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L1 + L2 to the power of culture: Acculturation and language use for cognitive domains in bilinguals.

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Abstract

This paper investigates the extent of second language (L2) use in four cognitive domains including mental calculation, planning (action plans), note-taking, and shopping lists. Participants include 149 highly educated L2-competent sequential Polish-English bilinguals who relocated to the UK* in early adulthood, and underwent processes of acculturation. The independent variables in this study include acculturation level, social network profile, predicted future domicile and length of residence. The study employed both quantitative and qualitative approaches. Participants completed an online questionnaire and were interviewed by the researcher. The study included the Complementarity Principle (CP) into the operationalisation and measurement of language use in bilinguals (Grosjean, 2010). The results show that acculturation level, social network profile and predicted future domicile are strong predictors of the extent of L2 use in cognitive domains. Effects of context-specificity and language-dependence were also found, the latter specifically in the domain of mental calculation.

* 12 out of the 149 participants were residing outside the UK (Republic of Ireland, USA, Canada, Australia).

Keywords: Acculturation, bilinguals, calculation, cognition, domains, L2 use, social network.

Introduction

Cognitive function of language is defined as verbalisation of analytical processes in which language is seen as a medium of inter-modular integration, in other words, a link between different areas of mind which perform different cognitive tasks (Carruthers, 2003). Processes of verbalisation are said to occur in conscious thinking activity, however, researchers seem to vary with regards to whether or not language is intrinsically involved in the structure of cognitive representation, or whether it serves only as a link between the elements of cognitive structure (Carruthers, 2003; Fodor, 1983). Bilingualism research provides evidence that language takes part in the processes of sculpturing the cognitive structure, and that it helps to build the network of knowledge in the mind (Bowerman & Levinson, 2001; Cook & Bassetti, 2011; Dewaele, 2007; Grosjean & Ping Li, 2013; Nelson, 1996; Pavlenko, 2014). Vygotsky (1986) viewed language as a cognitive scaffold for knowledge to be acquired, stored, accessed and modified; and a necessary condition to acquire further cognitive skills. Language is therefore an integral part of almost every kind of cognitive process including perception, conceptual thinking, reasoning, mental calculation, as well as domains of planning, problem solving and memorisation (Lewis, 1969). According to the Complementarity Principle proposed by Grosjean (1997, 2010, 2016) bilingual language use tends to be domain-specific, which is reflected in the selection of specific languages for particular purposes. Bilinguals may have different linguistic habits depending on the domain they operate in (Cooper, 1971; Hoffman, 1971). Some domains within the cognitive function of language tend to be more language-dependent than others, for example retrieving sequences of numbers and letters from memory, such as post codes, telephone numbers or passwords. The situation becomes even more prominent in case of sequential bilinguals, in situations of mobility-migration, where the L2 user changes the context of language use from L1- to L2-dominant. In her latest book, Pavlenko (2014, p. 101) reveals: “in my own case, the

number of my old apartment in Kiev may pop out in Russian, while my social security number comes out in English". Similar experiences were reported by American psychologist Spelke who "could readily provide American friends with her summer address in France but not with her telephone number. Retrieving the number required that she say it in (non-native) French, visualize the numerals, and then mentally read them off in English." (Spelke & Tsivkin, 2001, p. 69). Cook (2002) argues that the mind of an L2 user differs from that of a monolingual speaker, due to the development of multi-competence, which is not equivalent to the sum of two mono-competences. The latter links with Grosjean's (1989) assertion that a bilingual speaker is not a sum of two monolinguals in one. Knowledge of more than one language in one mind, and the development of multi-competence, is said to alter the mind of the bilingual speaker, and affect their cognitive representations (Cook, 2002; Cook & Bassetti, 2011). It can also impact ways in which knowledge is accessed and categorised, as the two languages can be found to interact and/or intertwine (Dewaele & Pavlenko, 2003; Jarvis & Pavlenko, 2008). Researchers have called for more studies to investigate how bilingual speakers process cognitive information, and what languages they use in that process (Cook & Bassetti, 2011; Dewaele, 2007; Pavlenko, 2014). This paper aims to address those calls by undertaking a comparative investigation of the extent of L2 use in cognitive domains, and analysing it against acculturation level, social network profile, length of residence in the L2-context, and predicted future domicile.

Literature review

Bilingual language use and cognitive domains

Research shows that in case of bilinguals, some domains of life may be covered by one language, others by the other language, while some domains may be covered by both languages (Grosjean, 2010; Schrauf, 2002). Multiple, large-sale studies revealed that people

who speak more than one language tend to have linguistic preferences when operating in different domains of life, or when communicating different types of content (Dewaele, 2004a, 2006, 2010). L2 dominant bilinguals were also found to occasionally revert to L1 in cases of translation non-equivalence, where L1-specific terms lack exact translation equivalents in the L2 (Pavlenko, 2014). According to the CP, bilinguals use their languages for different purposes, in different domains and contexts of their life, and that this linguistic complementarity is crucial when analysing language use in bilinguals (Grosjean, 1997, 2010, 2016). This applies to all functions of language use, including the cognitive function. Grosjean (2010) argues that the measurement of language use in bilinguals should include the CP into the operationalisation process, in order to measure the extent of domain-specific language usage, enabling more detailed investigations. Domain-based studies provide the evidence that even dominant bilinguals may use the non-dominant languages for specific domains (Grosjean, 2015).

Carroll and Luna (2011) conducted a study focusing on accessibility of words and concepts in 30 Spanish-English bilinguals based on domain-specificity. The authors argued that the use of different languages can impact accessibility of certain concepts. Their study showed that words presented in the language which is typical for a given domain, are accessed and linked to concepts more quickly, than words in the other language. Their study supported the importance of complementarity principle and its relevance when studying language use in bilinguals (Carroll & Luna, 2011).

Chiaro (2009) investigated domain-specific language practices in 59 English-Italian bilinguals. The results showed that the majority of domains were shared between the two languages, however, particular topics and activities had high L1 scores, and these included counting (74%) and mental calculation (88%).

Empirical studies into retrieval of numerical knowledge showed that speedier and more precise recall occurs when the language of retrieval is the same as the language of encoding, or instruction, in other words, in the situation of language congruency (Marian & Fausey, 2006; Marian & Kaushanskaya, 2004; Spelke & Tsivkin, 2001). As far as accessing numerical knowledge is concerned, researchers found a significant L1 advantage in that domain (Campbell, Kanz, & Xue, 1999; Frenck-Mestre & Vaid, 1993; Marsh & Maki, 1976; Tamamaki, 1993). A similar scenario surrounds the use of number for mathematical calculation. Mental calculation involves cognitive faculties which are, to a certain degree, based on language, often on the language of instruction (Campbell & Epp, 2004). This interdependency is particularly interesting in case of bilinguals. Empirical studies found that many sequential bilinguals and multilinguals, irrespective of language dominance, tend to use L1 for mental calculation and multiplication tables (Dewaele, 2007, 2009; Pavlenko, 2014; Spelke & Tsivkin, 2001). L1 advantage was also found for number-oriented memory span (da Costa Pinto, 1991; Hoosain, 1979).

Dewaele (2007) conducted a study on 1,454 adult multilingual speakers to measure language choice for mental calculation, and analysed it against a range of sociobiographical variables, including frequency of language use and L2 socialisation. Results showed that L1 was the preferred language for mental calculation in multilinguals (Dewaele, 2007). The findings also showed that multilinguals with higher frequency of L2 use and higher levels of L2 socialisation were more likely to use the target language for some elements of mental calculation. Readiness to use the target language for mental calculation proved to depend on the type and complexity of the mathematical task in hand. His finding coincided with that of Planas and Setati (2009).

Planas and Setati (2009) studied 24 immigrant South American native Spanish learners of mathematics in Catalan schools, with Catalan as the language of instruction. They

measured how Spanish dominant learners of mathematics engaged their two languages in the learning process. They found that shifts in language use (from L1 to L2 and vice versa) coincided with shifts in the complexity of the task. Participants were found to use their two languages for different purposes, according to the nature of the task. New mathematical concepts introduced in Catalan would promote activation of the participants' target language, while analytical reasoning and the actual process of "solving the task" would promote a shift to L1 Spanish (Planas & Setati, 2009, p. 49). L1 advantage in the domain of mental calculation is associated with language specific character of the initial arithmetic instruction, which results in a more efficient retrieval and shorter processing time (Dehaene, 2011; Dewaele, 2007; Epstein, 1915). Nevertheless, Pavlenko (2014) points out that language dominance also plays a significant role as far as language choice in this domain is concerned.

Dewaele (2004b) found a significant link between self-reported language dominance and language use for mental calculation. L1-dominant participants were found to be much more likely to use L1 for mental calculation, than L2-dominant participants, or those whose self-reported language dominance was balanced between the two languages (Dewaele, 2004b). This coincides with later findings by Dewaele (2007) which showed that higher levels of L2 socialisation and higher frequency of L2 use are linked with lower levels of L1 use for the domain of mental calculation.

Findings by Vaid and Menon (2000), as well as Tamamaki (1993), show that L1 preference for mental calculation decreases proportionally to the length of residence in the L2-speaking context. Vaid and Menon (2000) concluded that length of residence in the L2-dominant context (over six years), and high self-reported proficiency, lower the likelihood of L1 use for the domain of mental calculation. Greater length of residence in the host country is said to be linked with more extensive use of L2 in general, which can affect language dominance (Magiste, 1979). Greater length of residence has also been linked to processes of

cognitive restructuring in bilinguals, and a gradual act of "re-naming the world" (Pavlenko, 2011, p. 199).

The studies presented above suggest that the number-based domain of mental calculation tends to be L1-dependent. Other domains belonging to the cognitive function of language may be less language dependent, and more context- or even location-specific (Grosjean, 2010). Language dependent domains will therefore be less prone to changes in language use even when the context changes from L1- to L2-speaking. Context-specific domains, in contrast, will be more prone to changes in language use, and the direction of the change will be guided by the context. Grosjean (2010) points out that if one language is dominant in a given domain, language choice for that domain is usually the language of its practice, however, an instance of writing out a shopping list may be determined by the local language of the group where the speaker is at the time of creating the list, in other words, context-specific activation.

Cognitive aspects of acculturation

Acculturation is defined as a "process of cultural and psychological change" (Berry, 2005, p. 698). The acculturative process is initiated at the point of migration and it is said to comprise sociocultural, psychological, and cognitive aspects (Schrauf, 2002; Schumann, 1986). Voluntary migration is associated with higher levels of motivation when it comes to target language acquisition, use, and possibly further processes of L2 internalisation and language shift (Esser, 2006). Acculturation involves changes in the behavioural repertoire of the individual, which usually includes learning and extensive use of the target language, adoption of new communication styles, and other forms of sociocultural and psychological adjustment. Socialisation with members of the host culture is considered to be a strong component of the

acculturation process, and L2-oriented social networks have been linked with increased rates of integration and sociocultural adaptation (Chiswick & Miller, 2005; Singleton, Regan, & Debaene, 2013; Stoessel, 2002). Language use is considered to be one of the fundamental elements of the acculturation process (Acton & Walker de Felix, 1986). Acculturation is a complex process which combines psychological, cognitive, linguistic and social aspects (Ryder, Alden, & Paulhus, 2000; Sam & Berry, 2006; Schwartz, Unger, Zamboanga, & Szapocznik, 2010).

According to the Cognitive Theory of Acculturation, acculturation does not happen across all domains of life at the same time, but it progresses domain by domain (Schrauf, 2002). Gradual character of the acculturation processes is said to break down the overall cognitive effort required, into manageable chunks in order to avoid a cognitive overload. Schrauf (2002, p. 101) asserts that "language shifts in experiential domains provide the clues to patterns of acculturation". He also claims that some domains are more prone to language shift than others, and that it is often the level of need that dictates the development of L2 linguistic competence in a given domain (Schrauf, 2002).

Schrauf (2009), in his study of 60 older Spanish-English Puerto Rican bilinguals, investigated language use in social and private domains, where the latter included cognitive domains of writing notes to oneself, and counting. Results showed that lower proficiency levels in L2 positively correlated with lower levels of acculturation, which was reflected in language use. Higher proficiency groups were reported to use English significantly more frequently across different domains when compared with low proficiency groups. Schrauf (2009) concluded that acculturation is reflected in domain-specific language use, and that higher levels of L2 use are associated with higher levels of acculturation and L2 proficiency. Significant links between L2 proficiency and acculturation were also found by Hammer and Dewaele (2015).

Empirical research provided evidence for the effects of L2 socialisation on patterns of language use, as well as cognitive restructuring. L2 socialisation drives processes of cognitive restructuring, facilitates internalisation of translation non-equivalents, and aids lexicalisation of emotions in sequential bilinguals (Pavlenko & Driagina, 2007). The latter may result in a gradual loss of a discourse accent in L2, which stems from the existence of L1-oriented cognitive concepts, and leads to the development of new, L2-oriented concepts in the cognitive structure of the bilingual speaker (Pavlenko, 2011). Changes in L2 use and cognitive restructuring is associated with significant periods of L2 immersion, for example following migration (Grosjean, 2002, 2010).

Predicted future domicile has been linked with either integrative or instrumental motivation to acquire and use the L2 (Gardner & Lambert, 1972; Schumann, 1976). Permanent domicile in the host country is associated with integrative type of motivation, for the L2 users see themselves belong to the new sociocultural reality in the long run. This is in opposition to instrumental motivation, more typical of sojourners, where the L2 users treat their stay in the L2-speaking country as temporary (Bochner, 2006). Domicile of a finite nature is said to have an influence on how sojourners acculturate to the host society, which is viewed as a temporary arrangement. This in turn may link with other psychological as well as cognitive aspects of L2 acquisition and use, such as attitudes towards the L2-speaking community and culture, and desire to learn and use the L2 (Dörnyei & Ryan, 2015).

Methodology

Research questions

Two research questions have been formulated to investigate L2 use in cognitive domains including mental calculation, action plans, shopping lists, and note-taking:

1. To what extent do sequential bilinguals use the L2 in different cognitive domains following migration?
2. What are sources of variation?

Participants

Respondents included 149 highly educated L2-competent sequential Polish-English bilinguals who migrated to the UK at an average age of 23. Age at migration ranged from 18 to 41 years old (Mean = 23.6, SD = 3.8), and 128 participants migrated by the age of 26. The average length of residence was eight years. All respondents were professionally or academically active following migration, and the average age within the sample was 31, ranging from 23 to 45 years old (Mean = 31.1, SD = 4.7). Respondents were university/college graduates holding the following academic qualifications: MAs (58.4%), BAs (26.2%), PhDs (10.1%), and College Diplomas (5.4%). All participants were competent users of English, including 45.6% of proficient L2 users, 38.3% native-like L2 users, and 16.1% independent users of English, according to the Common European Framework of Reference for Languages (CEFR) (Council of Europe, 2011). The average age of L2 acquisition (AoA) was 12 years. The lowest AoA recorded was 3 years old (Mean = 12.3 years, SD = 4.6). Over a half of the respondents began learning English before the age of 13. Participants comprised 86% females and 14% males, which reflects a typical gender distribution in online questionnaires devoted to languages (Wilson & Dewaele, 2010).

Procedure

This study implemented both quantitative and qualitative approaches, which enabled the combination of statistical quantification with individual experience (Dewaele, 2015; Dörnyei, 2007). Participants completed an online questionnaire consisting of closed- and open-ended questions, and filled out a table of language use (Hammer, 2012). The closed-ended Likert scale questions elicited key sociocultural variables including acculturation level, social network profile, and predicted future domicile. Acculturation level scores were validated by means of correlating them with other relevant variables, including: social network profile (r_s = .454**; $p < .0001$); predicted future domicile (r_s = .279**; $p < .001$); L2 dominance (r_s =.450**; $p < .0001$), and length of residence (r_s = .264**; $p < .001$). Social network analysis adopted an anthropological approach in that the participants' personal network was investigated (Daming, Xiaomei, & Wei, 2009). Open-ended questions collected biographical information including education level, age at migration, current age, as well as the experience of a linguistic transition.

Fourteen participants were also interviewed in English as part of the study. The qualitative data were categorised according to themes which emerged from the data. The fragments quoted in this paper are illustrative examples of patterns of experience which were found particularly interesting and relevant (Smith, 2011; Straub, 2006).

Domain-specific language use data were collected using the table of language use which included the CP in the operationalisation process. The table recorded language use scores using a 5-point Likert scale including the following measures: (1) Polish, (2) Mainly Polish, (3) Equally Polish and English, (4) Mainly English, (5) English. Schrauf (2014) provided empirical validation for the use of domain-specific Likert-scale self-report in measuring language use in sequential bilinguals. The table of language use provided the total

of 20 domains, and the cognitive domains analysed in this paper include: mental calculation, planning (actions plans), shopping lists, and note-taking (Hammer, 2012). Domain of mental calculation is understood to be a language dependent domain of language use; while the remaining three domains are understood to be more context-specific (Pavlenko, 2014). Significant internal consistency reliability for language use scores across all domains in the table was provided by computing the Cronbach alpha score which equalled = .88. A series of one-sample Kolmogorov-Smirnov tests revealed that the scores for language use across all domains are not normally distributed (Kolmogorov-Smirnov Z values vary between 1.9 and 6.5, all $p < .0001$); therefore a non-parametric equivalent of a one-way ANOVA was used.

Results

Frequency of L2 use in cognitive domains

Across all participants, the highest L2 use scores were recorded for the domain of note-taking (3.9), followed by shopping lists (3.8), action plans (3.7), and mental calculation (2.7). Figure 1 presents frequency of L2 use in communicative domains.

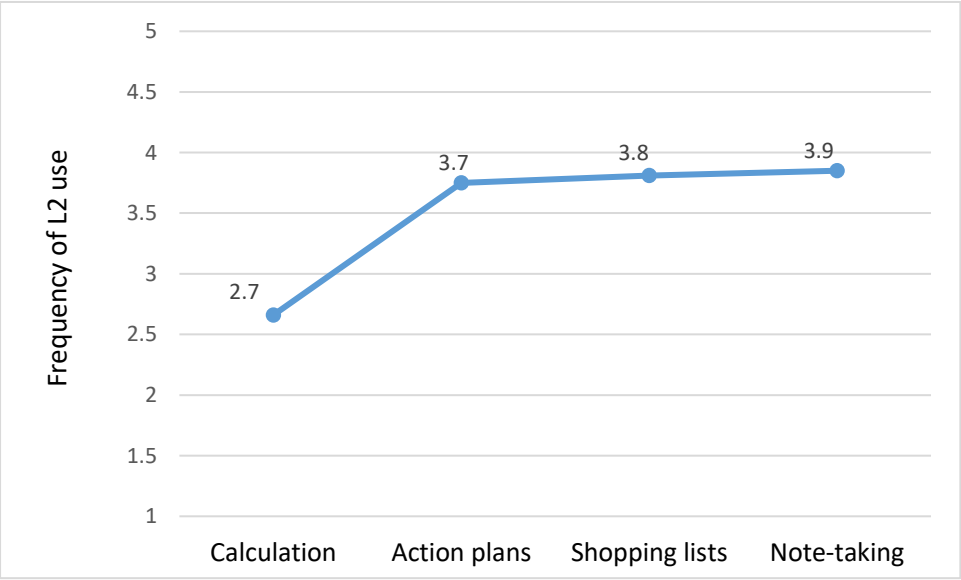

Figure 1. Frequency of L2 use in cognitive domains.

Acculturation level and L2 use in cognitive domains

Domain of note-taking

A Kruskal-Wallis test showed that there is a significant effect of acculturation level on frequency of L2 use in domain of note-taking ($\chi^2 = 18.8$, $p < .0001$) with a mean rank of 24.3 for the slightly acculturated group, 49.3 for the moderately acculturated group, 78.6 for the highly acculturated group and 97.8 for the completely acculturated group.

Domain of shopping lists

A series of Kruskal-Wallis tests showed no statistically significant effects of acculturation level on frequency of L2 use in domain of shopping lists ($\chi^2 = 6.6$, $p = .086$) with a mean rank of 55.1 for the slightly acculturated group, 66.0 for the moderately acculturated group, 74.4 for the highly acculturated group and 86.5 for the completely acculturated group.

Domain of action plans

A Kruskal-Wallis test showed that there is a significant effect of acculturation level on frequency of L2 use in domain of action plans ($\chi^2 = 12.5$, $p < .006$) with a mean rank of 51.9 for the slightly acculturated group, 57.9 for the moderately acculturated group, 77.1 for the highly acculturated group and 88.7 for the completely acculturated group.

Domain of mental calculation

A Kruskal-Wallis test showed that there is a significant effect of acculturation level on frequency of L2 use in domain of mental calculation ($\chi^2 = 8.6$, $p = .035$) with a mean rank of 51.6 for the slightly acculturated group, 61.5 for the moderately acculturated group, 77.5 for the highly acculturated group and 85.4 for the completely acculturated group.

Synthesis of acculturation level and frequency of L2 use in cognitive domains

The results showed that higher acculturation levels were tightly linked to higher levels of frequency of L2 use in the domains of note-taking, action plans and mental calculation. Higher levels of acculturation were linked to higher levels of frequency of L2 use across the three domains of language use. The domain of shopping lists noted an observable, monotonic increase in frequency of L2 use proportionally to acculturation level, however the result proved statistically non-significant. Figure 2 below presents a comparative illustration of the effect of acculturation level on frequency of L2 use in cognitive domains.

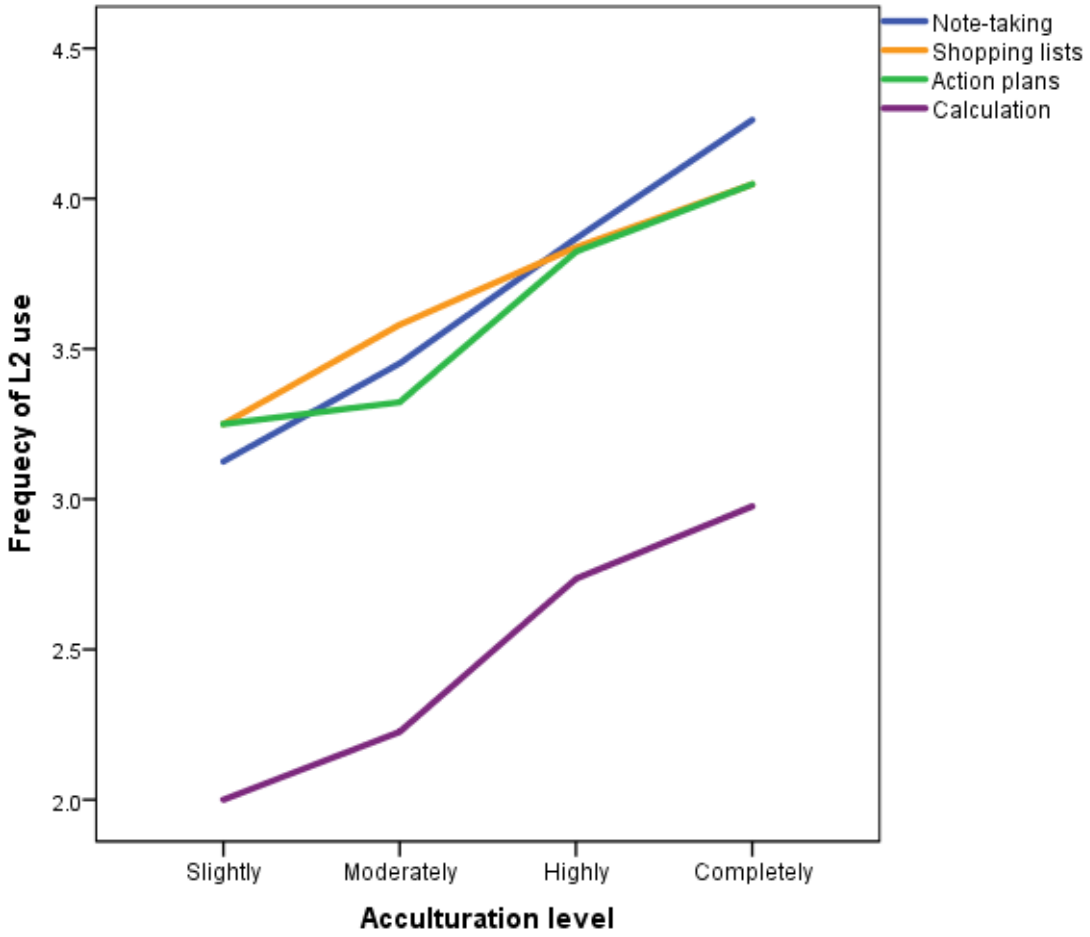

Figure 2. Acculturation level and frequency of L2 use in cognitive domains.

Social network profile and frequency of L2 use in cognitive domains

Domain of note-taking

A Kruskal-Wallis test showed that there is a significant effect of social network profile on frequency of L2 use in domain of note-taking ($\chi^2 = 30.3$, $p < .0001$) with a mean rank of 42.3 for the majority Polish-speaking social network, 62.4 for the equally Polish and English-speaking social network, and 92.6 for the majority English-speaking social network.

Domain of shopping lists

A Kruskal-Wallis test showed that there is a significant effect of social network profile on frequency of L2 use in domain of shopping lists ($\chi^2 = 14.6$, $p < .001$) with a mean rank of 63.7 for the majority Polish-speaking social network, 62.0 for the equally Polish and English-speaking social network, and 88.0 for the majority English-speaking social network.

Domain of action plans

A Kruskal-Wallis test showed that there is a significant effect of social network profile on frequency of L2 use in domain of action plans ($\chi^2 = 31.6$, $p < .0001$) with a mean rank of 52.9 for the majority Polish-speaking social network, 57.2 for the equally Polish and English-speaking social network, and 94.1 for the majority English-speaking social network.

Domain of mental calculation

A Kruskal-Wallis test showed that there is a significant effect of social network profile on frequency of L2 use in domain of thinking of mental calculation ($\chi^2 = 10.0$, $p < .007$) with a mean rank of 54.6 for the majority Polish-speaking social network, 68.4 for the equally Polish and English-speaking social network, and 85.0 for the majority English-speaking social network.

Synthesis of social network profile and frequency of L2 use in cognitive domains

The results showed that social network profile is tightly linked to higher levels of frequency of L2 use in the domains of note-taking, action plans, shopping lists and mental calculation,

respectively. Majority L2-speaking social networks were linked to higher levels of frequency of L2 across all domains. Figure 3 below presents a comparative illustration of the effect of social network profile on frequency of L2 use in all cognitive domains.

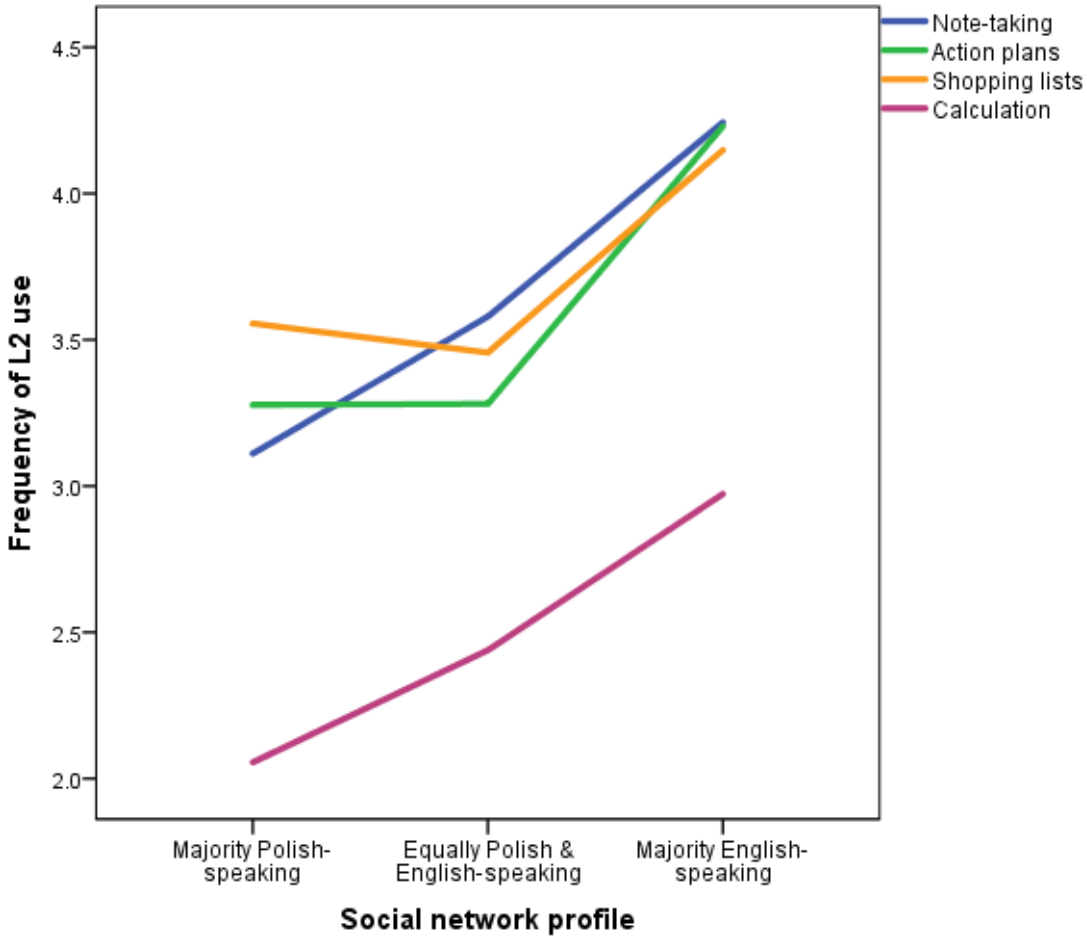

Figure 3. Social network profile and frequency of L2 use in cognitive domains.

Predicted future domicile and frequency of L2 use in cognitive domains

Domain of note-taking

A Kruskal-Wallis test showed that there is a significant effect of predicted future domicile on frequency of L2 use in domain of note-taking ($\chi^2 = 17.2$, $p < .0001$) with a mean rank of 85.7 for the intention to stay in the L2-speaking country indefinitely, 68.3 for being unsure about predicted future domicile, and 37.0 for the intention to leave the L2-speaking country at one point in the future.

Domain of shopping lists

A series of Kruskal-Wallis tests showed that there is no significant effect of predicted future domicile on frequency of L2 use in domain of shopping lists ($\chi^2 = 5.6$, $p < .060$) with a mean rank of 80.6 for the intention to stay in the L2-speaking country indefinitely, 72.2 for being unsure about predicted future domicile, and 51.4 for the intention to leave the L2-speaking country at one point in the future.

Domain of action plans

A Kruskal-Wallis test showed that there is a significant effect of predicted future domicile on frequency of L2 use in domain of action plans ($\chi^2 = 7.8$, $p < .020$) with a mean rank of 83.2 for the intention to stay in the L2-speaking country indefinitely, 68.2 for being unsure about predicted future domicile, and 53.9 for the intention to leave the L2-speaking country at one point in the future.

Domain of mental calculation

A Kruskal-Wallis test showed that there is a significant effect of predicted future domicile on frequency of L2 use in domain of thinking of mental calculation ($\chi^2 = 14.2$, $p < .001$) with a mean rank of 86.5 for the intention to stay in the L2-speaking country indefinitely, 64.7 for

being unsure about predicted future domicile, and 49.1 for the intention to leave the L2-speaking country at one point in the future.

Synthesis of predicted future domicile and frequency of L2 use in cognitive domains

The results showed that there is a significant effect of predicted future domicile on frequency of L2 use in domains of note-taking, action plans and mental calculation, but not in the domain of shopping lists, as little distinction was recorded between indefinite and unspecified types of residency. Figure 4 below presents a comparative illustration of the effect of predicted future domicile on frequency of L2 use in all cognitive domains.

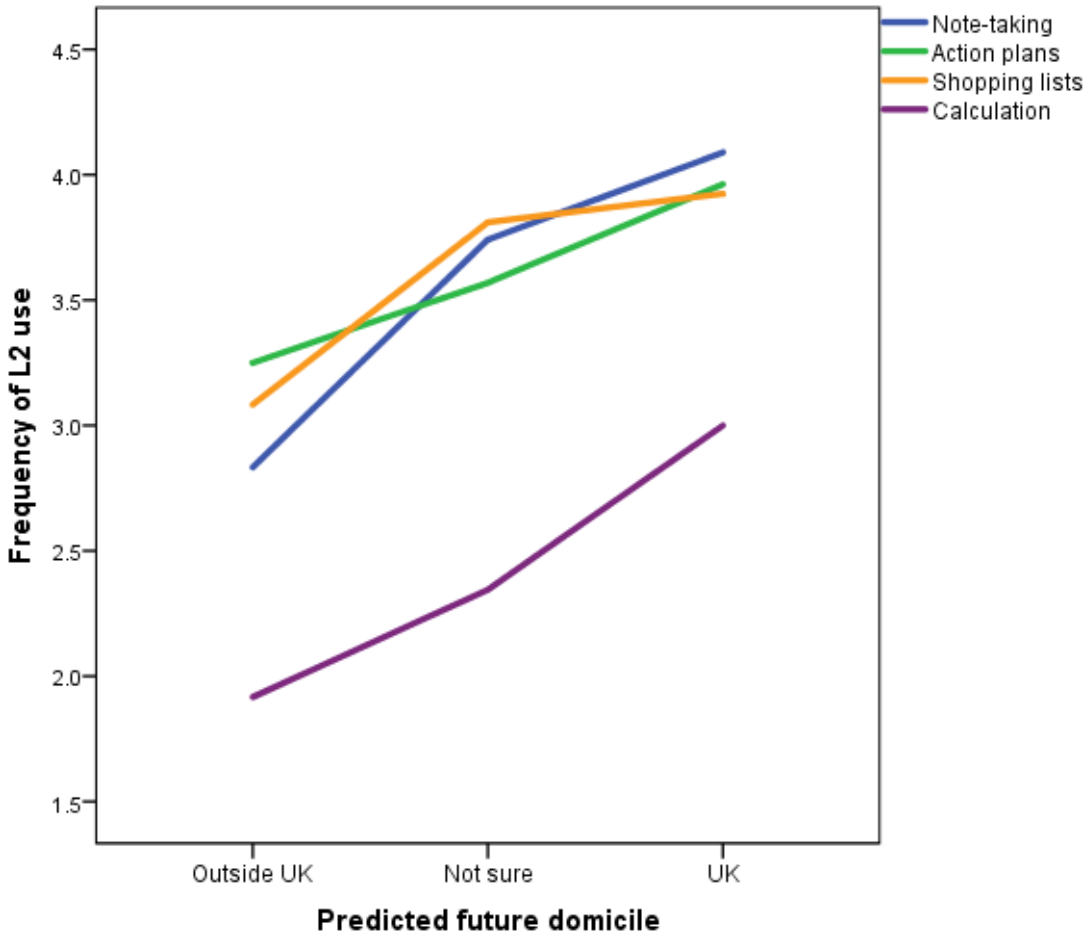

Figure 4. Predicted future domicile and frequency of L2 use in cognitive domains.

Length of residence and frequency of L2 use in cognitive domains

A series of Kruskal-Wallis tests showed no significant effects length of residence on frequency of L2 use in cognitive domains including: note-taking, shopping lists, action plans and mental calculation. The results are presented in Table 1 below:

Table 1. *Length of residence and frequency of L2 use in cognitive domains.*

Variable	**Statistic**		**Domain**			
			Note-taking	**Shopping lists**	**Action plans**	**Mental calculation**
Length of residence	χ^2		1.9	2.0	1.2	2.3
	p		.383	.367	.541	.317
	Mean ranks (Kruskal-Wallis)	under 5 years	74.3	75.0	73.3	70.6
		between 5 and 10 years	72.4	72.0	73.4	73.8
		10 years +	85.5	85.6	83.6	86.4

Qualitative illustrations

The feedback from the interviews and the open questions confirmed the statistical patterns. A selection of the most interesting and illustrative examples is presented below:

MI6 (highly acculturated) reported using L2 when making plans:

"A friend is going to visit me soon, a Polish friend, and I was thinking what we could do together, where to go out and that kind of stuff, and I was thinking about our conversations in English, while there is no logical reason why we would actually be using English to communicate."

MI2 (completely acculturated) reported using L2 for the majority of cognitive domains apart from mathematical calculation and L1-specific contexts for which there is no L2 experience:

"I always do shopping lists in English, irrespective where I am actually; and I would take notes as well. Note-taking depends on what it relates to, if I was taking notes at the lecture that would be conducted in Polish I'm sure I would be noting in Polish (…) When it comes to certain matters, like maths for example, I do all the maths in Polish… If I think about certain concepts then I would possibly have the Polish word for it rather than the English once because I've never experienced the English one, I don't do anything that would involve maths at the moment so I wouldn't have means to learn it and for it to sink in my head."

MI8 (completely acculturated) reported using L2 for making plans, and L1 for counting:

"There is one thing and I don't know what it is… counting… it's a part of inner speech as well and I don't know why, I did notice that if I start counting in English I will then switch to Polish. And thinking and planning… I tend to make lists and plans, and when I'm stressed and overwhelmed, I make them in English."

MI4 (completely acculturated) reported that she uses L2 for making plans and that it has become a part of her, yet her memory for numbers is language dependent:

"If you ask me for my telephone number, I prefer to say it in English, my English telephone number; however if you ask me for my Polish number I prefer to say it in Polish. I was thinking about it, I think there is a melody to it, the way it sounds, I can say it [the English number] very quickly in English, in Polish… I can do it but I have to think about it, for a split second but I do, and if I call my family and I have to dial the Polish number, in my mind I have to say it in Polish. And even when I was in Poland last time and someone asked me about my [English] phone number and then I said 'just wait a moment', I had to say it in English, write it down and then I could give it to them (…) I am generally a planner, so I lie down in the evening and I plan, I have to do this and that, and it's all in English. And I have no idea why, maybe because of my work and my marriage, it's all in English, so my relatives are English… I think in English, yeah. I think it really became a part of me."

MI9 (moderately acculturated) reported that her thinking and planning is done mainly in L1, however she uses the L2 context-specifically for it helps her to memorise or locate things quicker:

"Note-taking - it depends on the context, but normally when the conversation is taking place in English I would take notes in English too, note down bullet points, keywords, and I will be able to better memorise it and so on. Action plans - on a bigger scale that would be in Polish. Last year I planned a trip across some countries and I planned it in Polish. Shopping lists always in English so then I know what I'm looking for, so yeah. My thinking is done mainly in Polish."

MI8 (completely acculturated) reported that she remembered when the language of her action plans shifted to L2, yet her shopping lists would include items in both languages:

"When I came over to England, I don't know why I always used to make plans on paper, and I'm pretty sure that in the first couple of years they would be written in Polish but then I would change to English. I think pretty quickly note-taking and action plans I would do in English. Shopping lists, I think I used to… some of the things would be in English some in Polish, I don't know why. It depended on words which I liked, I don't know."

Discussion

The results revealed a variation in frequency of L2 use in cognitive domains. Across all participants, the L1-dependent domain of mental calculation recorded the lowest level of L2 use, in comparison with the remaining domains. The more context-specific domains of note-taking, shopping lists and action plans, recorded higher frequencies of L2 use across all participants, and their average frequencies were almost identical. Further variation among participants was revealed when investigating the effects of the independent variables.

The findings showed that acculturation level had a significant effect on the frequency of L2 use in cognitive domains including note-taking, planning (action plans), and mental calculation. An observable, yet statistically non-significant difference was noted for the domain of shopping list. Participants with higher levels of acculturation were found to use the L2 more frequently in all domains belonging to the cognitive function. Differences were also found in frequency of L2 use between domains, across all acculturation levels. Mental calculation was found to have the lowest level of L2 use, when compared to note-taking, shopping lists or action plans, which recorded a comparable level of L2 use on average. Completely and highly acculturated bilinguals were nevertheless found to use the L2

significantly more in the domain of mental calculation, than moderately or slightly acculturated participants.

This result provides empirical evidence that domain-specific language use reflects the degree of acculturation, which confirms earlier findings by Schrauf (2009). Bilinguals who acculturate to a higher level tend to use the L2 more frequently across the cognitive domains of language use, than participants with low acculturation levels. The findings link with Acton and Walker de Felix (1986) in that language is a fundamental component and marker of acculturation. Acculturation scores were found to strongly correlate with L2 dominance scores which was revealed as part of the validation process. This links with Dewaele (2004b) and Pavlenko (2014), in that overall language dominance may also be linked to an increased likelihood of choosing the L2 for mathematical operations.

Social network profile, an important constituent of the acculturative process, was found to be tightly linked to frequency of L2 use in all cognitive domains. Participants operating in majority L2-speaking social networks were found to use the L2 significantly more across all four cognitive domains. A steady monotonic increase in L2 use between groups was observed for domain of note-taking. Frequency of L2 use in domains of shopping lists and action plans was more similar in respondents operating in balanced and majority L1-oriented social networks, and significantly higher in respondents functioning in majority L2-operating networks. Participants operating in balanced and majority L1-speaking social networks were found to use the L2 more frequently in domains of shopping lists and action plans, than in domain of note-taking. Domain of mental calculation recorded the lowest level of L2 use across all three groups, but a significant, stable monotonic increase in levels of L2 use was noted between the groups, with the majority L2-speaking social network group recording the highest frequency of L2 use in this domain.

These results provide empirical evidence that social networks and linguistic enclaves have an effect on patterns of language use in cognitive domains in sequential bilinguals residing in L2-speaking context. This effect links with previous research by Dewaele (2007), as well as Stoessel (2002) and Chiswick and Miller (2005). The results show that the multidimensional character of acculturation, which combines social, cognitive and linguistic aspects, is an important factor in language performance following migration, for its effects are found in patterns of language use within cognitive domains (Ryder et al., 2000; Sam & Berry, 2006; Schwartz et al., 2010).

Also predicted future domicile was found to have significant links with frequencies of L2 use in domains of note-taking, action plans, and mental calculation, but not in the domain of shopping lists. Participants who planned to stay in the UK indefinitely were found to use the L2 significantly more than those who were unsure of their domicile, and definite sojourners. The domain of shopping lists recorded an observable and comparable higher level of L2 use in participants who planned to remain in the UK indefinitely, and those who were yet unsure; and a lower level of L2 use in those who planned to leave the UK at one point in time. Yet again, the domain of mental calculation was the one with the overall lowest frequency of L2 use across all groups, but participants who planned to remain in the UK indefinitely were found to use more L2 in this domain than the other two groups.

These results provide empirical evidence that, as far as language use for cognitive domains is concerned, intentions of the speakers are equally important as their competence in the L2. The findings suggest that bilinguals intending to remain in the UK indefinitely display a more integrative motivation in using the L2, which translates into a more extensive patterns of L2 use even in cognitive domains. The latter supports earlier assertions made by Schumann (1976) and Gardner and Lambert (1972).

The findings showed that the L1-dependent domain of mental calculation proved to shift towards L2 proportionally to acculturation level, which connects with studies by Vaid and Menon (2000) and Tamamaki (1993) who found that L1 preferences for mental calculation decrease proportionally to length of residence in the target language country. The present study found significant strong positive correlation between acculturation level and length of residence, which supports the above quoted studies. The increased frequency of L2 use for mental calculation, proportional to acculturation levels, also connects with Dewaele (2004b, 2007) who found that L2 can be used for mental calculation more frequently in L2 dominant bilinguals with high levels of L2 socialisation. On average however, the frequency of L2 use for the domain of mental calculation proved to be the lowest in comparison to other domains within the cognitive function, which reflected L1-dependent character of the domain and so linked this study with previous research on language-dependence in the domain of calculation and number (Campbell et al., 1999; Frenck-Mestre & Vaid, 1993; Marian & Fausey, 2006; Marsh & Maki, 1976; Spelke & Tsivkin, 2001).

The context-specific domains of note-taking, shopping lists and action plans saw significantly more L2 use when compared to mental calculation, which may link with the availability of context-specific content, and concepts in those domains (Carroll & Luna, 2011). It may also be linked, particularly in completely and highly acculturated bilinguals, with processes of cognitive restructuring and re-naming the surrounding reality (Pavlenko, 2011).

The qualitative data revealed how particularly significant the L2-dominant context proved to be, as far as language use in context-specific cognitive domains is concerned. Many respondents shared that following migration they started to use English L2 when making plans and drawing up lists. They explained that this shift towards L2 felt automatic, which suggests that functioning in the L2-dominant context, and integrating to the L2-dominant

society, has psycholinguistic consequences. Choosing the L2 was perceived as an automatic and a natural step, as well as a more efficient way to operate, which links with processing economy (Dehaene, 2011). The degree to which the sequential bilingual acculturated and the degree to which they felt part of the new culture and the host society, was reflected in the extent of L2 use across cognitive domains. Patterns of L2 use in cognitive domains and their links with acculturation, could suggest an ongoing process of conceptual restructuring in sequential bilinguals (Grosjean, 2002, 2010; Pavlenko, 2011).

The results provide support for the Cognitive Theory of Acculturation (Schrauf, 2002) in that the extent of L2 use in cognitive domains was not found to be equal, but related to degrees of acculturation, and domain-specific. Differences in the extent of L2 use between domains suggest a gradual spread of L2 across domains, and shows that L1-dependent domains are more resistant to the shift that context-specific domains.

No links were found between length of residence in the UK and frequency of L2 use in domains of note-taking, action plans, shopping lists and mental calculation. It should be stressed however that a strong positive correlation between length of residence and acculturation level was established. This may indicate that length of residence is not the causal variable in its own right, but it is the acculturative processes that happen to a higher or lower degree during that length of residency, that are linked to possible shifts in language use in cognitive domains. In other words, it may not be the number of years that matters, but the events and the level of sociocultural and psychological integration, which is then reflected in language use for cognitive function.

Conclusion

This study provides empirical evidence that acculturation level, and associated variables of social network profile and predicted future domicile, are strongly linked to frequency of L2 use in cognitive domains. The findings suggest that immersion in L2-dominant context and processes of acculturation have significant effects on language use for information processing. The findings also revealed that context-specific domains associated with the cognitive tasks of planning, organising and problem solving (Lewis, 1969), recorded an overall higher frequency of L2 use, as opposed to L1-dependent domain of mental calculation. L2 is seen to be used for the majority of cognitive operations in the L2-context, which links with Pavlenko's (2014) notion of context-specific activation in L2 following migration. Extensive use of L2 for context-specific information processing links with Grosjean's (2002) concept of cognitive restructuring, which may occur following migration (change of context), and acculturation. On the other hand, the L1-dependent domain of mental calculation recorded the lowest levels of L2 following migration when juxtaposed with the remaining cognitive domains. This supports previous findings by Spelke and Tsivkin (2001), Dewaele (2007, 2009), Planas and Setati (2009) and Dehaene (2011), in that L1 is typically the preferred language used for numerical processing, due to L1-dependent processing advantage. Nevertheless, completely and highly acculturated bilinguals were found to use more L2 even in this highly L1-dependent domain, which highlights the transformative effects of acculturation on language use in sequential bilinguals.

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