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## Does the Complementarity Principle apply to inner speech? A mixed-methods study on multilingual Chinese university students in the UK<sup>1</sup>

Pearl P.Y. Leung, Jean-Marc Dewaele

*Department of Applied Linguistics and Communication, Birkbeck, University of London, London, United Kingdom*

Corresponding author: Pearl P.Y. Leung, pleung01@mail.bbk.ac.uk, Department of Applied Linguistics and Communication, Birkbeck, University of London, 26 Russell Square, London WC1B 5DT, UK

**Abstract** This paper investigates how inner speech in English as a foreign language (LX) and Chinese first languages (L1s) of 425 multilingual Chinese university students in the UK is affected by their stay. An eight-item scale was developed to cover two different discourse domains for inner speech, namely the academic and the general domain. LX socialization was operationalized as frequency of English use in daily life, sociocultural adaptation, previous immersion, and length of stay. Factor analysis of the quantitative data combined with participants' reports show that English inner speech develops gradually in the academic domain and general domain, suggesting that the Complementarity Principle applies to inner speech as much as articulated speech (Grosjean, *Bilingual: Life and reality*. Harvard University Press, 2012). Frequency of academic English inner speech is linked to higher level of LX socialization, namely frequent use of English in daily life, a higher level of sociocultural adaptation, and having had previous immersion. However, sociocultural adaptation had no effect on the frequency of general English inner speech.

Keywords: Inner speech; Complementarity Principle; Study abroad; LX socialization

### Introduction

Grosjean (2012) asked bilinguals in a small survey what language they used to think in. A majority of participants answered that they used both languages depending on a number of factors. The author interpreted this as evidence that his Complementarity Principle (CP), which states that language preferences differ according to situations, interlocutors, and purposes, applies also to inner speech. The CP is widely accepted by multilingualism researchers (Grosjean, 2018) but the evidence so far comes mainly from studies on articulated or written speech. Only a few researchers have ventured in the systematic study of multilinguals' language preferences for inner speech (Dewaele, 2015; Hammer, 2017a, b, 2018), and more evidence is needed to establish whether the CP functions in inner speech as it does for articulated speech.

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Inner speech, i.e. '*silent speech for oneself*' (de Guerrero, 2018, p. 3), is not only a dialogue to oneself that is experienced day-to-day. It performs a range of cognitive functions including self-regulation, self-reflection, planning, critical thinking, problem-solving (Racy et al., 2019), managing emotions, and self-encouragement (Pavlenko, 2014). For multilinguals, knowing other languages means they have the linguistic resources to perform high-level cognitive functions in the LX(s), such as mental calculation (Dewaele, 2007). Being the medium of the most private communication with the self, Dewaele (2015) points out that the emergence of LX inner speech reflects increased language embodiment. When LX users start experiencing the *full impact* of the LX, they may start feeling it is becoming a language of the heart. The development of LX inner speech is a gradual process. Eva Hoffman (1989) recounted how as a young Polish teenager in Canada, her English LX inner speech initially felt like '*the voices of others invade me as if I were a silent ventriloquist*' (p. 220). With time, English inner speech started to become her own voice and she became able to '*speak a part of myself through it*' (p. 220). She describes the process as follows:

Eventually, the voices enter me; by assuming them, I gradually make them mine. I am being remade, fragment by fragment, like a patchwork quilt; there are more colors in the world than I ever knew. (Hoffman, 1989, p. 220)

While there is a fair amount of research on LX inner speech, questions remain about the timing of its emergence across discourse domains. The originality of the present study is based on its design and its population. Firstly, it uses a multi-item inner speech scale that allowed the use of factor analysis to identify dimensions in the dataset. Secondly, it focuses on the onset of LX inner speech among Chinese university students at the start of their study abroad. This study can thus contribute to a better understanding of the role of initial LX socialization on the development of LX inner speech.

## Literature review

### *Language preference and domains in inner speech*

The Complementarity Principle (CP) is based on the observation that in bilinguals' repertoire, different languages are used in different domains and that sometimes two or more languages can co-exist in a single domain (Grosjean, 2012). It adds nuance to the concept of language dominance in bilinguals because some may prefer a non-dominant language for certain domains (Grosjean, 2018). Another crucial point is the dynamic nature of bilinguals' language preferences and competence which is developed according to the needs of the domain and the frequency of use of that language in that domain. If a language is not needed in a specific domain, bilinguals do not have a need to develop domain-specific vocabulary, and the existing words and expressions may become dominant in one language only. Language domains are drawn according to the function and interlocutor, for example, college, shopping, religion, friends, siblings, hobbies, etc. The CP implies that bilinguals rarely attain equal fluency in all the languages they know (Grosjean, 2012). The inherent adaptability of the bilinguals' language repertoire means that a change in environment, e.g. migration, will create new linguistic needs, and thus will change the language configuration (i.e. domains of use, frequency of use) of the bilingual users.

Empirical evidence for the CP has emerged for multilinguals' language preferences for inner speech. Dewaele's (2015) mixed-methods study revealed that a large majority of 1579 adult multilinguals reported using the L1 most frequently for inner speech. LXs were used less frequently, according to the order in which they were acquired, i.e. the last acquired LX was used the least frequently. Comparing language preferences for general inner speech and emotional inner speech, Dewaele (2015) found that the preference for the L1 was significantly stronger for emotional inner speech than for general inner speech. In contrast, the LX was used more frequently in general inner speech than in emotional inner speech. The results suggest that the LX is gradually internalized, from the general domain to the emotional domain, evolving from an echo of social interactions to a language of the heart. Further statistical analyses revealed that frequencies of use of the LX for general and emotional inner speech were linked to context of acquisition, age of onset of acquisition, self-perceived proficiency, frequency of general use, degree of LX socialization, and degree of LX emotionality.

Pursuing this avenue of research, Hammer's (2017a) mixed-methods study looked at the language preferences for inner speech of 149 Polish-English bilinguals residing in the UK. Participants reported using English most frequently in thinking of events that had happened in L2, followed by keeping a diary, praying, and thinking of events that happened in L1. In a follow-up study, Hammer (2018) found that participants reported using English most frequently in note-taking, followed by shopping lists, action plans, and mental calculation. In particular, the difference in frequency of use between mental calculation and the three other domains was found to be statistically significant. In both studies, acculturation level and social network profiles were linked to the preference for English LX in inner speech across the various domains. Both Dewaele (2015) and Hammer (2017a, 2018) used cross-sectional designs that yielded data suggesting that the development of LX inner speech across domains is highly dynamic and the amount of inter-individual variation is considerable.

### ***Language socialization***

LX socialization causes shifts in language preferences for both articulated speech and inner speech. Focusing on the former, di Lucca et al. (2008) observed language shift over a period of six years among twenty adolescents who had migrated from Morocco to Italy with their family. The researchers found language reconfiguration in their language use, with Italian used more frequently in a growing number of domains, while Moroccan and Standard Arabic was exclusively used in the family domain. The language shift was rapid because of intense LX socialization through schooling and Italian friendship networks. The increasing use of the LX for inner speech has been linked to a cluster of factors that are closely related to language socialization. This is the process through which the LX acquires affective meanings and how LX emotional memories are built (Pavlenko, 2004). Intense LX use, in particular in the private sphere, boosts the emotional resonance of the LX and can lead to a high degree of LX socialization in adulthood (Pavlenko, 2004). For example, falling in love in an LX can boost LX socialization. Dewaele and Salomidou (2017) investigated the language use of 429 multilinguals who had used (or were using) an LX with a romantic partner. More than half of their participants felt that after initial challenges in communicating emotions, they were gradually better able to gauge the power of emotion words and emotion-laden words, to read between the words, to pay attention to silences, to body language, and they felt more authentic in expressing their feelings in the LX, with some even saying that the LX had become the language of the heart.

The size of the LX-speaking social network is also linked to the speed of LX socialization. In her 149 Polish-English bilinguals, Hammer (2017b) found that the frequency of use of English LX in inner speech was linked to the linguistic profile of their social network. Those who had a social network that consisted of a majority of English speakers used English more frequently in inner speech than participants whose social networks contained a larger proportion of Polish speakers.

Following a similar research avenue, Resnik (2021) looked at the frequency of use of the L1 and of LX English inner speech among 167 adult multilingual participants from German-speaking and Asian backgrounds who were highly proficient in English. Quantitative analyses showed that the L1 was used significantly more frequently than English in inner speech, though the effect size was small. Participants who were living in English-speaking countries used English significantly more frequently in inner speech than those living in their home countries. Furthermore, high frequency of use in daily life, high self-reported proficiency in English as well as a high number of languages known were linked with increased use of English for inner speech. The type of language dominance also played a role. Multilinguals perceiving themselves as L1 dominant reported increased use of the L1 in inner speech compared to those dominant in both the L1 and LX, while those dominant in the LX preferred that language for inner speech. The Western participants reported more frequent use of the LX for inner speech while the Asian participants reported a higher frequency of the L1 for their inner speech.

### ***Measurement of inner speech***

Research on inner speech relies on self-reports such as the thought-listing procedure where respondents are asked to list instances when they remembered talking to themselves in silence (Morin et al., 2011). The results showed that the three most frequent functions of inner speech are planning for tasks, assisting memory and remembering, and motivating oneself. In a follow-up study Morin et al. (2018) established that the most frequent function of inner speech is problem-solving, followed by emotions regulation, and time management. Using the same thought-listing procedure, Racy et al. (2019) developed the *General Inner Speech Questionnaire* (GISQ) consisting of 57 items. The findings confirmed previous studies with self-reflection and self-management functions of inner speech.

The above studies focused on functions of inner speech but did not consider language preference for each function. One study that did enquire about language preferences was Dewaele (2015). It was based on a database collected through the *Bilingualism and Emotions Questionnaire* (BEQ) (Dewaele and Pavlenko, 2001-2003) that contained two separate questions with a single item for language preferences in general and emotional inner speech. Respondents were asked to rate the frequency of use for their L1 and LX(s) in general inner speech and emotional inner speech on a 5-point Likert scale. The 5-point Likert scale runs from 1 (*Not at all*) to 5 (*All the time*). Hammer (2017a, 2017b, 2018) adapted the BEQ design by changing the Likert scale to 1 (*Polish*), which is participants' L1, to 5 (*English*), and inquiring about language preference in 20 domains, represented by a single item.

In sum, research on LX socialization and language preferences for inner speech is still in its infancy and some gaps remain. Firstly, participants in previous studies were typically already quite highly socialized in the LX. Secondly, information about inner speech was collected through a single item. The current study will focus on multilinguals in the early stage of LX socialization, considering language preferences

for inner speech in different domains using a multi-item scale. Such a scale will allow the use of more sophisticated statistical analyses which can produce more reliable measures. The addition of the sociocultural adaptation scale (Wilson et al., 2017) in the research design adds a novel independent variable in the research design.

### **Research questions**

Two research questions were formulated:

- (1) How frequently and in what domains do Chinese-English bilinguals studying in the UK use English LX and their Chinese L1(s) for inner speech?
- (2) Is LX socialization linked to change in language preferences for inner speech?

### **Methodology**

This study employed mixed-methods to investigate LX inner speech development from a micro perspective (i.e. the individual experience of inner speech) and a macro perspective (i.e. language internalization during study abroad). The collection and analysis of quantitative data (close-ended) and qualitative data (open-ended) in a parallel manner through an online questionnaire is a characteristic of a convergent design (Creswell, 2015). The advantage of such a design is that it provides a deeper understanding of the research problems through interpreting general trends from the quantitative database and individual perspectives from the qualitative database (Creswell, 2015). It allowed us to examine the general trends in frequency of use and domains in inner speech and link them with individuals' unique experiences during their stay in the UK. Snowballing sampling was used to recruit potential participants who had to fit a very specific profile: be aged 18 or above, have Chinese as an L1 and English as a foreign language, and study in the UK. Snowballing sampling is a nonprobability sampling technique, where participants are asked to forward the call for participation to their network of contacts (Dörnyei, 2007). A call for participation was posted on sites of various Chinese student societies in the UK, on social media, and was emailed to members of the authors' socio-professional networks. Ethics approval of this study was granted by the SSHP ethics committee at Birkbeck, University of London.

### **Participants**

A total of 425 Chinese students in the UK responded to the call for participation in the online questionnaire in late 2019. A majority of participants were female ( $n = 330$ ), 83 were male and 12 did not disclose their gender. The gender balance is similar to previous studies employing online questionnaires on multilingualism and emotion (Dewaele, 2018). Participants were all ethnically Chinese but grew up in different regions in the Greater China area. The majority of them grew up in Mainland China ( $n = 383$ ), followed by Hong Kong ( $n = 23$ ), Taiwan ( $n = 13$ ), Macau ( $n = 2$ ), and multiple cities within the region ( $n = 4$ ). The age range of participants was between 18 and 37 ( $M = 24$ ,  $SD = 3$ ). One hundred and ninety-three participants had two L1s, 22 had three L1s, and three had more than three L1s. Due to the small sample size with participants having three L1s or more ( $n = 25$ ), the third L1 was excluded from the analysis. Mandarin is the most frequent first language ( $n = 388$ ). In addition, a majority of participants ( $n = 252$ ) listed a regional language such as Cantonese as their only L1 or one of their L1s. All participants were full-time university students in the UK at the time of participation. Seventy participants were undergraduate students, 307 were postgraduate students, and 48 were PhD students. As part of the UK visa requirement, all participants had to achieve B2 upper intermediate level or above to study a degree

level or above course following the Common European Framework of Reference for languages (CEFR) (Council of Europe, n.d.). This upper intermediate language ability is reflected in participants' self-rated English proficiency. On a Likert scale from 1 (*Not at all fluent*) to 5 (*Fully fluent*) across four language skills (speaking, listening, writing, reading), the average rating of English proficiency was 13.04 out of a total of 20 ( $SD = 2.79$ , Cronbach's  $\alpha = 0.75$ ).

### ***The instrument***

#### *Inner speech scale*

An eight-item inner speech scale was developed based on Morin et al. (2011, 2018) and Racy et al. (2019). The inner speech scale of the present study included eight functions of inner speech (Appendix A). Based on the findings from previous studies and the participants' profile, we hypothesized that the eight items reflect three broad factors in the scale: general, academic, and emotional inner speech. Participants were asked to rate the frequency of using L1 Mandarin, L1 Chinese regional languages and LX English in inner speech on a 5-point Likert scale from 1 (*Never*) to 5 (*All the time*). The three inner speech scales had high internal reliability (L1 Mandarin, Cronbach's  $\alpha = 0.931$ ; L1 Chinese regional language, Cronbach's  $\alpha = 0.972$ ; English, Cronbach's  $\alpha = 0.886$ ).

#### *Frequency of general use*

Frequency of general LX English use was measured in eight domains: friends in home country, friends in the UK, family, academic work, daily life in the UK, free time, expressing feelings, and writing a diary. Frequency of use in each domain was rated from 1 (*Not at all*) to 5 (*All the time*). The eight items have an acceptable internal reliability (Cronbach's  $\alpha = 0.740$ ), therefore, a scale of frequency of general use was created by taking the average of the sum of the eight items. The mean frequency of general use is 3.04 ( $SD = 0.569$ ).

#### *Sociocultural adaptation scale*

An 11-item scale to measure participants' competence in navigating a new cultural environment was adapted from Wilson et al. (2017). Competence is measured on a 5-point Likert scale from 1 (*Not at all competent*) to 5 (*Extremely competent*). The eleven items have high internal reliability (Cronbach's  $\alpha = 0.918$ ). A scale of sociocultural adaptation was created by taking the average of the sum of the eleven items. The mean sociocultural adaptation is 3.70 ( $SD = 0.734$ ).

#### *Length of stay and previous study abroad*

The first independent variable about previous study abroad is a binary variable of whether participants had previously studied abroad or not. Participants were asked if they had previously studied in any English-speaking countries prior to their current study abroad. Eighty-four (19.8%) participants had done so. The second independent variable is length of stay. If participants responded they had studied abroad before, they were asked to provide the duration of study and the country of stay. The average length of stay is 29 months, ranging from 1 month to 8 years. This diversity is reflected in the large standard deviation of 22.3 months. For those who had previously studied abroad, a majority of them ( $n = 60$ ) stayed in the UK. A closer look at the data revealed that most

participants, 307 out of 425 (71%), had just arrived in the UK for a taught postgraduate degree at the point of participation. Participants who had attained their undergraduate degree abroad prior to their current study were labeled as having previous study abroad experience and their length of stay was recorded.

### *Open-ended questions*

Two open-ended questions at the end of the questionnaire asked about participants' experiences in LX English inner speech in relation to acculturation:

- 1) Have you noticed any change in your inner speech ever since you started studying in the UK?
- 2) If you experienced inner speech in English, can you provide an example of it?

## **Results**

The first research question focused on the differences in frequency of inner speech across domains between the L1s and LX English. First, Exploratory Factor Analysis (EFA) was conducted to identify clusters in the inner speech scale. When more than one factor was identified in EFA, it was followed by Confirmatory Factor Analysis (CFA) to test the hypothesis (Field, 2018).

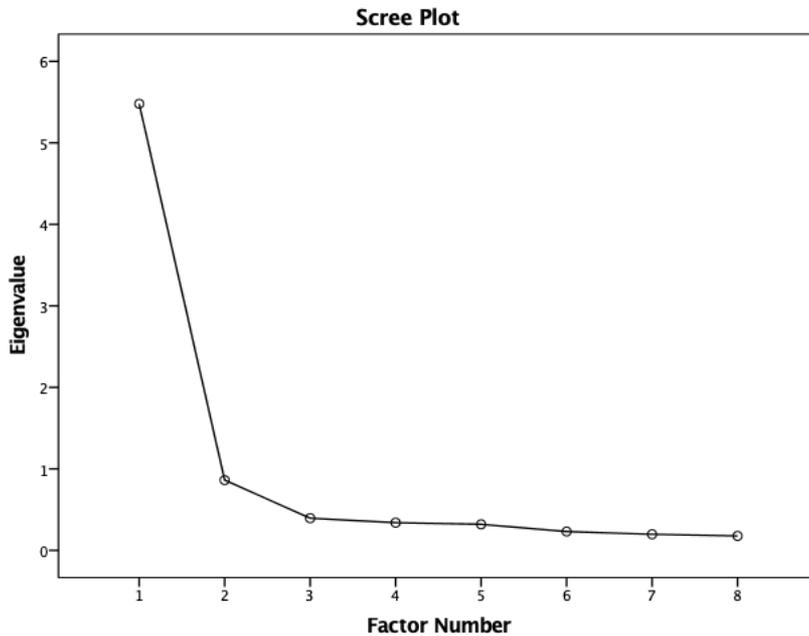
### *The first languages*

Assumptions for EFA include absence of multicollinearity, adequate sample size, and factorability in the data (Field, 2018). According to Yong and Pearce (2013), absence of multicollinearity is indicated by a determinant score above 0.00001; adequate sample size is reflected by the Kaiser-Meyer-Olkin (KMO) value falling between 0.8 and 1; and a significant result in the Bartlett's Test for Sphericity indicates factorability of the data. All assumptions were met for the L1 Mandarin inner speech scale (Table 1). Using principal axis factoring, one factor was extracted. The examination of the scree plot confirmed that there is only one factor in the L1 Mandarin inner speech scale (Figure 1). An average of L1 Mandarin inner speech was calculated from the sum of the eight items; and the mean frequency of use in inner speech is 3.93 ( $SD = 0.884$ ) (Cronbach's  $\alpha = 0.931$ ).

Table 1. Assumptions for EFA.

	Determinant score	KMO value	Bartlett's test for sphericity
L1 Mandarin	0.002	0.911	$p < 0.001$
L1 Chinese regional language	0.000008	0.928	$p < 0.001$
LX English	0.012	0.905	$p < 0.001$

Figure 1. Scree plot for the L1 Mandarin inner speech scale.



For the L1 Chinese regional language inner speech scale, the assumption of multicollinearity was violated (Table 1). The results using principal axis factoring extracted one factor from the L1 Chinese regional language inner speech scale. This is supported by examining the scree plot (Figure 2). A scale of L1 Chinese regional language inner speech was then created by taking the average of the sum of the eight-item scale. The mean frequency of L1 Chinese regional language use in inner speech is 2.14 (SD = 1.193) (Cronbach's alpha = 0.972).

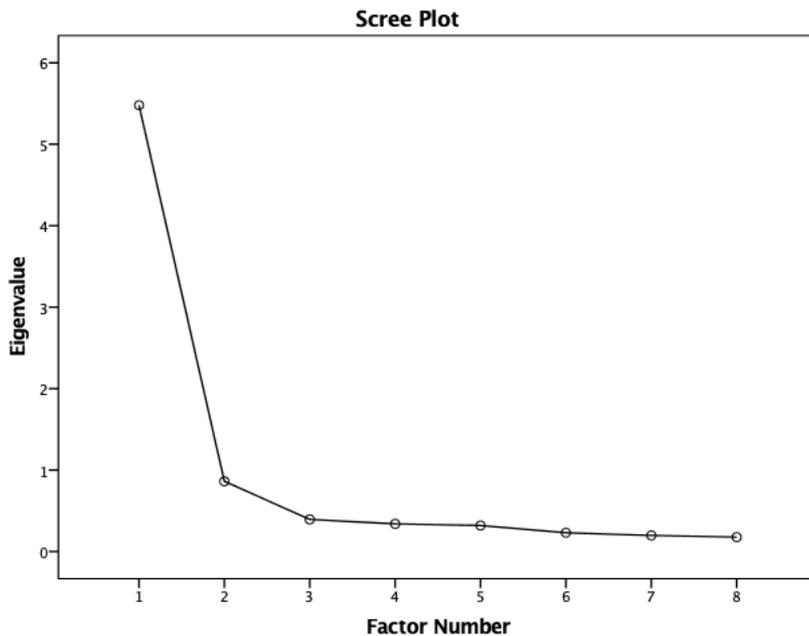


Figure 2. Scree plot for the L1 Chinese regional language inner speech scale.

**LX English**

Assumptions for factor analysis were met (Table 1). Principal axis factoring and Promax with Kaiser normalization rotation was conducted, and two factors were extracted. The scree plot shows that there are two components of eigenvalue above 1 (Figure 3), confirming that there are two factors in the LX English inner speech scale. As shown in Table 2, general inner speech (factor 1) consists of six items and academic inner speech (factor 2) consists of two items. However, factors with two or less variables could only be accepted when the two variables are highly correlated ( $r > 0.70$ ) and are uncorrelated with other variables ( $r < 0.30$ ) (Yong & Pearce, 2013). Upon examination of the correlation matrix (Appendix B), the two items in academic inner speech, essays and reading, and lectures are highly correlated ( $r = 0.787, p < 0.001$ ); and they are uncorrelated with other variables (highest  $r = 0.493$ ; lowest  $r = 0.303, p < 0.001$ ). Therefore, academic inner speech is accepted as a separate factor.

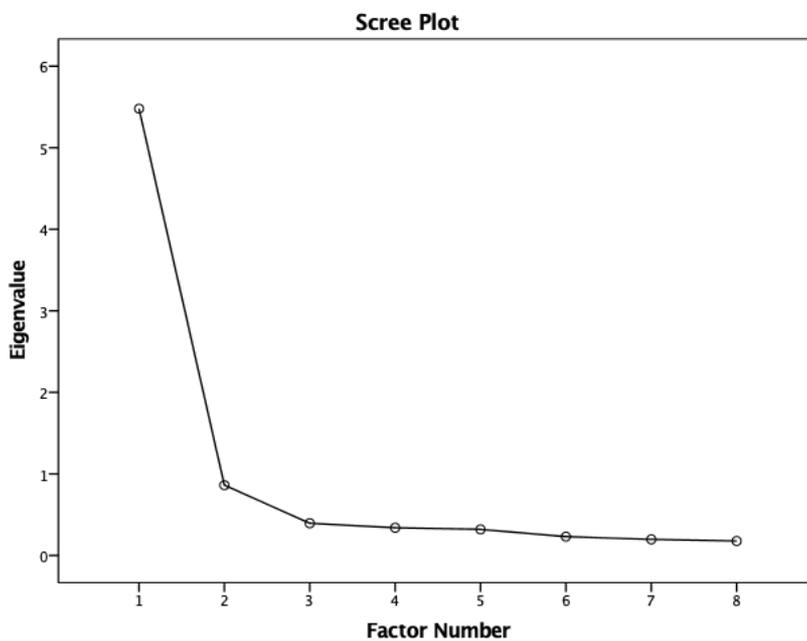


Figure 3. Scree plot for the LX English inner speech scale.

Table 2. Factor loading of the LX English inner speech scale

Factor	Item	Factor		Cronbach's alpha
		1	2	
English general inner speech	Reminder	0.816		0.887
	Encouragement	0.727		
	Planning	0.774		
	Problem solving	0.826		
	Casual topics	0.724		
	Calming down	0.660		
English academic inner speech	Essays		0.960	0.881
	Reading and lectures		0.815	

Extraction method: principal axis factoring, Rotation: Promax with Kaiser normalization, two factors extracted.

Subsequently, CFA was conducted to establish factorial validity of this two-factor model (Figure 4). According to Hooper et al. (2008), CFA model fit is indicated by an insignificant Chi-square, Comparative Fit Index (CFI) greater than or equals to ( $\geq$ ) 0.95, Tucker-Lewis Index (TLI) greater than or equals to ( $\geq$ ) 0.95, Root Mean Square Error

of Approximation (RMSEA) smaller than ( $<$ ) 0.08, and Standard Root Mean Square Residual (SRMR) smaller than ( $<$ ) 0.08. In this model, the Chi-square was significant,  $X^2(19) = 70.974$ ;  $p < 0.001$ , which indicated that the model did not fit. However, other fit statistics suggested an adequate fit. The RMSEA is close to the cut-off value (RMSEA = 0.082) and the SRMR is below cut-off value (SRMR = 0.033). In addition, Comparative Fit Index (CFI = 0.971) and Tucker-Lewis Index (TLI = 0.957) are both above cut-off of 0.95. Therefore, the model overall suggests an acceptable fit.

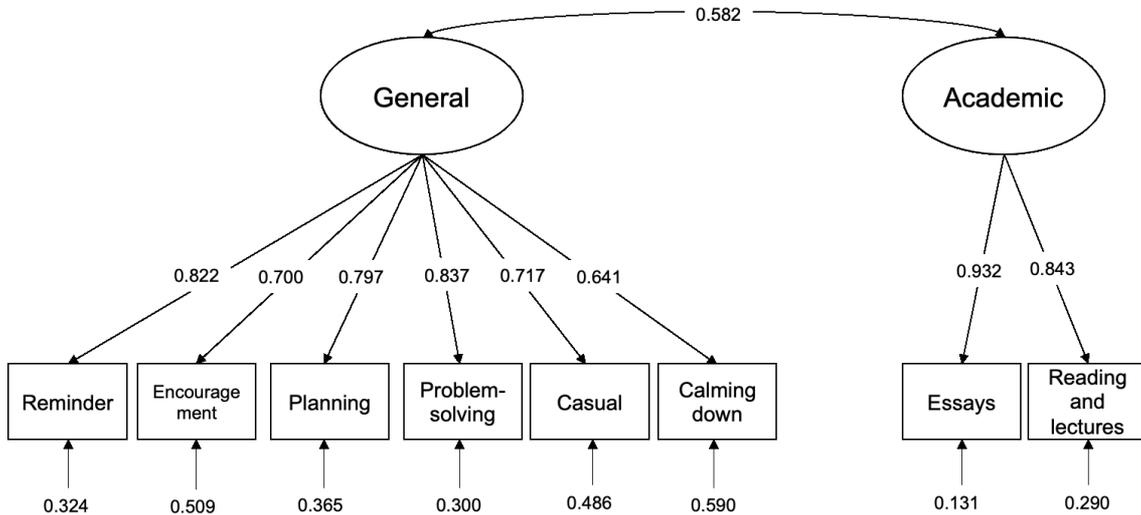


Figure 4. Path diagram.

The English general inner speech scale and the English academic inner speech scale were created by taking the average of the sum of the two scales. The mean frequency of use of English general inner speech and English academic inner speech is 2.24 ( $SD = 0.803$ ) and 3.42 ( $SD = 1.020$ ) respectively.

Shapiro-Wilk tests were conducted and revealed no normal distribution in the L1 Mandarin inner speech scale, the L1 Chinese regional language inner speech scale, the LX English general inner speech scale, and the LX English academic inner speech scale (all  $p < 0.001$ ). Therefore, Friedman’s ANOVA, the non-parametric alternative to one-way ANOVA with repeated measures, was run to assess the distribution of the four inner speech scales. The results showed a significant difference between the frequency of the four languages in inner speech,  $\chi^2(3) = 327.820$ ,  $p < 0.001$ . L1 Mandarin was the most frequently used language in inner speech (mean rank = 3.53), followed by English in the academic domain (mean rank = 3.01), English in the general domain (mean rank = 1.89), and lastly L1 Chinese regional language (mean rank = 1.57). Pairwise comparison showed significant differences between all pairings except for the pair of L1 Chinese regional language inner speech and English general inner speech (Table 3). The significant differences between L1 Mandarin and English academic domain, English general domain, and L1 Chinese regional language suggest that Mandarin is the preferred language for inner speech. A statistically significant difference was also found between LX English academic domain and L1 Mandarin, LX English general domain, L1 Chinese regional language. In other words, English in the academic domain is the second most frequently used language in inner speech (Figure 5).

Table 3. Dunn’s pairwise post-hoc tests

	Test statistics	Std. error	Std. test statistics	Sig.	Adj. sig.
L1 Regional language – LX English general	-0.311	0.129	-2.415	0.016	0.095
L1 Regional language – LX English	-1.438	0.129	-11.165	< 0.001	< 0.001

academic

L1 Regional language – L1 Mandarin	1.953	0.129	15.164	< 0.001	< 0.001
LX English general – LX English academic	1.127	0.129	8.750	< 0.001	< 0.001
LX English general – L1 Mandarin	1.642	0.129	12.749	< 0.001	< 0.001
LX English academic – L1 Mandarin	0.515	0.129	3.999	< 0.001	< 0.001

Asymptotic significances (2-sided tests) are displayed. The significance level is 0.05. Significance values have been adjusted by the Bonferroni correction for multiple tests.

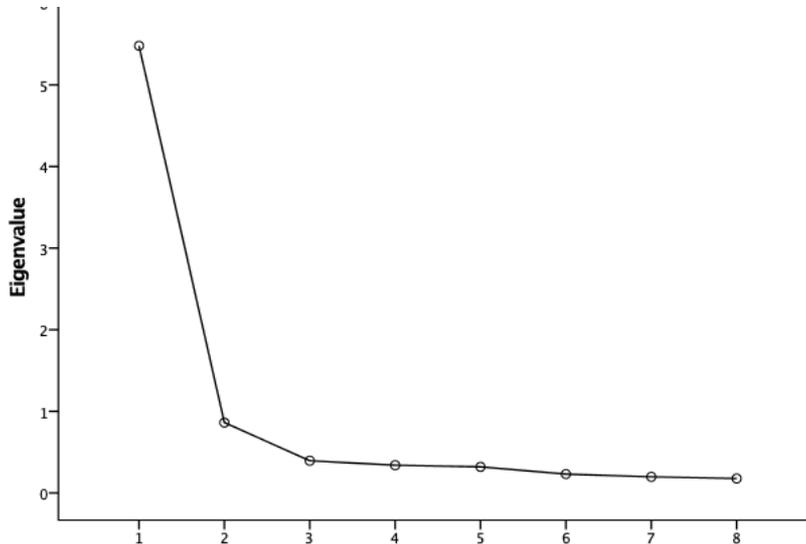


Figure 5. Mean rank of frequency of languages used in inner speech.

The second research question focused on language socialization and frequency of use of LX English inner speech. Language socialization included the measurement of frequency of general use, sociocultural adaptation, previous study abroad, and their length of stay. Correlation analyses revealed significant relationships between general inner speech and academic inner speech and the frequency of general use, sociocultural adaptation, but no significant correlation was found between general inner speech, academic inner speech and length of stay (Table 4).

Table 4. Correlation matrix for English general inner speech, English academic inner speech and independent variables

		FoU	SCAS	Length of stay
English general inner speech	Spearman's rho	0.501**	0.271**	0.087
	N	351	396	78
English academic inner speech	Spearman's rho	0.380**	0.334**	0.214
	N	360	404	81

FoU: Frequency of general use, SCAS: Sociocultural adaptation scale

\*\* Correlation is significant at the 0.001 level (2-tailed)

Two multiple regressions were carried out to investigate whether the independent variables could significantly predict the frequency of English use in general inner speech and academic inner speech. The results of general inner speech showed that frequency of general use and having previously studied abroad explained 27.8% of the variance ( $R^2 = 0.278$ ) and that the model was significant,  $F(3, 337) = 43.202, p < 0.001$  (Table 5). Frequency of general use ( $\beta = 0.465, p < 0.001$ ), and previous study abroad ( $\beta = 0.126, p = 0.008$ ) are the only two significant predictors in the model. Sociocultural adaptation failed to explain unique variance. Upon examination of Q-Q plot of residuals (Figure 6), a normal distribution was observed. Scatterplot of standardized residuals against standardized predicted values showed that most standardized residuals were within the +/- 3 range and no funnel shaped was observed (Figure 7). It suggested the

homoscedasticity assumption was met. There was no collinearity in the model (Table 5).

Table 5. Multiple regression analysis on English general inner speech and language socialization

Model	R	R square	Std. error	F	Sig. F	Durbin-Watson
H <sub>1</sub>	0.527	0.278	0.692	43.202	< 0.001	2.091

Model		Unstandardized coefficients B	Std. error	Standardized coefficients β	t	p	Collinearity diagnostics (VIF)
H <sub>1</sub>	(Intercept)	-0.069	0.237		-0.293	0.770	
	FoU	0.666	0.073	0.465	9.092	< 0.001	1.223
	PSA	0.247	0.093	0.126	2.656	0.008	1.047
	SCAS	0.069	0.057	0.055	1.067	0.287	1.242

FoU: Frequency of general use, SCAS: Sociocultural adaptation scale; PSA: Previous study abroad

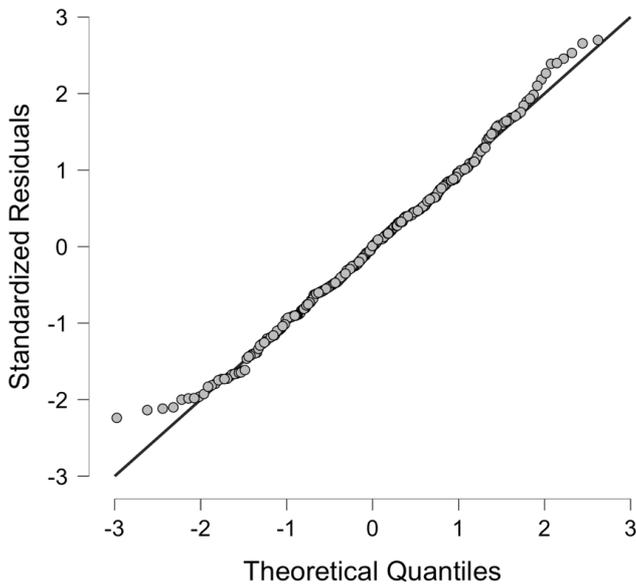


Figure 6. Q-Q plot of standardized residuals (English general inner speech).

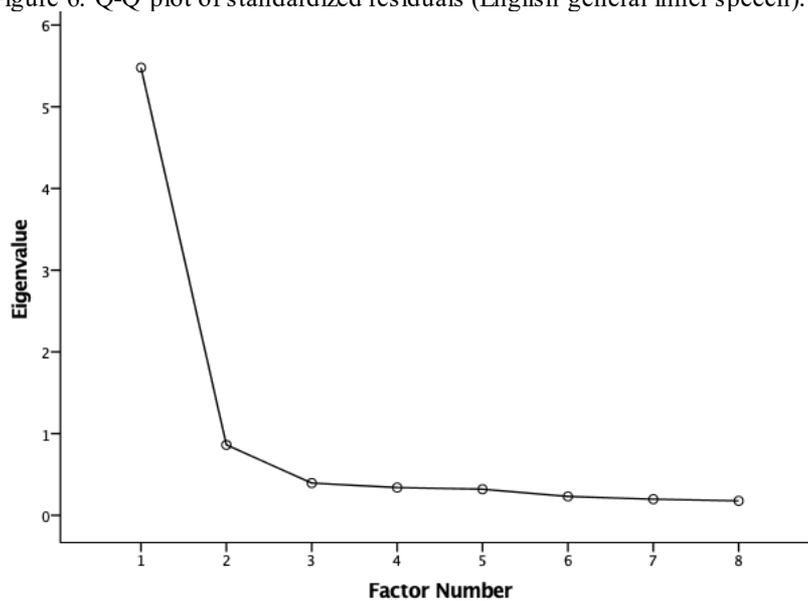


Figure 7. Scatterplot of standardized residuals against standardized predicted values (English general inner speech).

The results of academic inner speech showed that frequency of general use, having previously studied abroad, and sociocultural adaptation explained 19.9% of the variance ( $R^2 = 0.199$ ), and that the model was significant,  $F(3, 344) = 28.609$ ,  $p < 0.001$  (Table 6). Frequency of general use ( $\beta = 0.288$ ,  $p < 0.001$ ), having previously studied abroad ( $\beta = 0.106$ ,  $p = 0.033$ ), and sociocultural adaptation ( $\beta = 0.199$ ,  $p < 0.001$ ) are significant predictors to the model. Q-Q plot of residuals (Figure 8) suggested a normal distribution of the residuals in the academic inner speech model; heteroscedasticity was not observed (Figure 9); and no collinearity was observed (Table 6).

Table 6. Multiple regression analysis on English academic inner speech and language socialization.

Model	R	R square	Std. error	F	Sig. F	Durbin-Watson
H <sub>2</sub>	0.447	0.200	0.909	28.609	< 0.001	1.985

Model	Unstandardized coefficients B	Standard error	Standardized coefficients $\beta$	t	p	Collinearity diagnostics (VIF)
H <sub>2</sub>	(Intercept)	0.836	0.306	2.734	0.007	
	FoU	0.507	0.094	5.379	< 0.001	1.229
	PSA	0.257	0.120	2.137	0.033	1.047
	SCAS	0.273	0.074	3.699	< 0.001	1.240

FoU: Frequency of general use, SCAS: Sociocultural adaptation scale; PSA: Previous study abroad

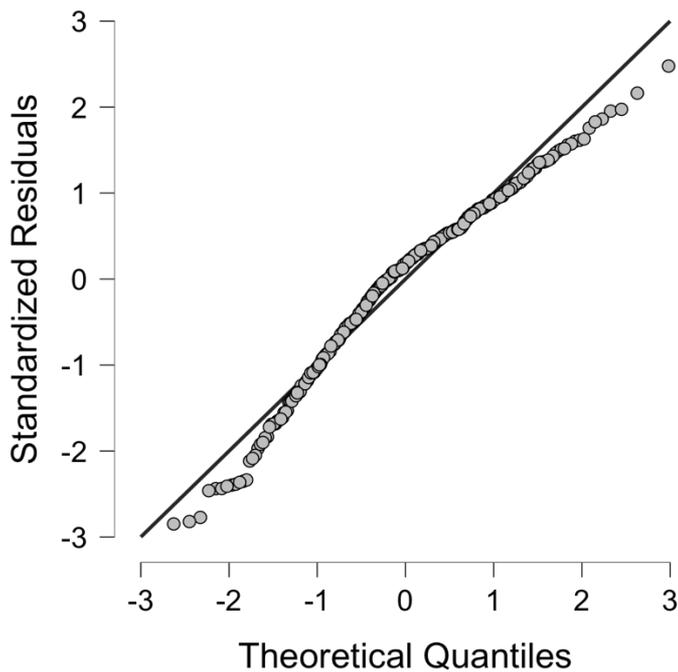


Figure 8. Q-Q plot of standardized residuals (English academic inner speech).

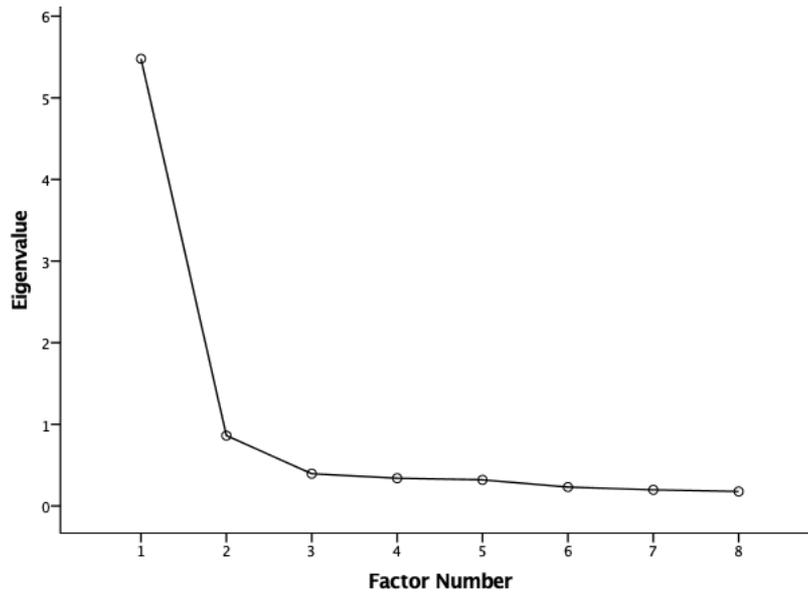


Figure 9. Scatter plot of standardized residuals against standardized predicted values (English academic inner speech).

### *Qualitative findings*

The two open questions gathered a total of 118 comments about using LX English in inner speech. Using thematic analysis (Braun & Clarke, 2006), we identified six main themes as shown in Table 7.

Table 7. Thematic analysis on LX English inner speech.

Themes	Freq.	Subthemes	Freq.
Emotional and private matters	34	Self-encouragement	13
		Swearing	11
		Calming oneself down	6
		Expressing intense emotions, e.g. love, anxiety	3
		Prayer	1
On everyday matters	32	Cognitive functions, e.g. making decision, planning, solving a problem	18
		About everyday topics, e.g. food, TV, commenting on the surroundings	14
Mental rehearsal	17	Practicing what to say in social interactions	11
		Rehearsing a presentation	6
On academic matters	16	In academic discussion, e.g. in class, with tutor	9
		Academic discipline specific words	7
About the self	13	Self-reflection	8
		Commenting on oneself	5
Reading aloud	6	In academic writing	4
		In leisure reading	2
Total	118		

Since participants were studying in the UK, English inner speech related to their studies was a recurring theme. Extracts with an asterisk (\*) were originally written in Chinese and have been translated into English.

Using English to think about things related to my course. \*  
(ID86, female, postgraduate)

When talking or thinking [about] things related to academic knowledge [I] always use English.  
(ID94, male, postgraduate)

As participants spent time living in the UK, some were aware of their English inner speech expanding outside the academic domain to the general domain.

I grew up in an EMI secondary school and university, particularly the English department, and then I worked in institutions where English is the working language. Therefore, I have always been talking to myself in English in my inner speech. But probably, after I've moved to the UK, my inner speech in English spread to aspects that are more related to the 'everyday life', such as thinking about how to talk to the plumber, the police, security and maintenance issues at the accommodation, etc.  
(ID29, female, PhD)

Multiple reasons were mentioned for the increased frequency of English inner speech, acculturation and LX socialization. Some participants felt an improvement in their English proficiency as a result of studying abroad. As participants' English proficiency increases, so does their confidence in using English and socio-pragmatic competence, e.g. in understanding slangs.

As my English improve[s] the use of English in my inner speech also increase[s]. Sometimes I'll use English vocabulary but linked with Cantonese ph[r]ases.  
(ID37, male, PhD)

I become more confident when speaking in English as I have studied in an English-speaking country. I am able to catch their slangs and understand more what those slangs mean.  
(ID20, female, undergraduate)

Frequency of use in daily life is another reason for the increased frequency of use in English inner speech, especially when English was used to socialize with friends or in shared accommodation.

After I lived with some English speakers for a long time, I felt that my inner speech has changed to English. After that, to think in Chinese feels complicated. \*  
(ID233, male, undergraduate)

I realize if I do not practice my English often, my inner speech remains in my mother tongue and I find it more difficult to communicate with my friends... \*  
(ID102, gender not disclosed, undergraduate)

## Discussion

The first research question focused on the frequency and domains of use of English LX and Chinese L1(s) in inner speech. A different configuration emerged for inner speech in the L1s and LX English. Exploratory factor analysis revealed two domains for English inner speech, academic and general, which was verified in confirmatory factor analysis. The same analyses yielded only a single factor in the L1s which implies no difference in pattern of use between the eight items in the inner speech scales. Two domains were identified for LX inner speech indicating that there is a distinct difference

in frequency of use in English LX inner speech between the general domain and academic domain. English academic inner speech was used significantly more frequently than English general inner speech.

Our participants used L1 Mandarin most frequently for inner speech, followed by English in the academic domain, English in the general domain, and lastly L1 Chinese regional language. The result of the L1 being the preferred language in inner speech is consistent with previous studies (e.g. Dewaele, 2015; Resnik, 2021). English was used more frequently for the academic domain than the general domain (cf. a typical illustration of the CP, Grosjean, 2012). As one of the participants, ID29, pointed out, English academic inner speech had already developed prior coming to the UK because of her English-medium education background. Indeed, participants were proficient in English and had developed a habit of using English in the academic domain. Their arrival in the UK may have further accelerated the use of English academic inner speech. For participants who had not gone through English-medium education, they would have acquired the academic content knowledge in the L1 and had translated and developed it in English. The increased English use in academic inner speech can be explained by the higher amount of input and output in that language and the participants' increasing familiarity with the academic language.

English general inner speech ranked third in frequency of use in inner speech. This is linked to socialization in the UK which requires the use of English outside the academic context, e.g. socializing with British or other international students. The increased opportunity in affective language use is linked to increased frequency of use in general inner speech (c.f. Dewaele, 2015; Hammer, 2017b).

Pairwise comparisons on frequency of use showed that English academic inner speech was used significantly more frequently than English general inner speech. It shows that English penetrated participants' inner speech preferences through the academic domain but that they had, on average, not been in the UK long enough for English to have taken over the general domain. The findings thus confirm the Complementarity Principle for inner speech: language preferences differ between discourse domains.

L1 Chinese regional language ranked last in frequency of use in inner speech. Jiang and Dewaele (2019) found lower frequency of use of L1 regional language in articulated speech compared to L1 Mandarin in a sample of Chinese university students residing in China. Moving to the UK may further limit the use of the regional languages as participants had fewer potential interlocutors to use the language with. This may have resulted in increased use of L1 Mandarin for both articulated and inner speech and a decrease in the use of the L1 regional language.

The second research question aimed to examine the relationship between LX socialization and language preference in inner speech. By moving to the UK for study, participants found themselves in a new cultural and linguistic environment which required rapid linguistic adjustment to cope with day-to-day social interactions. This was confirmed in the qualitative data that illustrated a gradual expansion of English inner speech from the academic to the general domain. A thematic analysis showed that English LX was used most frequently for emotional and private matters, followed closely by everyday matters. This finding is surprising as it deviates from the finding in Dewaele (2015) that the LX is preferred for inner speech about non-emotional issues and that it takes time for the LX to be used more frequently for emotional inner speech. The findings offer support for Grosjean's Complementarity Principle in the domain of inner speech. Indeed, the LX does not spread evenly across domains or even topics for inner speech. As our participants were students, it is not surprising that English emerged in academic inner speech before appearing in general inner speech. The qualitative data

did suggest that the speed with which this happened, and the domains and sub-domains which it covered varied between individuals.

Frequency of general use is the most significant predictor for frequency of English general inner speech and English academic inner speech. It implies that the more English is used in articulated speech, the more it is used in inner speech. The relationship between frequency of general use and frequency of LX inner speech confirms earlier studies (Dewaele, 2015; Resnik, 2021).

Sociocultural adaptation is found to be a significant predictor for frequency of English academic inner speech only. Sociocultural adaptation is correlated with frequency of English general inner speech but is not a significant predictor in the multiple regression. It implies that more frequent use of English academic inner speech is linked to a higher level of sociocultural adaptation, i.e. an increased ability to function in a new environment. A possible interpretation of this result is that participants reside in the UK to study, therefore, adaptation to the new environment may refer chiefly to the university environment. The more profound effect of sociocultural adaptation on English academic inner speech compared to English general inner speech further suggests academic inner speech as the “entrance” of English in inner speech for international students, while it takes longer time for English inner speech to penetrate to the general domain.

The analyses also revealed that previous study abroad is a significant predictor for frequency of English general and academic inner speech. This binary variable implies that those having previously studied abroad use English in general inner speech and academic inner speech more frequently than those who had not. This suggests that participants who had previously studied abroad may already have reached an acculturation threshold that allowed their English inner speech to blossom more rapidly in the UK (Hammer, 2017a, 2018). However, length of stay did not correlate to the frequency of use of English in general inner speech and academic inner speech. A similar lack of relationship was reported in Hammer (2017a) where length of residence was not linked to frequency of LX inner speech, possibly because the process of language internalization lies in the social experience during the stay rather than merely the amount of time spent in the LX environment.

One limitation of the current study is that we can only conclude that study abroad facilitates LX internalization, but no conclusion can be reached on the specific effect of length of residence which would require a longitudinal design.

## **Conclusion**

This study showed that full immersion in an English context affected the language preference for inner speech of 425 multilingual Chinese university students. The use of an eight-item scale to cover two different discourse domains for inner speech allowed us to draw an accurate picture of the language preference across domains. Factor analysis revealed a single dimension for L1 Mandarin and L1 Chinese regional language but two separate dimensions for LX English, namely academic inner speech and general inner speech. L1 Mandarin remained the preferred language for inner speech, followed by LX English academic inner speech, which had probably started developing before arriving in the UK, then LX English general inner speech, which emerged at the beginning of the participants’ stay in the UK, and lastly L1 Chinese regional languages. Frequency of use of English academic inner speech was found to be linked to higher levels of LX socialization, namely frequent use of English in daily life, a higher level of sociocultural adaptation, and having had previous immersion. However, sociocultural adaptation had no effect on the frequency of general English inner speech. Analysis of participants’

words suggested that LX socialization contributes to increased use of the LX for inner speech from the early stages of the stay in the UK.

To conclude, the findings suggest that Grosjean's (2012) Complementarity Principle applies as much to the inner speech as it does to the articulated speech of multilinguals.

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## Appendix A Inner speech scale

The following questions are about inner speech, which means when you talk to yourself silently. In any question if you encounter difficulty, try speaking to yourself silently according to the situation of the question, and then report on the language you experienced.

I talk to myself silently in my L1a / L1b / English when I...

	(Not at all)				(All the time)
a. Remind myself to do something	1	2	3	4	5
b. Encourage myself when I face difficulties	1	2	3	4	5
c. Plan for the day	1	2	3	4	5
d. Think about how to solve a problem	1	2	3	4	5
e. Think about casual topics, e.g. hobby, entertainment, food, what to wear	1	2	3	4	5
f. Think about my essays	1	2	3	4	5
g. Think about what I learnt from a course reading / in a lecture	1	2	3	4	5
h. Calm myself when I am nervous	1	2	3	4	5

**Appendix B Correlations between items in the inner speech scale**

		Reminder	Encouragement	Planning	Problem solving	Casual	Essays	Reading and lecture
Reminder	<i>r</i>	1						
	Sig. (2-tailed)							
	N	417						
Encouragement	<i>r</i>	0.606**	1					
	Sig. (2-tailed)	< .001						
	N	417	421					
Planning	<i>r</i>	0.702**	0.507**	1				
	Sig. (2-tailed)	< .001	< .001					
	N	415	419	419				
Problem solving	<i>r</i>	0.678**	0.567**	0.667**	1			
	Sig. (2-tailed)	< .001	< .001	< .001				
	N	413	417	416	419			
Casual	<i>r</i>	0.543**	0.527**	0.569**	0.618**	1		
	Sig. (2-tailed)	< .001	< .001	< .001	< .001			
	N	415	418	417	415	418		
Essays	<i>r</i>	0.438**	0.303**	0.471**	0.493**	0.377**	1	
	Sig. (2-tailed)	< .001	< .001	< .001	< .001	< .001		
	N	417	421	419	419	418	424	
Reading and lecture	<i>r</i>	0.382**	0.337**	0.383**	0.455**	0.341**	0.787**	1
	Sig. (2-tailed)	< .001	< .001	< .001	< .001	< .001	< .001	
	N	415	419	417	415	416	420	420
Calming down	<i>r</i>	0.505**	0.556**	0.447**	0.513**	0.484**	0.351**	0.299**
	Sig. (2-tailed)	< .001	< .001	< .001	< .001	< .001	< .001	< .001
	N	414	417	416	414	416	417	415

\*\* Correlation is significant at the 0.01 level (2-tailed)