undergraduates (Kamwangamalu and Lee 1991; Chen 1992; Ng, 1997; Chong 2001; Lee 2003). The participants were young educated Singaporean English-Mandarin bilinguals who received formal education in both the languages of English and Mandarin at the time of data collection.

The overwhelming recurrence from the naturalistic data collected by prior studies indicated that there is a prevalent preference for the Chinese D + English N pattern over the English D + Chinese N pattern, regardless of language dominance and pragmatic intention. However, the CS studies on Chinese Singaporeans’ code-pairing behaviour overlooked the Mandarin D + English N pattern and failed to probe the psycholinguistic factors behind the prevalence of it. Instead, the earlier studies mostly focused on pragmatic motivations of CS, failing to observe the recurring preference and to account for it. What is needed in the bilingualism research literature is a micro-analysis of CS data to predict how and why bilinguals make language choices in intra-sentential CS, particularly when there is evidence of recurring associations between language codes and syntactic categories reflecting selective inhibitory effects during spontaneous CS. Our study collected both naturalistic and elicited CS data from Chinese-Singaporean polytechnic students to ascertain if this pattern persists amongst young bilingual adults, and accounting for this psycholinguistic preference with Green’s IC model as the theoretical framework. We argue that semantico-syntactic patterns

of code choices are evidence of schematic metalinguistic parameters within the bilingual language faculty. Meisel (1994, as cited in Francis 2004) correspondingly postulates that CS constraints will be most efficiently understood from the point of view of psychological processing. He added that the excitation and inhibition of lexical items from each language to form codeswitched phrases or “couple constituents” reflect underlying linguistic knowledge.

The central research objectives of this paper are as follows:

- (1) What is the executive mechanism that selects and suppresses languages during spontaneous CS based on the evidence from functional-lexical code-pairings?
- (2) How do these executive operations discriminate the languages in constructing impromptu CS utterances?

The significance and importance of uncovering the workings of neural mechanisms involved in regulating language use cannot be ignored. Grosjean (2001) states that research into bilingual activation and selection of languages clarifies current empirical knowledge which in turn, can be applied to interpret CS data from diverse bilingual societies. Syntactic patterns of language choice form a significant area of research in probing the workings of cognitive mechanisms of the bilingual mind. The implication of such a higher level of understanding will enable greater accuracy in predicting language selection and suppression within the bilingual language faculty.

In this article, code-pairing and CS are used interchangeably although code-pairing stresses the coupling of lexical items from two languages within a two- constituent phrase while CS is a broader term encompassing code-pairing, intrasentential CS and intersentential CS.

Method

Participants

The CS data reviewed in this study are produced by Chinese Singaporean students of various levels. Chinese Singaporeans learn both English as a first language and Mandarin as the second language formally between the ages of 4–5 at the pre-school level to college level under the bilingual education policy (Saravanan 1999). Not surprisingly, the Department of Statistics of Singapore (2001) reported that 84% of Chinese Singaporeans are Mandarin-English bilinguals, supporting Gupta’s (1994) remark that almost every Singaporean is a bilingual.

Xu et al. (1998) reported that 76% of Chinese Singaporeans they surveyed admitted to codeswitching Mandarin with other languages. Code switching is most frequent between Mandarin and English (Kamwangamalu and Lee 1991; Chen 1992; Teo 2000; Chong 2001; Lee 2003; Tan 2004; Lee 2005). Significantly, Chen (1992) found that amongst Chinese bilingual students, 81% of CS utterances in Mandarin are paired with English amongst tertiary students, while Chinese dialects and Malay are recorded at 15 and 2% respectively.

Our CS data were culled from 140 bilingual students studying in a polytechnic in Singapore. Their age ranged from 16 to 25 years, of which a majority of the respondents fell within the age range of 17–19 years. Taking the commonly understood definition of the critical period of learning, which ends “after puberty” according to MacSwan 1999, p. 36), we have decided that none of the Singaporean Chinese students can be considered as adult second language bilinguals. It can be argued that most Singaporean Chinese post-secondary students are “proficient bilinguals” (see MacSwan 1999, for a definition) and that they are simultaneous bilinguals.

Instruments for Data Collection

This study adopts a mixed methods approach advocated by [Creswell \(2003\)](#), which is a blend of both quantitative and qualitative approaches. There are two major research methods for collecting the data — a questionnaire and a language observation journal. The declarative data culled from the responses to a questionnaire administered to Mandarin-English bilingual students are analyzed statistically for code-paired patterns of DPs. The results of the descriptive analysis are compared with the findings from the language observation journal of students' spontaneously uttered code-paired phrases in order to ascertain whether the findings of the questionnaire are consistent with the findings of the journal. This test for consistency would ensure that the findings obtained through two different data collection instruments are corroborative and reliable. Furthermore, the code-paired phrases used as test items in the questionnaire are extracted from naturalistic data collected in the journal to maintain the authenticity of the survey items. Unlike prior CS studies that rely only on qualitative data taken from small sample sizes, this study used a survey that reached to a large population sample which in turn provided more generalizable insights and enriched the ethnographic account of CS phenomena ([Codó 2008](#)).

The questionnaire of code-paired phrases was designed and given to 140 polytechnic students who are young Mandarin-English bilinguals (refer to Appendix). The questionnaire consisted of three sections. Section 1 entitled "Personal Data" was designed to probe some sociolinguistic information about the respondents. Eighty percent (80%) of the respondents admitted to codeswitching Mandarin and English within determiner phrases. This shows that CS is a widespread language phenomenon amongst Mandarin-English bilingual polytechnic students, corroborating with our observations and findings of earlier CS studies.

In section "Method" entitled "Code Paired Noun Phrases", there were 20 questions to which respondents were required to select a graded response along a Likert-scale for each question to indicate their preference for a code-paired phrase they would use or hear, between pattern A and B. The students were asked to select the Likert-scaled response for which they felt strongest if they were to be engaged in an informal conversation with fellow Chinese-English bilinguals who codeswitched Chinese with English. The responses desired from students were not of grammaticality judgments but their spontaneous preferences or perceived likelihood of code-paired patterns. The difference was that students were not expected to select code-paired phrases based on their perceived grammatical correctness, but on the strongest likelihood of the phrases spoken or heard during informal conversations. The questionnaire was intended to collect sufficient data about spontaneous code-paired production. In the case of students who stated that they did not codeswitch, they were to indicate their observation of a code-paired phrase that they heard more frequently between pattern A and B. Students who perceived no preference for either pattern, either for themselves, and/or for their language contact with peers, were allowed to choose the "not sure" option in the questionnaire.

The language observation journal recorded spontaneous code-paired utterances of some of these students. There were 20 code-paired noun phrases extracted from the naturalistic data recorded in the language observation journal. A notebook was used to record spontaneous English-Mandarin code-switched sentences that were heard over a period of eight months. Code-switched utterances by students were quickly jotted down on the notebook. The contexts of the code-switched utterances are informal oral discourses amongst students and between students and the authors in classrooms, canteens and within the polytechnic campus. The Mandarin characters were transcribed in *hànyǔ pīnyīn* in this study, the most commonly used system of romanisation for Standard Mandarin. As Mandarin is a tonal

language, the suprasegmental features were represented by diacritical marks to represent the tones of Mandarin. Twenty code-paired noun phrases were randomly extracted and used for the questionnaire items.

As the focus of this study was on determiner phrases, the majority of the code-paired phrases are DPs. Nevertheless, APs and NP + N were used in the questionnaire. These questions containing non-DPs may give a preliminary indication of whether there could be a similar pattern in another syntactic domain of frequent Mandarin-English CS, Adj + N (Lu 1991). We inserted a contrived codeswitched NP + N phrase, “Zhè yàng dè teacher”, as a questionnaire item. The phrase consisting of a noun phrase² “Zhè yàng” coupled with a noun “dè teacher” can be classified as an infrequent code-switched domain (NP + N) according to Lu (1991). The purpose for this insertion was to check if any code-paired pattern found in the other items may or may not be generalized to a code-switched phrase that belonged to an infrequent code-switched domain, NP + N.

Each of the Mandarin-English mixed noun phrases was presented in the questionnaire as one end of a continuum of the Likert-scaled responses with a transposed version at the other end. For example, each Mandarin D + English N phrase were presented with an inverted English D + Mandarin N phrase, such as “tā de bag” is contrasted with “his shū bāo”. Students were to register their preferences between the Mandarin D + English N phrases by selecting a graded response along a Likert-scaled continuum for each question. Care was also given in the questionnaire design to ensure that the positioning of the code-paired phrases was randomized so that the respondent would not associate either side of the continuum with a particular code-paired phrase pattern.

The third section of the questionnaire was designed to find out whether respondents were aware of the lexical items, as tested in section “Method”, in both Mandarin and English. There were twenty questions, and each question was subdivided to enquire respondents’ awareness of the lexical items in Mandarin and English. This section serves to check if CS was used as a compensatory strategy to fill in lexical gaps or a speech style as claimed by MacSwan (1999).

The elicited data from 140 completed questionnaire forms were subjected to statistical analysis using SPSS (Statistical Package for Social Sciences, Ver. 15). Mean and standard deviation calculations were performed; *t*-test procedures were used to compare the mean scores between the male and female participants and the two groups of respondents designated by their dominant home languages (Mandarin or English) that they reported using most frequently so as to find out significant differences of each item in question.

Results

Statistical results from section “Method” of the questionnaire show that there is a clear preference for Mandarin D + English N pattern for 17 of the 20 question items. This is determined by the mean of the respondents’ graded responses, where a mean of 1–3.99 would show a clear preference for pattern A, while a mean of 5–7 show a clear preference for pattern B. As the Mandarin D + English N and English D + Mandarin N patterns are randomized between pattern A and B, a close reference to section “Method” of the questionnaire would aid in identifying which predominant code-pairing the mean points to. The standard deviation would show the spread of responses. The statistical findings are detailed in Table 2 below.

² Lu (1991) subsumed all determiner phrases as noun phrases. “Zhè yàng” is arguably a DP as indicated by the demonstrative “zhè” and its noun complement “yang”. However, it is treated as a noun phrase if it is classified under Lu’s classification system of grammatical categories.

Table 2 Means, standard deviations, and predominant code-paired patterns of participants' preferences for code-paired phrases

| Questions | Min | Max | Mean | Std deviation | Predominant code-paired pattern |
|-----------|-----|-----|------|---------------|---------------------------------|
| 2item1 | 2 | 7 | 6.05 | .999 | Mandarin D + English N |
| 2item2 | 1 | 7 | 2.29 | 1.500 | Mandarin D + English N |
| 2item3 | 2 | 7 | 6.14 | 1.015 | Mandarin D + English N |
| 2item4 | 1 | 7 | 2.87 | 1.521 | Mandarin D + English N |
| 2item5 | 1 | 7 | 4.79 | 1.617 | Indeterminate |
| 2item6 | 1 | 7 | 4.11 | 1.621 | Indeterminate |
| 2item7 | 4 | 7 | 6.10 | .962 | Mandarin D + English N |
| 2item8 | 1 | 7 | 3.09 | 1.598 | Mandarin D + English N |
| 2item9 | 4 | 7 | 6.12 | .993 | Mandarin D + English N |
| 2item10 | 1 | 7 | 5.64 | 1.194 | Mandarin D + English N |
| 2item11 | 1 | 7 | 5.36 | 1.270 | Mandarin D + English N |
| 2item12 | 1 | 7 | 4.04 | 1.963 | Indeterminate |
| 2item13 | 3 | 7 | 5.42 | 1.170 | Mandarin D + English N |
| 2item14 | 1 | 7 | 2.49 | 1.538 | Mandarin D + English N |
| 2item15 | 1 | 7 | 5.75 | 1.087 | Mandarin D + English N |
| 2item16 | 1 | 7 | 5.18 | 1.395 | Mandarin Adj + English N |
| 2item17 | 1 | 7 | 5.74 | 1.161 | (Mandarin D + Adj) + English N |
| 2item18 | 1 | 7 | 3.19 | 1.799 | Mandarin D + English N |
| 2item19 | 1 | 7 | 5.42 | 1.415 | Mandarin D + English N |
| 2item20 | 2 | 7 | 5.38 | 1.220 | Mandarin Adj + English N |

Items 1, 7 and 9 show the strongest collective preferences for Mandarin D + English N code-pairing, with a mean value closest to the extreme position of the graded continuum, and low standard deviation values. There is statistical evidence for a preference amongst bilingual post-secondary students for Mandarin D + English N pattern.

Results from three question items (5, 6 and 12) indicate that the respondents were mostly unsure in identifying a clear preference for a code-paired pattern, with a mean value between 4–4.99 and high standard deviation scores. The statistical results show that the respondents are divided between pattern A and B, with a majority having indicated that they are unsure. For item 6, this was the only NP + N phrase used in the questionnaire. As Lu (1991) pointed out that NP + N is an infrequent codeswitched syntactic domain, this may account for the lack of precise indication of a code-switched pattern.

The compilation of code paired phrases extracted from the language observation journal is shown in Table 3. The Mandarin D + English N pattern is evident from the list of code-paired phrases, while English D + Mandarin N pattern was not produced by English–Mandarin bilinguals. This corroborates with the statistical evidence from the questionnaire analysis, as well as the Mandarin D + English N recurrence noted in naturalistic data culled from prior CS studies as reported in our literature review.

In reference to Table 3, there is evidence that bilinguals use English noun inflexion in code-switched noun phrases, such as “yì xiē coins”, where there is a plural marker in “coins”.

Findings from the statistical analysis of the questionnaire data, through means, standard deviations and the *t*-test comparing the responses between students whose dominant home

Table 3 Compiled code-paired DPs from the language observation journal

| Code-paired determiner phrases | | | |
|--------------------------------|----------------------|-------------------|---------------------|
| Dem + Cl + N | Num + Cl + N | PostDet + N | Pron + Poss + N |
| Dem + Qu + N | Num + Qu + N | | |
| zhè gè MMC card | liǎng gè A4 size | bíe de design | wǒ de bottle |
| wǒ de birthday | yì gè present | bíe de friends | wǒ de way |
| nà gè toilet | yì gè prize | líng wài de class | wǒ de name |
| nà gè file | yì gè cake | dì yī gè runner | tā de bag |
| zhè gè test | sān gè As | zuì duō de votes | wǒ de notes |
| nà xiē plates | liǎng gè assignments | jǐ gè hours | nǐ de muscles |
| zhè xiē pens | yì xiē coins | | tā mén de projects |
| nà gè photograph | | | lǎo shī de files |
| nèi jiàn uniform | | | jīn tiān de lecture |

language is English and students whose dominant home language is Mandarin are shown in Tables 4 and 5. Table 4 shows that the means and standard deviations of the dominant Mandarin and English groups are close. Table 5 shows the results of the *t*-test done on the two groups. Results of the *t*-test suggest that for most of the items on the survey questionnaire, no statistically significant differences were found. However, for Questionnaire items 4, 8 and 18, those whose dominant home language is Mandarin appeared to be inclined to use the “Chinese D + English NP” structure in their code-paired mixings, except for item 16 where those whose dominant home language is English tended to use the “English D + Chinese N”.

The statistical evidence shows that there is a general agreement between the dominant Mandarin and dominant English groups in preferring Mandarin D + English N. Students whose dominant language is English generally prefer to use Mandarin determiners than English determiners, like their dominant Mandarin counterparts. It is noted that the results of a *t*-test analysis on all the 20 items in section “Method” of the questionnaire show that women and men are not statistically significantly different in terms of their preferences for a particular code-paired phrasal pattern.

Mandarin Determiners Versus English Determiners

The clear preference for Mandarin determiners rather than English determiners amongst bilinguals could be accounted for by their semantico-syntactic differences. It is observed that some Mandarin determiners play multiple functional roles vis-à-vis their English counterparts. For example, Mandarin does not have articles as found in English, such as “the” and “a”, or “an” to denote definiteness and indefiniteness. However, Num + Cl and Dem + Cl can multifunction to denote indefiniteness and definiteness respectively (Williamson 1947; Li and Thompson 1981; Chu 1983). For example, the Num + Cl determiner, “yī gè” can be translated in English as the numeral “one” or the indefinite articles “a” and “an”. There is greater economy in semantico-syntactically versatile determiners since their phonetic forms are used for more than one grammatical function. The phonetic form economy of Mandarin determiners entails the frequent activation of Chinese lemmas at the lemma level—multitasking lemmas are linked in sense to more lexical concepts than their English counterparts. It

Table 4 Descriptive statistics for the differences in the choice of code-paired mixing by dominant home language use ($n = 98$ Mandarin home language; $n = 39$ English home language)

| Questions | Dominant home language | Mean | Std deviation | Std error mean |
|-----------|------------------------|------|---------------|----------------|
| 2item1 | Mandarin | 6.06 | 1.003 | .101 |
| | English | 6.03 | 1.013 | .162 |
| 2item2 | Mandarin | 2.15 | 1.311 | .132 |
| | English | 2.59 | 1.860 | .298 |
| 2item3 | Mandarin | 6.16 | 1.012 | .102 |
| | English | 6.08 | 1.036 | .166 |
| 2item4 | Mandarin | 2.64 | 1.221 | .123 |
| | English | 3.44 | 1.997 | .320 |
| 2item5 | Mandarin | 4.76 | 1.586 | .160 |
| | English | 4.82 | 1.730 | .277 |
| 2item6 | Mandarin | 4.08 | 1.577 | .159 |
| | English | 4.10 | 1.729 | .277 |
| 2item7 | Mandarin | 6.14 | .952 | .096 |
| | English | 5.95 | .999 | .160 |
| 2item8 | Mandarin | 2.89 | 1.449 | .146 |
| | English | 3.64 | 1.871 | .300 |
| 2item9 | Mandarin | 6.20 | .963 | .097 |
| | English | 5.90 | 1.046 | .168 |
| 2item10 | Mandarin | 5.56 | 1.227 | .124 |
| | English | 5.79 | 1.105 | .177 |
| 2item11 | Mandarin | 5.37 | 1.238 | .125 |
| | English | 5.33 | 1.364 | .218 |
| 2item12 | Mandarin | 3.99 | 1.966 | .199 |
| | English | 4.31 | 1.962 | .314 |
| 2item13 | Mandarin | 5.48 | 1.177 | .119 |
| | English | 5.28 | 1.191 | .191 |
| 2item14 | Mandarin | 2.51 | 1.568 | .158 |
| | English | 2.44 | 1.465 | .235 |
| 2item15 | Mandarin | 5.80 | .994 | .100 |
| | English | 5.67 | 1.284 | .206 |
| 2item16 | Mandarin | 5.36 | 1.221 | .123 |
| | English | 4.77 | 1.677 | .269 |
| 2item17 | Mandarin | 5.82 | 1.097 | .111 |
| | English | 5.54 | 1.315 | .211 |
| 2item18 | Mandarin | 2.95 | 1.695 | .171 |
| | English | 3.69 | 1.922 | .308 |
| 2item19 | Mandarin | 5.50 | 1.310 | .132 |
| | English | 5.31 | 1.641 | .263 |
| 2item20 | Mandarin | 5.43 | 1.244 | .126 |
| | English | 5.21 | 1.174 | .188 |

Table 5 Differences in the choice of code-paired mixing by dominant home language use

| Survey items | <i>F</i> | Sig. | <i>t</i> | <i>df</i> | Sig. (2-tailed) |
|--------------|----------|------|----------|-----------|-----------------|
| 2item1 | .014 | .905 | .187 | 135 | .852 |
| 2item2 | 6.722 | .011 | −1.552 | 135 | .123 |
| 2item3 | .141 | .708 | .448 | 135 | .655 |
| 2item4 | 16.009 | .000 | −2.828** | 135 | .005 |
| 2item5 | .317 | .574 | −.212 | 135 | .832 |
| 2item6 | .346 | .557 | −.068 | 135 | .946 |
| 2item7 | .117 | .732 | 1.062 | 135 | .290 |
| 2item8 | 4.965 | .028 | −2.519** | 135 | .013 |
| 2item9 | .411 | .523 | 1.641 | 135 | .103 |
| 2item10 | .812 | .369 | −1.033 | 135 | .303 |
| 2item11 | .002 | .969 | .141 | 135 | .888 |
| 2item12 | .002 | .967 | −.854 | 135 | .394 |
| 2item13 | .000 | .997 | .883 | 135 | .379 |
| 2item14 | .002 | .961 | .255 | 135 | .799 |
| 2item15 | 2.647 | .106 | .630 | 135 | .530 |
| 2item16 | 4.489 | .036 | 2.275** | 135 | .024 |
| 2item17 | 3.460 | .065 | 1.263 | 135 | .209 |
| 2item18 | 1.093 | .298 | −2.228** | 135 | .028 |
| 2item19 | 2.398 | .124 | .720 | 135 | .473 |
| 2item20 | .488 | .486 | .964 | 135 | .337 |

Note: ** Significance level: $p < .05$

can be seen that the bilinguals are metalinguistically sensitive to frequently activated lemmas which in turn may facilitate their easy retrieval from the mental lexicon. Significantly, all seven Mandarin Dem + Cl, Mandarin Num + Cl and Mandarin Num + Qu questionnaire items show a predominant preference for Mandarin D + English N pattern. Evidently, it is noted that there is a high count of Mandarin Dem + Cl, Num + Cl and Num + Qu paired with English nouns in prior CS studies as shown in Table 1 and from this study's language observation journal as shown in Table 3.

Another class of versatile Mandarin determiners is the pronouns, such as *tā*, which can be used to express “he”, “she”, animate “it” or inanimate “it” in spoken Mandarin (Chao 1968). The plural suffix “*mén*” is affixed to “*tā*” or any other Mandarin pronoun in situ to denote group pronouns (ibid.). Similarly, the possessive subordinate suffix “*de*” is affixed to “*tā*” or any other Mandarin pronoun in situ to denote possessive pronouns. It can be seen then that the Mandarin pronoun “*tā*” accomplishes more functions than its English counterpart, as Mandarin pronouns do not have case-triggered declension, unlike English pronouns. Furthermore, pronouns are references that are contextually deducible, whether they are endophoric and exophoric in nature. This is contrasted in English where pronouns indicate gender and animacy and inanimacy via multiple free morphemes. Furthermore, English plural pronouns are not variant forms of singular pronouns unlike their Mandarin counterparts but are separate functional lexemes. For example, “they” is morphologically unrelated to “he” in English. In comparison to English, Mandarin pronominal system is simple (Li and Thompson 1981). Lin (2001) observes that Mandarin pronouns do not require any change in form across all

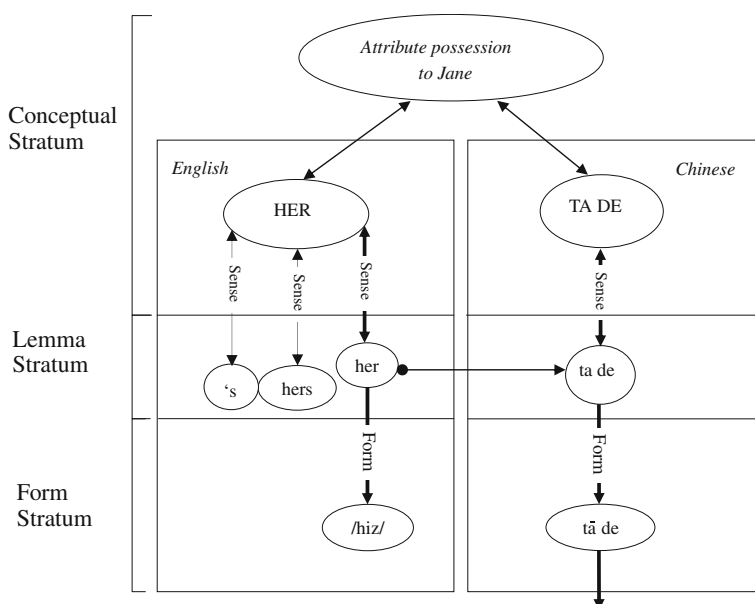


Fig. 1 An architecturally simplified part of Levelt et al.'s modified feedforward activation spreading network showing underlying lexical access in producing the Chinese determiner 'tā de'

meanings. This semantico-syntactic advantage of Mandarin determiners over their English counterparts can be related to the frequent activation of Chinese lemmas and their easy retrieval from the mental lexicon during online demands of spontaneous CS. Evidently, all three Mandarin Pron + Poss + English N questionnaire items show a predominant preference for Mandarin D + English N pattern. Furthermore, it is observed that there is a high count of Mandarin Pron + Poss + English N phrases as noted in prior CS studies as compiled in Table 1 and findings from this study's language observation journal as listed in Table 3.

Also, the lemma selection of Chinese determiners can be seen as less complicated a process than the process of selecting their English counterparts, as illustrated in Fig. 1, within Levelt et al.'s (1999) theory of lexical access in speech production which Green (1998a) subscribed to in explicating the mapping of thought into language. We also take into account that Levelt et al.'s lexical access theory needs to be modified for bilingual processing based on Hirst's (1999) commentary and de Bot's (2007) adaptation of Levelt's speaking model to a bilingual processing model. Figure 1 depicts a portion of Levelt et al.'s modified feedforward activation spreading network of a Chinese-English lexico-semantic system.

The conceptual stratum consists of non-language specific notions leading to the pragmatic and context-dependent activation of lexical concepts in both languages. This is similar to Green's (1998a, 2007) proposal of a language-independent conceptualizer and de Bot's "macroplanning" tier of the conceptualizer. The activated concept nodes are "HER" and "TA DE", which stands for the meaning of the possessive determiner "her". Lexical concepts from both languages are activated simultaneously during the "microplanning" stage which is language-specific based on recent evidence that lexical representations of both lexicons are activated during lemma selection (e.g. Colomé 2001). The concept nodes are necessarily language-specific as noted by Hirst (1999) since "TA DE" has a more comprehensive conceptual coverage than that of "HER" lexical concept. However, the packages of syntactic

information related to the activated concept nodes are accessed only at the lemma stage. Grammatical variation of the concept nodes is made available in separate lemmas to reflect the lemmas' differences in syntactic categorization (Hirst 1999). The activation of the “ta de” lemma is straightforward while the selection of the English “her” lemma is selected after its activation is boosted above other activated lemmas (the strong possessive form “hers” and the possessive clitic “s”) linked to the lexical concept node. There is also the lemma correspondence or lemma-to-lemma link between the English lemma “her” and its Chinese counterpart which serves as a lateral inhibitory link as indicated by an arrow with its round head denoting inhibition and its arrow head denoting excitation/selection.

The frequent production of Chinese determiners over their English counterparts may be attributed to the retrieval ease of frequently activated Chinese lemmas and the uncomplicatedness of Chinese lemma selection. The successful production of Chinese determiners implies that their English counterparts are suppressed. We agree with Green (1998b) in proposing that there is an inhibitory mechanism at work during CS in that less versatile lemmas are inhibited, i.e., activated English lemmas are suppressed while Chinese lemmas are produced.

Evidence that Chinese Singaporeans maintain their knowledge of Mandarin determiners due to their preference for Mandarin D + English N pattern is found in a study done by Poh (2003). She found that Chinese Singaporeans' usage of classifiers is shown to be almost similar to those used in Putonghua, the Mandarin variety spoken in China with influences from the Southern Min dialect which results in a few discrepant classifier uses in Singapore.

A parallel can be drawn with Clyne's (1991) principle of speech economy. Clyne found that bilinguals subconsciously prefer simpler forms from either lexicon, supporting his view with a few illustrations of sentences in German as spoken by German-English bilinguals to show a general preference for Germanized English words or English words that are morphosyntactically intergraded with German morphosyntax over their Standard German counterparts due to the former's pattern of semantic non-differentiation. Likewise, Li (1996) illustrated the principle of economy or least effort in English-Chinese code-switched writing where the intransitive Chinese O-V phrase is increasingly replaced by the simpler English V-O phrase with an embedded English verb. However, both studies did not specify the computational basis of the economy principle nor elaborate on the conditions for the adherence to the principle to take place.

Lemma Versatility Filter

To account for bilinguals' metacognitive manipulation of lemma versatility of Mandarin determiners, we proposed that at the lateral inhibitory linkage between lemmas during lexical selection, the preference for economical lemmas can be operationalized as the Lemma Versatility Filter (LVF), as formalized in the probability expression in (4).

$$(4) \quad P(l_2|L_x \cap L_y) + e \leq P(l_1|L_x \cap L_y) - i$$

Where $l_1 \in Lex(L_x)$, $l_2 \in Lex(L_y)$

LVF can be encapsulated as the bilingual's preference for the lemma which is semantic-syntactically more versatile with the precondition of a semantic overlap of both lexicons triggering the code switch as indicated by the intersection of L_x and L_y . LVF is an economy filter that operates at the concept-lemma link, exciting versatile lemmas frequently via straightforward lemma selection processes while proactively suppressing the less versatile lemma equivalents from the other language. LVF accounts for the predominant Mandarin D + English N patterns as observed from the questionnaire data and language observation journal.

The variables e and i denote the net excitatory resource boosting activation of the versatile lemma and inhibitory resource suppressing the less versatile lemma respectively. Both e and i are consistently equivalent in value although both values are not constant depending on the perceived level of semantico-syntactic versatility of a particular lemma relative to its counterpart tagged as another language. If the values of e and i are low or even null, LVF would not exert suppressive and excitatory effects over lemmas of either language. It appears that the LVF works within the functional category. However, further research may possibly show that LVF filters lemmas of lexical words as well in other dissimilar language pairings.

Illustratively, the strongest statistical evidence of Mandarin D + English N is from the test items 1, 7 and 9. In test item 1, “tā de” is a possessive determiner whose functional versatility is explained earlier in the article. It is semantico-syntactically more versatile than its English equivalent, “his”. Similarly, the same versatility in test item 1 is present in test item 9, “tā mén de”, which is the same pronoun added with a plural suffix “mén”. The same personal pronoun “tā” functions not only to refer as “he”, “she”, animate “it” and inanimate “it” in spoken Mandarin, it functions as a plural pronoun when it is affixed with the suffix “mén” (Lin 2001). The highly excited “tā de” lemma is selected while the LVF blocks the equivalent English determiner, “his”.

However, in item 7, “jīn tiān de”, there is very little or no perceived lexico-syntactic versatility relative to the English counterpart, “today’s”. One explanation can be found from an analysis of section “Results” of the questionnaire which shows that 19% of the respondents were unaware of the Chinese lexical item, “jīng kè”. CS in this case is a strategy to fill a lexical gap. A stronger explanation is found in the Chinese determiner, “jīn tiān de”. Although it lacks semantico-syntactic versatility, it is a specific referring expression (Brown and Yule, 1983). It appears that the specific reference in “jīn tiān de” strongly attracts the [+Interpretable] feature of number in the English noun as the number feature complements and enriches the specificity in reference. The number feature of the English noun is complementary as it is specific in number unlike the Mandarin noun, which is a weak indefinite that is ambiguous in denoting number (Krifka 1995).

For Items 5 and 12, their perceived semantic-syntactic versatility is null, and hence they register indeterminate patterns as the responses were dispersed between Mandarin D + English N and English D + Mandarin N. The LVF accounts for these results. Another evident reason is that most respondents were unsure of both the Mandarin D + English N pattern and English D + Mandarin N pattern for Item 5 and 12. As such, although both are DPs, CS is infrequent in Mandarin infinite + possessive suffix + English N phrase and Mandarin general ordinal + possessive suffix + English N phrase. Both the Mandarin infinite, “lǐng wài” and Mandarin general ordinal, “bìe” are non-specific referring expressions, and hence does not strongly attract the interpretable feature of number in English nouns.

English Nouns Versus Mandarin Nouns

There is a clear preference within code-paired determiner phrases to use English nouns rather than Mandarin ones. There is evidence of English noun inflexion for plurality in this study, as well as CS data from prior studies (refer to Tables 1 and 3) with the exception of one non-adherent DP (jǐ gè module or few module) from a total of 68 code-switched DPs. This could be due to speakers’ preference for English nouns’ [+Interpretable] feature of number over Mandarin nouns’ lack of the same feature. Mandarin common nouns do not inflect for number (Chao 1968; Liu et al. 2006). A bare Mandarin common noun on its own or paired with a classifier is a weak indefinite (Cheng and Sybesma 1999), and any instance of gram-

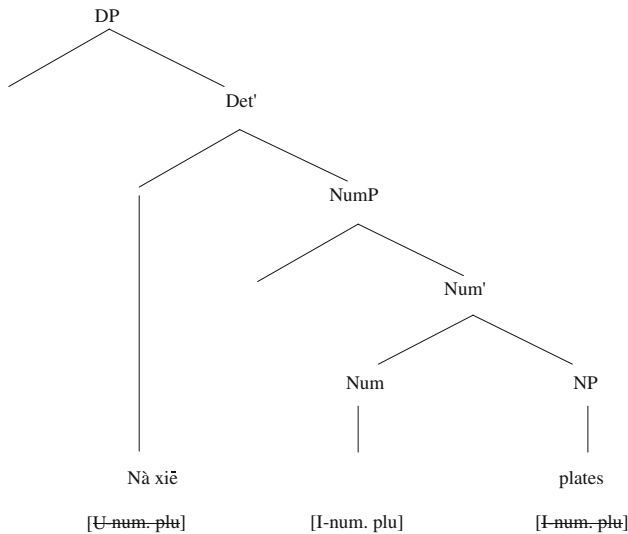


Fig. 2 Tree diagram of Mandarin-English code-paired determiner phrase

mathematical number and denotation of individuals is projected within the functional category, viz. Cl, Num + Cl, Dem + Cl (Gao 1994; Krifka 1995), while other determiners such as possessive pronouns do not carry grammatical number of nouns. However, it is not compulsory for a classifier to be paired with an overt numeral to denote singularity (Cheng and Sybesma 1999). The relationship between Mandarin determiners and English nouns can be illustrated in the tree diagram in Fig. 2.

In Fig. 2, the code-paired phrase, “Nà xiē plates” is taken from item 4, Sect. method of the questionnaire. The [–Interpretable] number feature of the Mandarin D is projected and checked by the [+Interpretable] one of the noun, “plates”. There is an agreement relation between the Mandarin D and the English N. An agreement relation is also evident in questionnaire item 14, where the [–Interpretable] number feature in “zuì duō de” is checked by the [+Interpretable] number feature in “votes”.

This is clearly in alignment with Licerias et al.’s (2005, 2006, 2008) Grammatical Features Spell-Out Hypothesis (GFSH) which states that bilingual speakers prefer to use the more transparent language that has one more grammatical feature. However, in this study, this preference is within the lexical category rather than the functional category as proposed by Licerias et al. This is due to the unique case of Mandarin nouns, which do not inflect for number. The English noun has the added [+Interpretable] feature of number which the Mandarin noun does not activate.

In the case of test item 7, “jīn tiān de lecture”, the English noun lecture is inflectional for number, and hence, number is interpretable. This would not be so if the non-inflectional Mandarin equivalent noun, “jiāng kè”, is used. The greater transparency in the English noun complements the specific reference in the Mandarin determiner, “jīn tiān de”, in a collaborative conveyance of explicit meaning. This is evident in questionnaire item 15 as well, where the [+Interpretable] feature of number in “files” is clearly preferred over its Mandarin noun counterpart for its greater transparency, and that it also complements the specific reference in “lǎo shī de”.

The language situation in Singapore contrasts with that of Chinese EFL (English as a Foreign Language) learners whose competencies in English are weaker than those of Singaporean Chinese bilinguals who learnt English as a first language from kindergartens. Therefore, Chinese EFL learners have shown to commonly omit English inflectional morphemes “-s/es” as their matrix language (Mandarin) do not allow noun inflection for plurality (Liu et al. 2006). Hence, it is clear that GFSH holds only in simultaneous bilinguals and not in English L2 adult learners, in alignment with the findings of Licerias et al. (2006, 2008).

Grammatical Feature Filter

The preference as predicted by GFSH can be seen as a filter similar to the LVF and located at the lateral inhibitory linkage between the two lexicons’ lemmas. This can be termed as the Grammatical Feature Filter (GFF) and formalized as a probability expression in (5).

$$(5) \quad P(l_{1+f}|L_x \cap L_y) + e \leq P(l_2|L_x \cap L_y) - i$$

Where $l_{1+f} \in Lex(L_x)$, $l_2 \in Lex(L_y)$

The subscript symbol f denotes the grammatical feature of l_1 . The variables e and i represent the amount of excitatory resource targeting the transparent lemma and inhibitory resource suppressing the less transparent lemma respectively. The probability expression (5) shows that the selection of l_{1+f} depends on the values of e and i —when the bilingual prefers l_1 over l_2 for the former’s additional feature, e and i would increase. The need to communicate count senses of nouns boosts the value of e and i , particularly when number is not contextually deducible. On the other hand, the need to convey mass senses of nouns will not increase e and i (since mass nouns are similar to Chinese nouns in lacking number contrast) which consequentially reduces the inhibitory control of GFF and render equal probability of selecting nouns in either language. GFF works at the lemma-word form link, where obligatory features or diacritic parameters of lemmas are set based on their values determined by conceptual representation and grammatical encoding. In this study, the participants are simultaneous bilingual adults and the findings corroborate with spontaneous data of simultaneous bilingual Spanish-English adults in prior research studies reviewed by Licerias et al. (2006, 2008). They concluded that besides Spanish L1 speakers, simultaneous bilinguals are the ones who preferred the Spanish determiner, which has one more [–Interpretable] feature (Gender) than its English counterpart.

Although GFF only filters lexical lemmas in this study, it filters functional words in other language pairings, such as in the study by Licerias et al. (2005) who found that Spanish-English bilinguals preferred the Spanish determiners over English determiners. Unlike the GFSH, which claims that the language preference for more abstract features occurs within the functional category, the GFF shows that the preference is indicated within the lexical category.

Topic and addressee affect the activation of the guest language (Grosjean 2001). While the addressees are homogeneously Singaporean Chinese bilinguals, discourse topics and contexts which activate domain-specific concepts vary. These concepts may be frequently expressed in a language which consequentially biased language choice of nouns that is not necessarily motivated to maximize transparency. This led to a deliberate omission of nouns that are deemed domain-specific jargon from the study and the focus on frequent nouns.

A lower proficiency in Mandarin relative to English for some items is evident in results from section “Results” of the questionnaire, where we enquired the respondents’ awareness of both the Mandarin and English lexical items as tested in section “Method” of the questionnaire. The respondents were aware of all the twenty English lexical items. However,

some of the respondents were unaware of some of the Mandarin lexical items used in section “Method” of the questionnaire, such as “*zhuān tí zuò yè*”, “*yìn bì*” and “*sài pǎo tián jìng jiàn jiàng*”, as found in Item 9b, 10b and 13b respectively. A number of the respondents reported that they were unaware of a few of the Mandarin lexical items. The preference for English nouns in these cases is to fill in lexical gaps. In the case of the Mandarin noun, “*sài pǎo tián jìng jiàn jiàng*”, 56 out of 140 respondents or 40% of the study participants were unaware of it. It is evident that some bilinguals use CS as a compensatory strategy to fill in lexical gaps in their Mandarin lexical store. The lower Mandarin nominal proficiency could be partially accounted for by GFF which predicts the reduced usage of Mandarin nouns during fluent CS.

General Discussion

Both filters apply within semantic overlaps of the two languages when natural CS is employed as a speech style by proficient bilinguals. We note that one-to-one mappings between lemmas of two languages are not typical and that there are varying noisy semantic mappings (e.g. one to many, many to one, many to many) (Schreuder and Hermans 1998). In the latter case, we believe that only the most activated lemma from each language is filtered by LVF and GFF for selection. Recent neuroimaging data show that bilinguals rely on a non-language specific semantic system (Green et al. 2006), which entails semantic networks consisting of lateral linkages (lemma-to-lemma links) between semantically related words from both languages.

Although the code-paired patterns are metalinguistically derived, automaticity of the code-paired norm generation over time and habitual usage is likely to occur (Wheatley and Wegner 2001), leading to the largely unconscious production of fluent CS (Grosjean 2001). Automatic performance of CS is accounted for by a controlling CS schema that is easily retrievable from memory and adaptable via modulations of the supervisory attentional system. We postulate that the filters are activated within the CS schema in a functional control circuit that regulates the L1 and L2 production schemas. The word production schemas are subject to inhibitory and excitatory resources which would in turn influence lexical selection via lateral inhibitory links within the lexico-semantic system. Schemas during fluent CS operate proactively upon activated lemmas in the bilingual lexico-semantic system, particularly so when there is no switching cost involved during natural CS (Li 1998; Grosjean 1997).

The LVF favors multitasking lemmas which are activated by excitatory resources and selected frequently. Consequentially, they are also easily retrievable from the mental lexicon with straightforward concept-lemma links while inhibiting their counterparts tagged in the other language. In this study, multitasking lemmas are not globally present in Chinese and LVF is limited to their presence. In contrast, GFF is more extensive in that it works on the preference for a systemic grammatical feature, viz. the number feature of English nouns which Mandarin nouns lack. These filters work in tandem in producing code-paired determiner phrases.

It may appear that the excitatory and inhibitory effects of LVF and GFF counteract each other. For example, the Chinese determiner “*tā de*” which is favored by LVF for its semantico-syntactic versatility appears to be less transparent which in turn would antagonistically be inhibited by the GFF in favor of the gender marked “his”. However, it is noted that gender marking is severely limited to pronouns in English. English is not considered as having grammatical gender based on the absence of gender declension and the general non-requirement for gender agreement between related words. GFF applies only to systemic features like GFSH and does not work in local or endemic features such as English gendered pronouns. Hence, the workings of the filters are not antithetical and are discrete in this study.

Another notable difference between the filters is their distinct loci of inhibition in the bilingual lexico-semantic system. LVF operates at the lateral linkage between translation equivalents during lemma selection inhibiting semantico-syntactically less versatile lemmas and selecting their counterparts in the other language. GFF also works at the lateral linkage between equivalents within the lemma stratum but at the post lemma selection stage, where lemma feature values are set by conceptual representation and grammatical encoding and phonologically realized, being preferred over equivalent lemmas in the other lexicon that lack these features.

In some code-switched phrases, such as “jīn tiān de lecture”, the LVF would not be able to filter out the English functional equivalent, “today’s”. However, the GFF strongly inhibits the Mandarin noun, “jiāng kè”, as evident in a statistically significant mean denoting a strong dis-preference and subsequent preference for the Mandarin D + English N pattern. The absence of “today’s jiāng kè” in the naturalistic data culled from this study corroborates with this finding. Moreover, the Mandarin determiner, “jīn tiān de”, is a specific referring expression that strongly attracts the greater transparency found in the English noun, as it appears that the English noun’s [+Interpretable] number feature enriches the specific referential function of the Mandarin determiner. Nevertheless, the codeswitched noun could also be a compensatory strategy for some bilinguals to fill in a lexical gap for some respondents.

Although the LVF filters functional morphemes while the GFF filters lexical morphemes in this study, the filters may work in other syntactic categories in other language pairings. It can be speculated that the filters exist because the metacognitively well-developed bilingual exploits the semantico-syntactic and morphosyntactic dissimilarities between English and Mandarin for economy and transparency. It also appears that these dissimilarities in the Mandarin-English pairings activates the filters within the natural CS schema. Hence, it is likely that the filters may affect grammatical categories in other dissimilar language pairings, such as Japanese and English. It is likely that the filters will not be activated in morpho-syntactically and semantico-syntactically similar language pairings like Tagalog and Malay. Illustratively, [Liceras et al. \(2005\)](#) found that there is no clear preference for either Italian or German determiners as both are similar in that both have number and gender [–Interpretable] features. Therefore, it can be seen that the filters are metalinguistic parameters that are activated by the extent of dissimilarity within the morphosyntactic and semantico-syntactic relationships of language pairings.

Conclusion and Recommendations for Future Research

Building on the premise that bilingual language processing is an efficient and transparent process, the present study is interested in examining if metalinguistic filters exist as part of an executive mechanism within the bilingual language faculty. Based on the pool of naturalistic data collected by several prior studies and this study, and elicited data culled from this study, it was found that the semantico-syntactic and morpho-syntactic dissimilarities between Mandarin and English activated both filters. Our findings lend support to the postulation that LVF and GFF are metalinguistic parameters of a CS schema based on the semantico-syntactic and morphosyntactic relationships of the language pairing. Activated lemmas are selected or inhibited through two filters of lemma versatility and grammatical feature, when CS is used as a speech style. It is clear that some simultaneous bilinguals (including bilinguals deemed as proficient) also use CS as a compensatory strategy to fill in lexical gaps like adult L2 bilinguals ([Faersch and Kasper 1984](#); cf. [Zhang 2002](#)).

Given the scope of the study, we think research can be extended to explore the following three areas. One possible area of future research would be whether there is a Mandarin Adj + English N pattern or English Adj + Mandarin N patterns in code-paired APs. The three Adj + N phrases in the questionnaire showed there is a preference for Mandarin Adj + English N pattern in both phrases. However, the study did not delve into the reasons for the code-paired pattern due to the focus on DPs. Nevertheless, it is noted that Mandarin adjectives function as verbs as well (Chao 1948, 1968; Chu 1983; Lin 2001), and this lemma versatility is likely to activate the LVF that leads to a preference for Mandarin adjectives, while the number feature of English nouns activates GFF that leads to a preference for English nouns. This preliminary finding can be further established in further research.

Another possible area of research is to extend the focus of study to other syntactic domains, such as ADV + V(P) and V + N(P), which Lu (1991) found are frequent points of Mandarin-English CS. The study could also be extended to a larger sample size of students so that findings can be generalized to a wider population.

Further research can also be conducted on whether other semantico-syntactically and morphosyntactically dissimilar language pairings would activate LVF and GFF in bilinguals' codeswitching. This would substantiate the view that both filters are universals that operate as parameters of a controlling CS schema within the bilingual language faculty.

Appendix: Questionnaire

Mandarin-English Codeswitching Questionnaire

Purpose: The code mixing questionnaire contains twenty questions of 40 Mandarin-English pairings. It aims to find out how Mandarin-English bilingual post-secondary students like you in Singapore codeswitch during informal conversations.

Instructions: There are THREE sections. Section "Introduction" contains questions about you and the languages you speak. Section "Method" contains twenty question items. Each question contains two code-paired noun phrases and a Likert-scale of 7 graded responses. Tick only one of the graded responses on the scale per question. The Mandarin component is expressed in *hànyǔ pīnyīn* and italicized, accompanied with Simplified Chinese characters. Section "Results" enquires about your knowledge of the Chinese and English vocabulary items that appear in section "Method".

Please read each question item carefully and choose the option that you feel strongest for, if you are conversing with fellow Mandarin-English bilinguals who codeswitch Chinese and English. Mark your answers with a tick on the selected numbered option.

Please answer each item quickly according to your first reaction. There is no right or wrong answer. You DO NOT need to ask your classmates how they answer each item. You DO NOT need to guess how your teacher would like you to answer each item. Your answers will NOT in any way influence your Language and Communication module results.

If you have any questions about how to answer the questionnaire, please ask now.

Thank you.

Section 1: Personal Data

There are 9 questions in this section. Please complete all questions in section “Introduction” before you start on the next section. Blacken the circle of your choice completely using a 2B pencil.

1. Name: _____ Class: _____

2. Age

| | |
|--|--|
| | |
|--|--|

- ① ①
② ②
③ ③
④ ④
⑤ ⑤
⑥ ⑥
⑦ ⑦
⑧ ⑧
⑨ ⑨

3. Sex

- ① Male
② Female

**Directions For Marking
Answers**

- Shade heavy black marks that fill the circle completely
- Make no stray marks on the answer sheet please
- Example: If you think the 2nd option is your preferred answer, shade the oval ② like this:

① ●

4. Which is the language you speak most at home? (Please shade only 1 option)

- ① Mandarin
② English
③ Other (please specify) _____

5. Who do you speak Mandarin to?
(You may shade more than 1 option)
option)

- ① Family Members
② Friends
③ Others (please specify):

6. Who do you speak English to?
(You may shade more than 1 option)

- ① Family Members
② Friends
③ Others (please specify):

7. Do you mix English and Mandarin within a noun phrase (e.g. determiner + noun) when you speak to friends and/or family?

- ① Yes ② No

8. What is your O' Level grade for English?

- ① A1 ② A2 ③ B3 ④ B4 ⑤ C5 ⑥ C6 ⑦ D7 ⑧ E8 ⑨ F9

9. What is your O' Level grade for Mandarin?

- ① A1 ② A2 ③ B3 ④ B4 ⑤ C5 ⑥ C6 ⑦ D7 ⑧ E8 ⑨ F9

Section 2: Code-Paired Noun Phrases

There are 20 questions in this section. There are two code-paired patterns, A and B per question. Choose the response you feel strongest for, if you are to be engaged in an informal conversation with fellow Chinese-English bilinguals who codeswitch Chinese with English. There is a Likert-scale of 7 graded responses per question. **Tick only one graded response within the box for each question.**

1)

A. *Tā de bag*

他的 bag

B. His *shū bāo*

His 书包

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

2)

A. This *cē yàn*

This 测验

B. *Zhè gè test*

这个 test

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

3)

A. *Wǒ de notes*

我的 notes

B. My *bǐ jì*

My 笔记

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

4)

A. Those *pán zi*

Those 盘子

B. *Nà xiē plates*

那些 plates

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

5)

A. *Bíe de friends*

别的 friends

B. Other *péng yǒu*

Other 朋友

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

6)

A. *Zhè yàng de teacher*

这 样 的 teacher

B. This kind of *lǎo shī*

This kind of 老 师

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

7)

A. *Jīn tiān de lecture*

今 天 的 lecture

B. Today's *jīng kè*

Today's 讲 课

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

8)

A. The *bǐ*

The 笔

B. *Zhè xiē pens*

这 些 pens

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

9)

A. *Tā men de projects*

他 们 的 projects

B. Their *zhuān tí zuò yè*

Their 专 题 作 业

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

10)

A. *Yī xiē coins*

一 些 coins

B. Some *yìn bì*

Some 银 币

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

11)

A. *Yī gè prize*

一个 prize

B. One *jiāng pǐn*

One 奖品

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

12)

A. Another *bān*

Another 班

B. *Líng wài de class*

另 外 的 class

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

13)

A. *Dì yī gè runner*

第 一个 runner

B. First *sài pǎo tián jìng jiàn jiāng*

First 赛 跑 田 径 健 将

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

14)

A. Most *xuǎn piao*

Most 选 票

B. *Zuì duō de votes*

最 多 的 votes

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

15)

A. *lǎo shī de files*

老 师 的 files

B. Lecturer's *wén jiàn jiā*

Lecturer's 文 件 夹

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

16)

A. *Yì yàng de cups*

一样的 cups

B. Same *bēi zi*

Same 杯子

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

17)

A. *Zuì xǐhuan de lesson*

最喜欢的 lesson

B. Most likeable *kè*

Most likeable 课

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

18)

A. The *zhào piàn*

The 照片

B. *Nà gè photograph*

那个 photograph

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

19)

A. *Yì gè cake*

一个 cake

B. A *dàn gāo*

A 蛋糕

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

20)

A. *Xīn de mobile phone*

新的 mobile phone

B. New *shǒu tí diàn huà*

New 手提电话

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---------------------------------------|----------------------------------|-----------------------------|----------|-----------------------------|----------------------------------|---------------------------------------|
| Extremely likely to say and/or hear A | Very likely to say and/or hear A | Likely to say and/or hear A | Not sure | Likely to say and/or hear B | Very likely to say and/or hear B | Extremely likely to say and/or hear B |

Section 3: Knowledge of Lexical Items

There are 20 questions in this section, each with 2 sub-questions. The lexical items appear in the same order as in section “Method”. Circle the appropriate response by circling **either Y for yes or N for no**.

| | | |
|---|---|---|
| 1a. Are you aware of the English expression ‘bag’? | Y | N |
| 1b. Are you aware of the Chinese expression ‘ <i>shū bāo</i> (书 包)’? | Y | N |
| 2a. Are you aware of the Chinese expression ‘ <i>cē yàn</i> (测 验)’? | Y | N |
| 2b. Are you aware of the English expression ‘test’? | Y | N |
| 3a. Are you aware of the English expression ‘notes’? | Y | N |
| 3b. Are you aware of the Chinese expression ‘ <i>bǐ jì</i> (笔 记)’? | Y | N |
| 4a. Are you aware of the Chinese expression ‘ <i>pán zi</i> (盘 子)’? | Y | N |
| 4b. Are you aware of the English expression ‘plates’? | Y | N |
| 5a. Are you aware of the English expression ‘friends’? | Y | N |
| 5b. Are you aware of the Chinese expression ‘ <i>péng yǒu</i> (朋 友)’? | Y | N |
| 6a. Are you aware of the English expression ‘teacher’? | Y | N |
| 6b. Are you aware of the Chinese expression ‘ <i>lǎo shī</i> (老 师)’? | Y | N |
| 7a. Are you aware of the English expression ‘lecture’? | Y | N |
| 7b. Are you aware of the Chinese expression ‘ <i>jiǎng kè</i> (讲 课)’? | Y | N |
| 8a. Are you aware of the Chinese expression ‘ <i>bǐ</i> (笔)’? | Y | N |
| 8b. Are you aware of the English expression ‘pens’? | Y | N |
| 9a. Are you aware of the English expression ‘projects’? | Y | N |
| 9b. Are you aware of the Chinese expression ‘ <i>zhuān tí zuò yè</i> (专 题 作 业)’? | Y | N |
| 10a. Are you aware of the English expression ‘coins’? | Y | N |
| 10b. Are you aware of the Chinese expression ‘ <i>yín bì</i> (银 币)’? | Y | N |
| 11a. Are you aware of the English expression ‘prize’? | Y | N |
| 11b. Are you aware of the Mandarin expression ‘ <i>jiāng pǐn</i> (奖 品)’? | Y | N |
| 12a. Are you aware of the Mandarin expression ‘ <i>bān</i> (班)’? | Y | N |
| 12b. Are you aware of the English expression ‘class’? | Y | N |

| | | |
|--|---|---|
| 13a. Are you aware of the English expression 'runner'? | Y | N |
| 13b. Are you aware of the Chinese expression 'sài pǎo tián jìng jiàn jiāng(赛 跑 田 径 健 将)'? | Y | N |
| 14a. Are you aware of the Chinese expression 'xǔn piào(选 票)'? | Y | N |
| 14b. Are you aware of the English expression 'votes'? | Y | N |
| 15a. Are you aware of the English expression 'files'? | Y | N |
| 15b. Are you aware of the Chinese expression 'wén jiàn jiā (文 件 夹)'? | Y | N |
| 16a. Are you aware of the English expression 'cups'? | Y | N |
| 16b. Are you aware of the Chinese expression 'bēi zi(杯 子)'? | Y | N |
| 17a. Are you aware of the English expression 'lesson'? | Y | N |
| 17b. Are you aware of the Chinese expression 'kè(课)'? | Y | N |
| 18a. Are you aware of the Chinese expression 'zhào piàn(照 片)'? | Y | N |
| 18b. Are you aware of the English expression 'photograph'? | Y | N |
| 19a. Are you aware of the English expression 'cake'? | Y | N |
| 19b. Are you aware of the Chinese expression 'dàn gāo(蛋 糕)'? | Y | N |
| 20a. Are you aware of the English expression 'mobile phone'? | Y | N |
| 20b. Are you aware of the Mandarin expression 'shǒu tí diàn huà (手 提 电 话)'? | Y | N |

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