Predicting executive functions in bilinguals using ecologically valid measures of codes-witching behaviour.

Abstract

One of the factors which has been claimed to impact on executive functions in bilinguals is code-switching behaviour. New insights into how exactly code-switching affects executive functions can be obtained if attention is paid to the kind of code-switching bilinguals engage in, and not just the frequency of code-switching. This raises the question how code-switching habits can be assessed in experimental research. This study presents two ecologically valid, yet efficient, methods of assessing code-switching habits: a frequency judgement task based on authentic stimuli, and a bilingual email production task. The two tasks converged in revealing differences at Dense code-switching in two groups of German-English bilinguals. They also correlated when assessing Dense code-switching on an individual basis. Importantly, both tasks revealed code-switching patterns that could explain group differences observed in executive performance. The bilinguals engaging in frequent Dense code-switching excelled at the aspect of executive functions (conflict-monitoring) predicted to be related to code-switching based on existing processing models. Hence, both methods are recommended for use as code-switching measurements in bilingualism research.

1. Introduction

Bilingualism has been shown to modulate executive functions because bilinguals constantly use cognitive control to monitor language selection (Bialystok, Craik & Luk, 2012). However, bilingual advantages at executive control are not undisputed because some studies have failed to replicate previous findings (Paap & Greenberg, 2013). Nevertheless, there currently appears to be relative consensus that a closer inspection of bilinguals' sociolinguistic practices may provide insights into the complex relationship between bilingualism and executive functions (Bak, 2016).

In a field that is largely quantitative and experimental in nature, this is easier said than done. It raises the question how sociolinguistic habits can be quantified and adequately assessed in experimental settings, in which bilinguals are assessed outside of their social context and speech community. Methods used to assess sociolinguistic habits in experimental research must be both ecologically valid and efficient enough for the use with large sample sizes. This paper discusses two novel methods of assessing sociolinguistic habits in bilingualism research: frequency judgement tasks and emails produced by bilinguals in the bilingual mode (Soares & Grosjean, 1984).

The paper focuses on the measurement of a sociolinguistic variable that has been suggested to modulate executive functions, i.e. code-switching (Green & Wei, 2014). Code-switching is defined as the mixing of languages for socio-pragmatic optimization purposes (Bhatt & Bolonyai, 2011). Different types of code-switching have been suggested to modulate executive functions differentially (Green & Wei, 2014). However, in the literature on executive functions little attention has been paid to the different types of code-switching bilinguals engage in (Muysken, 2000). This study investigated how bilinguals' code-switching practices can be measured, which is a

prerequisite for understanding the impact of engaging in different code-switching types on executive functions.

Code-switching typically occurs in informal situations involving high degrees of interlocutor familiarity (Gardner-Chloros, 2009). While Gullberg and Muysken (2009) have shown that it is possible to assess code-switching experimentally, it is particularly hard to obtain valid data about informants' actual code-switching practices in experimental settings. Most studies investigating code-switching and executive functions to date have therefore relied on self-reported code-switching behaviour (Soveri et al., 2011, Rodriguez-Fornells, Kraemer, Lorenzo-Selva, Festman, Muente, 2012, Verreyt, Woumans, Vandelanotte, Szmalec & Duyck, 2016, Hartanto & Young, 2016).

To operationalise the measurement of code-switching in a systematic way, a Bilingual Switching Questionnaire (BSWQ) was developed by Rodriguez-Fornells et al. (2012). In this questionnaire, bilinguals read statements, such as "I tend to switch languages during a conversation", and rate the extent to which the statements apply to them on a scale from 1 to 7. Bilinguals also indicate whether they code-switch intentionally because it is assumed that intentional code-switching requires higher levels of cognitive control than unintentional code-switching. In some studies (Hartanto & Young, 2016), bilinguals are also asked to differentiate between inter- and intra-sentential code-switching using questionnaires.

Although these studies have contributed to bilingualism research by revealing significant correlations between code-switching and executive functions, they share one weakness. They all rely exclusively on self-reports to measure code-switching. There

are several issues with this approach. Firstly, self-reported and actual behaviour often diverge (Zell & Krizan, 2014). The more complex the behaviour under investigation, the less reliable the self-report. Code-switching can certainly be regarded as "complex behaviour" involving challenging monitoring processes, so self-reports need to be taken with a pinch of salt.

Secondly, asking participants to correctly report their code-switching behaviour presupposes high levels of metalinguistic awareness, particularly when it comes to teasing apart the usage of different code-switching types, e.g. by differentiating between inter-sentential versus intra-sentential code-switching (Hartanto & Young, 2016). Moreover, a reliable self-report depends on participants' ability to memorise past behaviour. Hence, it is questionable whether bilinguals can reliably differentiate, recall and report whether and how frequently they switch between "sentences" or "words". If self-awareness is a requirement for reliable self-reporting, it is also unlikely that bilinguals can provide a reliable testimony of the frequency of their unintentional code-switching (Rodriguez-Fornells et al., 2012).

Importantly, code-switching is a highly stigmatised bilingual practice in many cultures (Gardner-Chloros, 2009; Poplack, 1980). Given participants' tendency to provide socially desirable responses in questionnaires (Dewaele & Wei, 2014), self-reported code-switching behaviour is therefore confounded by attitudinal aspects. Attitudes towards inter-sentential code-switching are more positive than attitudes towards intra-sentential code-switching, for instance. These negative attitudes towards intra-sentential code-switching are expressed in early code-switching research, which claims that bilinguals switch languages "according to appropriate changes in the speech situation (interlocutors, topic, etc.), but […] not within a single sentence" (Weinreich,

1963:73). Current code-switching research clearly proves that intrasentential code-switching exists (Muysken, 2000). The existence of negative attitudes towards intra-sentential code-switching increases the likelihood of bilinguals scoring their inter-sentential code-switching frequency more highly than their intra-sentential code-switching. The differential effects of inter-sentential and intra-sentential code-switching on executive control observed by Hartanto & Young (2016) thus need to be interpreted with that limitation in mind. To address the above-mentioned issues, research into code-switching and executive functions should therefore move towards the use of more ecologically valid direct methods of assessing code-switching.

As Muysken's (2000) work shows, the distinction between intrasential and intersentential code-switching does not capture the complexity of code-switching behaviour that is found across typologically different languages and different types of bilingual speech communities. Studies based on socio-linguistic corpora reveal that code-switching can not only be sub-divided into inter-sentential and intra-sentential code-switching, but that there is variation within intra-sentential code-switching. Three types of intra-sentential code-switching patterns have been identified (Muysken, 2000): (1) *Alternation* of structurally independent stretches of languages, (2) *Insertion* of lexical items from one language into the grammatical framework of another, (3) *Congruent Lexicalisation* or *Dense code switching* involving convergence between lexis and grammar of both languages. Table 1 shows German-English examples of the three code-switching types. Most existing code-switching questionnaires do not distinguish between different types of code-switching because they ask bilinguals about their code-switching frequency in general. For bilingualism research, it is however crucial to differentiate between different code-switching types because they differ in the amount

of executive control recruited (Green & Wei, 2014). Code-switching types that keep languages more separate (Alternation) recruit high levels of inhibitory control (Treffers-Daller, 2009). Dense forms of code-switching on the other hand place greater demands on the conflict-monitoring skills required to manage the co-activation of competing language-specific lexical items and structural rules (Hofweber, Marinis & Treffers-Daller, 2016).

Table 1 German-English code-switching examples

Code-switching type	**Example**
Alternation	*Ich kann heute nicht kommen* BECAUSE I'M ILL. *I can today not come* BECAUSE I'M ILL. *I cannot come today BECAUSE I'M ILL.*
Insertion E > G	*Wir suchen noch* VOLUNTEERS *fuer das Projekt.* *We search still* VOLUNTEERS *for the project.* *We are still looking for VOLUNTEERS for the project.*
Insertion G > E	*We didn't bring* SCHUHWERK *for hiking.* *We didn't bring* SHOES *for hiking.* *We didn't bring SHOES for hiking.*
Dense code-switching	*Wir haben* FRIENDS *gemacht mit'm* SHOP OWNER. *We have* FRIENDS *made with'th* SHOP OWNER. *We have made FRIENDS with'th SHOP OWNER.*

In a study about code-switching and executive functions, Yim & Bialystok (2012) addressed the concerns surrounding the validity of self-reported behaviour. Instead of measuring code-switching using questionnaires, they elicited short conversations from English-Cantonese bilinguals. To generate code-switching instances, bilinguals were instructed to use language A to discuss topics culturally connected to language B and vice versa, e.g. converse about Chinese New Year in English. This is a promising method increasing the ecological validity of the code-

switching measure, compared to questionnaires. However, this experimental design bears the risk of creating a bias towards insertional code-mixing by priming participants into slotting expressions associated with culture A into the conversational base language B. Moreover, although the recording and transcription of conversational data is the ecologically most valid method of assessing code-switching practices, it is highly time-consuming and labour-intensive. Hence, it may not be efficient enough for use with large sample sizes. Instructing bilinguals which base language and topic to engage in also reduces the intuitiveness of the task and relies on sufficient levels of meta-linguistic awareness amongst participants to implement the instructions.

To summarize, several studies have investigated the relationship between code-switching and executive functions (Costa et al., 2009). However, findings about the relationship between code-switching and executive functions have been inconsistent. Whilst some studies (Soveri et al., 2011, Rodriguez-Fornells et al., 2012) find a correlation between code-switching frequency and executive functions, other studies (Yim & Bialystok, 2012) find no relationship. The observed inconsistencies may be due to a lack of systematically controlling for participants' code-switching practices in terms of the quality of bilinguals' code-switching. Different types of code-switching modulate executive functions differentially (Green & Wei, 2014), so a more fine-grained assessment of code-switching is needed. Moreover, previous studies have relied on measuring code-switching frequency using questionnaires, a method that may be suitable for measuring attitudes towards code-switching (Dewaele & Li Wei, 2014), but lacks ecological validity when it comes to measuring bilinguals' actual behaviour. Attempts to measure code-switching by collecting and transcribing conversations are ecologically valid (Yim & Bialystok, 2012), but likely to be too time-consuming to be

used with large sample sizes. Hence, it is necessary to develop measures of code-switching that are both ecologically valid and efficient.

This study is an extension of a recent study investigating the relationship between dense code-switching and executive functions in two groups of German-English bilinguals (Hofweber, Marinis & Treffers-Daller, 2016), which showed that frequent dense code-switchers outperformed a group of infrequent dense code-switchers at conflict-monitoring, i.e. the aspects of the executive system assumed to be trained during dense code-switching. To make this comparison, it was first necessary to establish whether the two groups of bilinguals differed in dense code-switching frequency, as predicted based on their different sociolinguistic backgrounds (Muysken, 2000). In the original study, a frequency judgement task confirmed that the bilingual group with long-standing bilingual traditions engaged in denser code-switching than the group of more recent bilinguals. The present paper presents additional data from the same participants using a novel and efficient method to assess bilinguals' code-switching habits: emails produced in the bilingual mode.

Bilingual emails have the potential to generate data that taps into bilinguals' intuitive language production, without involving the time-consuming recording and transcription of real-time speech data. The bilingual emails discussed in this paper were employed to compare the code-switching practices of two groups of German-English bilinguals predicted to differ in dense code-switching frequency (Hofweber et al., 2016). Two methods with greater ecological validity than mere self-reports were used to assess bilinguals' regular code-switching habits: a frequency judgement task using utterances from authentic sociolinguistic corpora, and a bilingual email production task. The instructions and stimuli of both tasks were carefully drafted to reduce confounds arising

from bilinguals' attitudes towards code-switching and from the need to possess high levels of meta-linguistic awareness.

Frequency judgement tasks are an established method of measuring sociolinguistic habits (Backus, 2014). They are nevertheless based on self-reports, whilst the email task generates freely produced language data. Hence, the email task was assumed to have greater ecological validity and used as the benchmark of the comparison. If both tasks are equally ecologically valid measures of code-switching habits, then the results should converge. A lack of such convergence of results would be interpreted as a lack in ecological validity of the task with less ecological validity, i.e. the judgement task.

The emergence of code-switching patterns depends on bilinguals' sociolinguistic environment (Muysken, 2000). Therefore, we identified two groups of German-English bilinguals differing in their sociolinguistic environments: (1) L1-German bilingual L2-users of English who are 1st generation immigrants to the UK, (2) 5th generation heritage speakers of German in South Africa. Bilinguals in communities with long-standing traditions of language contact tend to code-switch more densely, whilst 1st generation immigrants who have only recently become active bilinguals through immersion in an L2-context engage primarily in Insertion and Alternation. Hence, the 1st generation immigrants were predicted to engage predominantly in Alternation and Insertion, whilst the 5th generation bilinguals were predicted to engage in more Dense code-switching. Code-switching preference was measured using a bilingual email production task, as well as a frequency judgement task. This paper discusses the suitability of the two tasks for assessing code-switching, focusing on the following research questions:

1. Do the code-switching frequency measures from the judgement task and the bilingual emails converge when it comes to assessing group differences in code-switching patterns?

   If both tasks are equally good measures of code-switching, they should reveal similar code-switching patterns in the group comparison.

2. Do the code-switching frequency measures from the judgement task and the bilingual email task correlate?

   If both tasks are adequate measures tapping into bilinguals' code-switching habits, then results should correlate.

3. How well do the two tasks explain the pattern observed in the executive functions task?

A group difference was found for executive performance in the flanker task challenging conflict-monitoring (Hofweber et al., 2016). Differences in code-switching habits have been argued to modulate conflict-monitoring performance (Costa et al., 2009). If the measure of code-switching reveals that the observed executive function modulations map onto group differences in code-switching in line with existing processing models of code-switching (Green & Wei, 2014), then this speaks for the robustness of the code-switching measure.

To summarize, this paper discusses whether bilingual emails and frequency judgement tasks based on authentic stimuli are valid methods of assessing bilinguals' code-switching habits. If so, the results from the two tasks should converge. The paper also explores whether the results from the email task are in line with predictions derived from a code-switching typology based on authentic socio-linguistic corpora (Muysken, 2000), as well as with existing processing models of code-switching (Green & Wei, 2014). If the use of bilingual email data proves to be an adequate method of assessing code-switching habits, then the use of this method could be extended to measuring other socio-linguistic practices, facilitating their use as independent variables in experimental

research. Likewise, this finding could be extended to the use of other digital media data, such as chatting, blogging or forum discussions, which can be obtained without time-consuming transcription.

2. Methods

2.1. Participants

To avoid confounds from differences in typological distances between languages, all participants shared the same German-English language combination.

Group 1: 5th generation heritage speakers of German in South Africa (N=11). German was their first language. Exposure to English began after the age of 6. These bilinguals lived in communities with long-standing multilingual traditions and spoke at least one additional local language, e.g., Afrikaans, Zulu, Setswana.

Group 2: 1st generation German immigrants in the UK (N=11). German was their first language. English was the second language acquired after the age of 8. All bilinguals spoke additional school-taught languages.

Since the sample size was small, participants could be carefully matched for a range of non-linguistic (Table 2) and linguistic variables (Table 3) that have been shown to modulate executive functions.

Table 2 Non-linguistic control variables

		5th generation bilinguals	1st generation bilinguals	F-value	Df	p-value
Age	M	38.91	39.09	0.001	1, 20	0.98
	SD	16.11	15.55			
	Range	19.00 - 65.00	21.00 - 70.00			
Education	M	3.82	3.64	0.225	1, 20	0.64
	SD	0.40	1.21			
	Range	3.00 - 4.00	1.00 - 5.00			
Non-verbal IQ	M	108.52	108.64	0.000	1, 20	0.99
	SD	12.00	17.04			
	Range	85.00 - 130.00	75.00 - 125.00			
SMG	M	5.95	6.82	3.130	1, 20	0.09
	SD	0.84	1.40			
	Range	5.00 - 7.00	5.00 - 9.00			
SME	M	5.75	6.64	4.183	1, 20	0.05
	SD	0.66	1.29			
	Range	5.00 - 7.00	5.00 - 9.00			
WMG	M	4.31	4.82	1.311	1, 20	0.27
	SD	0.78	1.25			
	Range	3.00 - 6.00	3.00 - 7.00			
WME	M	4.61	4.91	0.391	1, 20	0.54
	SD	0.92	1.30			
	Range	3.00 - 6.00	3.00 - 7.00			

As can be seen from Table 2, the groups did not differ in Age, Education (taken to be an indicator of SES) and cognitive abilities. Non-verbal IQ was measured using Raven's Standard Progressive Matrices (Raven, Raven, & Court, 1998). Short term memory (SM) and working memory (WM) were measured using Wechsler's (1997) digit span, administered in English (SME, WME) and German (SMG, WMG) language separately.

Table 3 Linguistic control variables

		5th generation bilinguals	1st generation bilinguals	F-value	df	p-value
German Proficiency	M	6.76	6.88	1.29	1, 20	0.27
	SD	0.08	0.08			
	Range	6.00 - 7.00	6.50 - 7.00			
English Proficiency	M	6.24	6.34	0.12	1, 20	0.74
	SD	0.22	0.22			
	Range	5.25 - 7.00	4.25 - 7.00			
Balance	M	0.53	0.54	0.00	1, 20	0.96
	SD	0.20	0.20			
	Range	-0.25 - 1.75	0.00 - 2.25			
AoO English	M	6.45	11.00	5.43	1, 20	*0.03
	SD	1.38	1.38			
	Range	0.00 - 10.00	5.00 - 27.00			

To assess bilinguals' language background, the online language history questionnaire LHQ (Li, Zhang, Tsai & Puls, 2014) was administered. All bilinguals rated their English proficiency as advanced with 6 out of 7 points, but declared that German was their native language. Balance was computed as the difference between the participants' proficiency in the two languages (Kupisch & De Weijer, 2016). Both groups were German-dominant. The 5th generation heritage speakers displayed a fairly high level of proficiency in their home language because schooling in the heritage language is available. The only linguistic control variable in which the two groups differed was Age of Onset (AoO) of learning English with 5th generation bilinguals displaying an earlier AoO than the 1st generation bilinguals.

2.2. Tasks

All online tasks were created using Psychopy 1.81 and presented on a 13-inch-screen laptop.

2.2.1. Frequency Judgment task

Frequency judgement tasks have been argued to be representative of cognitive embedding indicating language use (Backus, 2015). The frequency ratings in judgement tasks require less metalinguistic awareness than those in questionnaires because they present participants with concrete example sentences, rather than with an abstract judgement about their language switching behaviour. In this study, participants were visually and auditorily presented with 56 utterances containing 14 code-switches of each type: 1) Insertion English into German, 2) Insertion German into English, 3) Alternation, and 4) Dense code-switching (Table 1). To increase the validity of the task, the stimuli were taken from existing German-English code-switching corpora (Eppler, 2005; Clyne, 2003). The code-switches were presented in pseudo-randomized order to avoid priming participants into a code-switching mode.

To induce an informal language mode, evoking the contexts in which code-switching occurs, the participants were instructed to imagine that they were having an informal conversation with a German-English bilingual friend and were asked to rate the frequency with which they would encounter "utterances similar to the stimuli" on a scale from "1"="never" to "7"="all the time". We asked about "frequency" instead of "acceptability" because it was feared that the term "acceptability" would introduce an unintended attitudinal element and would lead participants to refer to norms that are prevalent in a monolingual mode rather than in a bilingual mode (Onar Valk & Backus, 2013). Moreover, we did not ask participants to report their own behaviour, but simply state whether they encountered these types of sentences. This was done to reduce the

attitudinal aspect even further, assuming bilinguals are less likely to distance themselves from behaviour in general than from their own behaviour.

2.2.2. *The bilingual emails*

To tap into free language production, a discourse completion task (DCT) asking participants to compose a bilingual email was administered to participants online. In DCTs participants are asked to respond to a given text in written format. DCTs are an economical way of collecting language output from large numbers of participants and have yielded insightful results in previous studies (Sweeney & Hua, 2012). They are frequently used in pragmatic research, but could provide an economical way of collecting production data in experimental research. However, due to the written format they have been argued not to be fully representative of authentic language use. As the email is a written form of communication, this limitation applies to a lesser extent to this study. Nevertheless, the question remains as to how representative code-switching in written emails is of code-switching in general.

Code-switching predominantly occurs in informal contexts involving spontaneous online processing (Gardner-Chloros, 2009), whilst written language is typically associated with a high degree of formality and planned controlled processing (Koch & Oesterreicher, 2007). However, there are forms of communication that combine the formal characteristics of written language with the spontaneity and informal character of spoken registers (Koch & Oesterreicher, 2007). Its relative informality (Crystal, 2006) suggests that the email is such a hybrid medium. Email communication is therefore assumed to be a context encouraging code-switching in a

similar way as other informal speech settings would. Hence, the email DCT was deemed to be indicative of participants' code-switching habits in real speech. At least, it was assumed that participants' code-switching frequency in emails would provide a conservative estimate of their code-switching in real speech because speech will generally be less formal, thus generating more frequent and more Dense code-switching.

It would be an oversimplification to state that all email communication is equally informal. There are differences in register, depending on a variety of factors, such as the relationship between the interlocutors: an email written to a work colleague will be more formal than an email written to a friend. To induce an informal mode mimicking the contexts in which code-switching occurs, participants were instructed to write an email to another German-English bilingual friend telling them what they had done at the weekend and asking them to go to the cinema together. The instructions themselves contained some code-switching, naturally generating a bilingual mode.

Instead of drafting an email on the given topic, participants could also copy and paste an authentic bilingual email they had written prior to taking part in the study into the text box. In fact, most participants opted for providing authentic emails, thus increasing the ecological validity of the collected response emails. In addition to being instances of authentic language production, the advantage of the real emails is that the observer's paradox effect (Labov, 1972) is minimal as these emails had been written before participants even took part in the study. Participants may nevertheless have selected the emails specifically for this study, which means that their selection may not have been entirely random, but guided by the frequency of code-switching to some extent. However, this project focused on the relative frequency of code-switching types

rather than overall code-switching frequency, meaning that the emails are still representative from the point of view of assessing the relative frequency of different code-switching types.

2.2.3. Flanker Task

Executive performance was measured using the flanker task. Participants were presented with rows of 5 arrows and instructed to indicate the direction of the central arrow. In the congruent condition, all arrows faced in the same direction. In the incongruent condition, the arrows surrounding the target arrow faced in the opposite direction. Thus, the incongruent condition required participants to use inhibition to suppress the distractor arrows and yielded higher RTs, due to an increase in inhibitory cognitive load. Inhibition is measured in the conflict effect calculated by subtracting RTs in the congruent from those in the incongruent condition. A smaller conflict effect indicated greater inhibitory skills. Three blocks of 96 flanker trials were presented. The blocks differed in the proportion of congruent-incongruent trial-switching and resulting load to conflict-monitoring (cf. Hofweber et al., 2016 for further details). This manipulation allowed for the calculation of executive performance under "high-monitoring" conditions, requiring increased levels of conflict-monitoring, relative to "low-monitoring contexts".

3. Results

3.1. Group differences in code-switching

As the two groups differed in AoO of English, this variable was entered as a co-variate in the following analyses.

3.1.1. Frequency judgment task

Some similar code-switching patterns were observed across both groups. Firstly, bilinguals reported to engage in all types of code-switching to some extent. Moreover, both groups displayed a preference for Insertion of English into German (M=4.42,SD=1.50) over Insertion of German into English (M=2.20,SD=1.02) in an ANCOVA with Matrix language (German versus English) as the within-subject variable, Rating (1,2,3,4,5,6,7,) as the dependent variable and Group (5^{th}-generation, 1^{st}-generation) as the between-subject variable [$F(1,20)=44.92, MSE=1.20, p<0.000, \eta^2=0.69$]. The interaction between Group and Matrix language was not significant [$F(1,20)=0.06, MSE=1.20, p=0.82, \eta^2=0.00$], suggesting that both groups used German as the matrix language. The subsequent analyses therefore focus only on Insertion of English into German.

To address group differences at code-switching frequency ratings, an ANCOVA with the between-subject variable Group (5^{th} generation, 1^{st} generation) and the within-subject variable Code-switching (Alternation, Insertion, Dense) was conducted. This revealed a significant effect of Code-switching [$F(1,20)=11.13, MSE=1.03, p<0.01, \eta^2=0.37$], as well as a marginally significant Group*Code-switching interaction [$F(1,20)=3.27, MSE=0.90, p<0.07, \eta^2=0.15$] suggesting that the pattern across the two groups differed. In line with the prediction that the two groups would differ in Dense code-switching frequency, a group comparison revealed that the interaction was due to a

marginally significant Group difference in frequency at Dense code-switching [$F(1,20)=4.25$, MSE=1.24, $p=0.05$, $\eta^2=0.18$]. The German-English 5th generation bilinguals reported to densely code-switch more frequently (M=3.4, SD=1.2) than the German-English 1st generation bilinguals (M=2.4, SD=0.9).

i. Email production task

Code-switches occurring in the email production task were classified using an analysis method developed by Deuchar, Muysken & Wang (2008). The aim of this approach is to quantify the classification of code-switching. Each code-switching instance is assessed using a catalogue of criteria (cf. Appendix 1). For each criterion, each code-switch is given either a neutral score of "0", a negative score of "-1" or a positive score of "+1. These individual scores are added up and the code-switching type receiving the highest score is taken to be the predominant pattern of a given code-switching instance.

For instance, a "+1" score for Insertion is given if a matrix language can be identified, or if the inserted item is a content word that is not peripheral in the sentence structure, i.e. a complement rather than an adjunct. Scores of "-1" are given when a criterion strongly speaks against the presence of a code-switching pattern, e.g. flagging of the switch point through commas or speech pauses is associated with a "-1" score for Dense code-switching because it makes the switch point clearly identifiable, indicating an Alternational pattern. If a criterion is not applicable, the "0" score applies. Many code-switches in naturally occurring data bear characteristics of more than one code-switching type. It is therefore often impossible to unambiguously allocate code-switches exclusively to one category. This approach considers the fluidity of bilingual speech

phenomena by locating each code-switching instance on a continuum for each code-switching type.

The bilingual emails generated 1,248 words, 617 in 5th generation bilinguals and 631 in 1st generation bilinguals. There were 101 code-switching instances, 54 in the 5th generation bilingual group and 47 in the 1st generation bilingual group. Appendix 2 provides example emails from each group. Frequency for each type of code-switching was calculated by dividing the number of times it occurred by the number of overall code-switches. It is noteworthy that only one of the 53 Insertions had an English matrix language. The remaining 52 Insertions were based on a German matrix language. Hence, there was a strong preference for using German as the base language. As the number of English matrix language Insertions was negligible, the two types of Insertion were combined into one category. Table 5 shows the relative code-switching frequencies in the two groups.

Table 3 Code-switching frequency in the email production task

	5th generation bilinguals	1st generation bilinguals	Total	Chi-square	p-value
Insertion	44.40%	61.70%	52.00%	3.00	0.08
Alternation	24.10%	23.40%	23.50%	0.01	0.94
Dense	31.50%	14.90%	23.50%	3.82	0.05

Three separate chi-square tests were conducted to identify interactions (Group * Dense code-switching frequency, Group * Insertional code-switching frequency, Group * Alternational code-switching frequency). Although the proportion of Insertional code-switching was higher amongst 1st generation bilinguals (61.7%) than in 5th generation bilinguals (44.4%), the interaction was not significant. Crucially, for Dense code-switching the opposite preference pattern was observed in the two groups. The

frequency of Dense code-switching in 5th generation bilinguals (31.5%) was more than double that of 1st generation bilinguals (14.9%). This interaction between Group and Dense code-switching frequency was marginally significant (p=0.05). Finally, there was no significant difference for Alternation.

3.2. Correlation and Regression analyses

To investigate whether results from the two tasks correlated, the two groups were combined to increase the amount of individual data points from each task. Correlational analyses are based on individual variation, so subjects-based scores needed to be created for the emails. These were computed as the proportion of times each bilingual produced a certain type of code-switch. If a bilingual produced 10 code-switches overall and 5 were classified as Insertion, their Insertional score would be 50%. 2-tailed Pearson's correlation analyses were conducted, relating the Judgement task ratings to the email production task scores. The correlations for Alternation [R(1,20)=-0.25,p=0.26] and Insertion [R(1,20)=0.16,p=0.48] were not significant. However, as illustrated in Figure 1, bilinguals who rated their Dense code-switching frequency highly in the judgement task also used more Dense code-switching in the email task [R(1,20)=0.51,p=0.01].

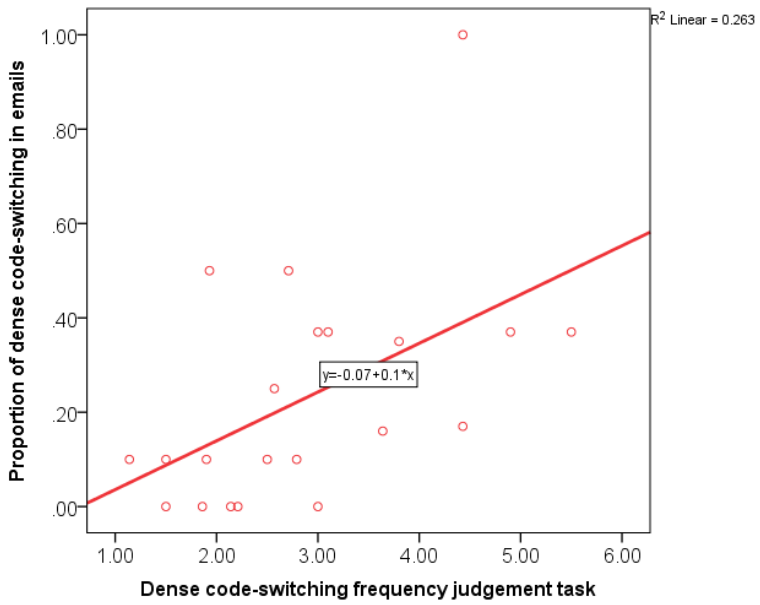

Figure 1 Correlation for Dense code-switching

Regression analyses were conducted to investigate the explanatory value of the judgement task when it came to predicting actual code-switching in the email data. For this purpose, exploratory stepwise regressions were conducted. The frequency judgement task ratings for each code-switching type were used as predictors. The frequency of the different code-switching types occurring in the emails as the outcome variables. Three analyses were conducted with frequency of each code-switching type produced in the emails as an outcome variable respectively. The case-wise diagnostics did not identify any outliers.

The regression analyses with the outcome variables Insertion and Alternation produced no conclusive results. Crucially, the stepwise regression with the outcome variable Dense code-switching in emails identified the judgement task ratings for Dense code-switching as the only significant predictor explaining 22.6% of variance at Dense code-switching production [R(1,20)=0.51, Adj. R square=0.226, F-change=7.12,

p=0.02, B=0.10, β=0.51]. Taken together, the correlation and regression analyses suggest that the two tasks correlate when it comes to assessing Dense code-switching.

3.3. Executive performance in the flanker task

A detailed discussion of the executive function task results has been published in Hofweber et al. (2016). However, the analysis of additional linguistic background data revealed a group difference for AoO, making it necessary to add this variable as a covariate. Hence, this section will provide a summary of a replication of the key findings, considering the covariate. An ANCOVA was conducted with Group (5^{th} generation, 1^{st} generation) as the between-subject factor, Monitoring condition (low, medium, high) as the within-subject factor and the Conflict effect as the dependent variable. The significant Group*Monitoring Interaction [F(1.39,26.33)=4.09, MSE=728.68, p=0.041, η^2=0.18] of the original study was replicated. In line with the original analysis, the interaction was due to a significant Group effect in the high-monitoring condition [F(1,20)=5.66, MSE=522.30, p=0.03, η^2=0.23]. The 5^{th} generation bilinguals who densely code-switched more frequently experienced a smaller conflict effect (M=47.56ms,SD=27.53ms) than the bilinguals engaging in less dense code-switching (M=80.36ms,SD=16.00) in the condition posing greatest load to conflict-monitoring.

6. Discussion

This paper aimed to contribute to the development of ecologically valid, yet efficient, methods of assessing sociolinguistic habits in bilingualism research. It compared two

novel tasks assessing code-switching that are assumed to be more representative than questionnaires: a frequency judgement task based on authentic stimuli, and an email production task. The tasks were administered to two groups of German-English bilinguals who were predicted to differ in code-switching patterns. Convergence of the two tasks in comparing code-switching patterns across the two groups and on an individual basis was taken as evidence for their ecological validity. The results of the two tasks are also discussed in relation to a group comparison of executive performance. A previous study with the same participants had shown that the bilinguals engaging in more dense code-switching outperformed the less frequent dense code-switchers at conflict-monitoring (Hofweber et al., 2016). If the additional email data presented in this study are in line with predictions based on existing processing models of code-switching (Green & Wei, 2014), then that speaks for the ecological validity of this novel method.

Results from the email production task generally converged with results from the frequency judgement task. Both tasks revealed a significantly greater preference for Dense code-switching in 5th generation bilinguals compared to 1st generation bilinguals. The two tasks also showed greater frequency of Insertion in 5th generation bilinguals compared to 1st generation bilinguals, although this difference was not statistically significant in either task. They also converged when it came to identifying the preferred matrix language in Insertional code-switching, which is clearly German in the sociolinguistic circumstances investigated by this study. It is possible that other sociolinguistic environments and language profiles might favour a reversal of matrix languages (Myers-Scotton, 1996), e.g. in the case of L1-English speakers living in German-speaking contexts. In view of the strongly converging evidence, the results

from the free production task support the ecological validity of the more experimental frequency judgement task.

The correlations between the frequency of code-switching as measured by the two tasks were less clear. The frequency scores from the judgement task and the email production task correlated only for Dense code-switching, but not for Alternation and Insertion. It is possible that the absence of a significant correlation was due to the small sample size of this study. However, the data converged for the crucial variable revealing the group difference. Results from the judgement task successfully predicted the frequency of Dense code-switches occurring in the production data. Hence, both tasks converged in revealing the crucial group difference in code-switching patterns.

The predictions for the differential code-switching patterns in the two groups were derived from Muysken's (2000) observations, which in turn were based on authentic sociolinguistic corpora. It was predicted that the 5th generation bilinguals would engage in more Dense code-switching than the recent bilinguals because Dense code-switching is a language practice that typically emerges in communities with long-standing bilingual traditions. This prediction was confirmed by both the judgement task and the bilingual email production task. The alignment of the task results with Muysken's (2000) empirically grounded framework suggests that both tasks represent assessment methods with a high level of ecological validity.

The results from the executive function task chimed well with the group differences revealed by both the email production task and the frequency judgement task. Existing models of code-switching suggest that Dense code-switching will recruit executive functions involved in the management of co-activated languages and competing linguistic items and structures (Green & Wei, 2014). It is likely that Dense forms of

code-switching therefore train bilinguals' conflict-monitoring skills. Indeed, a re-analysis of the Hofweber et al. (2016) results confirmed that the group engaging in more Dense code-switching showed enhanced performance in the high-monitoring condition of the flanker task. The significant group differences at Dense code-switching were revealed by both the email production task and the frequency judgement task. Hence, both tasks were well-suited for explaining the observed group differences at executive functions, based on existing processing models of code-switching.

A potential concern surrounding the email production task was whether production in a written medium would be representative of language practices in the spoken modality. The instructions of the judgement task asked participants to indicate their frequency of using the stimulus utterances in spoken conversations and the stimuli were presented in an auditory format. Despite of this difference in modality between the two tasks, the tasks converged in revealing the crucial group difference at Dense code-switching. This suggests that code-switching in emails is representative of code-switching in speech.

To summarise, this study suggests that both the frequency judgement task using authentic utterances from corpora and the bilingual email production task are suitable methods for assessing bilinguals' code-switching habits. However, several limitations apply. Firstly, the data set was small, so only limited generalisations can be made. Secondly, we did not have a benchmark of actual bilingual speech data, which would be necessary to fully assess the ecological validity of the two tasks. Thirdly, and possibly due to the small data set, the results from the two tasks only correlated for Dense code-switching. Future research should therefore investigate additional methods of eliciting production data, such as sentence repetition tasks (Marinis & Armon-Lotem, 2015).

Indeed, Gullberg and Muysken (2009) argue that important new insights into code-switching can be obtained through such experimental techniques. A future large-scale study that assesses the validity of a range of tasks by systematically comparing quasi-authentic data to a corpus of authentic speech data from the same participants could pave the way for considering sociolinguistic practices as an independent variable in bilingualism studies, as well as in psycholinguistic research.

7. Conclusion

This study was an extension of a previous study investigating the impact of dense code-switching on executive functions (Hofweber et al., 2016). It presented two novel and efficient methods of assessing code-switching practices in bilingualism research: a frequency judgement task and a bilingual email production task. The two tasks converged in describing similar and differential code-switching patterns in two groups of bilinguals with different sociolinguistic backgrounds. Moreover, the frequency scores from the two tasks correlated for the type of code-switching that differentiated the two groups, i.e. Dense code-switching. The bilinguals who code-switched more densely were shown to outperform the other group at the aspect of executive functions assumed to be involved in Dense code-switching, i.e. conflict-monitoring. Hence, the two tasks assessing code-switching provided useful data for explaining an observed group difference at executive functions. The use of similar tasks to assess sociolinguistic practices as independent variables in bilingualism research is therefore recommended.

References

Backus, A. (2015). *A usage-based approach to codeswitching: The need for reconciling structure and function*. In: G. Stell and K. Yapko (eds). Code-switching at the crossroads between structural and sociolinguistic perspectives. Berlin: Mouton de Gruyter.

Bak, T. (2016). Cooking pasta in La Paz: Bilingualism, bias and the replication crisis. *Linguistic Approaches to Bilingualism*, 6 (5), 699-717.

Bhatt, R., Bolonyai, A. (2011). Code-switching and the optimal grammar of bilingual language use. *Bilingualism: Language and Cognition*, 14, 522-546.

Bialystok, E., Craik, F.I.G., Luk, G. (2012). Bilingualism: Consequences for Mind and Brain. *Trends in Cognitive Science*, 16, 240-250.

Clyne, M. (2003). Dynamics of Language Change. Cambridge Approaches to Language Contact, Cambridge University Press.

Costa, A., Hernandez, M., Costa-Faidella, J., Sebastian-Galles, N. (2009). On the bilingual advantage in conflict processing: Now you see it, now you don't. *Cognition*, 113, 135-149.

Crystal, D. (2006). Language and the internet. Cambridge University Press

Deuchar, M., Muysken, P. & Wang, S. (2008). Structured Variation in Codeswitching: Towards an Empirically Based Typology of Bilingual Speech Patterns. *International Journal of Bilingual Education and Bilingualism*, 10, 298-34.

Dewaele, J. M., & Wei, L. (2014). Attitudes towards code-switching among adult mono-and multilingual language users. *Journal of Multilingual and Multicultural Development*, 35(3), 235-251.Pedro Macizo

Eppler, E. (2005). The Syntax of German-English code-switching. PhD Thesis, UCL.

Gardner-Chloros, P. (2009). Code-switching. Cambridge: Cambridge University Press.

Green, D.W., Wei, L. (2014). A control process model of CS. Language, *Cognition and Neuroscience*, 24, 499-511.

Gullberg, M., Indefrey, P., & Muysken, P. (2009). *Research techniques for the study of code-switching*. In: B.E. Bullock and J. A. Toribio (eds.). The Cambridge Handbook of linguistic code-switching, pp. 21-39, Cambridge University Press.

Hartanto, A., Young, H. (2016). Disparate bilingual experiences modulate task-switching advantages: A diffusion-model analysis of the effects of interactional context on switch costs. *Cognition*, 150, 10-19.

Hofweber, J., Marinis, T., & Treffers-Daller, J. (2016). Effects of dense code-switching on executive control. *Linguistic Approaches to Bilingualism*, 6(5), 648-668.

Koch, P., Oesterreicher, W. (2007). Schriftlichkeit und kommunikative Distanz. *Zeitschrift für germanistische Linguistik*, 35(3), 346-375.

Kupisch, T., Van de Weijer, J. (2016). *The role of the childhood environment for language dominance: A study adult simultaneous bilingual speakers of German and French.* In: C. Silva-Corvalan and J. Treffers-Daller (eds.). Language Dominance in Bilinguals. Issues of Measurement and Operationalization. Cambridge University Press, pp. 174-195, Cambridge University Press, Cambridge

Labov, William (1972). Sociolinguistic Patterns. Philadelphia: University of Pennsylvania.

Li, P., Zhang, F., Tsai, E., Puls, B. (2013). Language history questionnaire (LHQ 2.0): A new dynamic web-based research tool. *Bilingualism: Language and Cognition*, 17, 673-680.

Marinis, T. and Armon-Lotem, S. (2015). *Sentence repetition*. In: S. Armon-Lotem, J. de Jong, and N. Meir (eds.). Methods for assessing multilingual children: disentangling bilingualism from Language Impairment. Multilingual Matters, pp. 95-124.

Muysken, P. (2000). Bilingual Speech: A Typology of Code-mixing. Cambridge: Cambridge University Press.

Myers-Scotton, C. (1998). *A way to dusty death:the Matrix Language turnover hypothesis.* In: L. A. Grenoble and L.J. Whaley (eds.). Endangered languages: language loss and community response, 289.

Onar Valk, P., Backus, A. (2013) 'Syntactic change in an immigrant language: from non-finite to finite subordinate clauses in Turkish'. *Journal of Estonian and Finno-Ugric Linguistics*. Areal linguistics, grammar and contacts, 4 (2): 7-29.

Paap, K.R., Greenberg, Z.I. (2013). There is no coherent evidence for a bilingual advantage in executive processing, *Cognitive Psychology*, 66, 232-258.

Poplack, S. (1980). Sometimes I'll start a sentence in Spanish Y TERMINO EN ESPAÑOL: toward a typology of code-switching. *Linguistics*, 18(7-8), 581-618.

Raven, J., Raven, J. C., & Court, J. H. (1998). Manual for Raven's progressive matrices and vocabulary scales. Oxford: Oxford Psychologists Press.

Rodriguez-Fornells, A., Kraemer, U.M., Urbano, L., Festman, J., Muente, T.F. (2012). Self-assessment of individual differences in language switching. *Frontiers in Psychology*, 2, Article 388

Soares, C. & Grosjean, F. (1984). Bilinguals in a monolingual and a bilingual speech mode: The effect on lexical access. *Memory & Cognition*, 12, 380-386

Soveri, A., Rodriguez-Fornells, A., Laine, M. (2011). Is there a relationship between language switching and executive functions in bilingualism? Introducing a within-group analysis approach. *Frontiers in Psychology*, 2, Article 183.

Sweeney, E., & Hua, Z. (2010). Accommodating toward your audience: do native speakers of English know how to accommodate their communication strategies toward nonnative speakers of English? *The Journal of Business Communication*, 47(4), 477-504.

Treffers-Daller, J. (2009). *Code-switching and transfer: an exploration of similarities and differences.* In: B.E. Bullock and J. A. Toribio (eds). The Cambridge Handbook of Linguistic Codeswitching. Cambridge University Press, pp.58-74.

Verreyt, N., Woumans, E., Vandelanotte, D., Szmalec, A., Duyck, W. (2016). The influence of language-switching experience on the bilingual executive control advantage. *Bilingualism: Language and Cognition*, 19 (1), 2016, 181–190.

Wechsler, D. (1997). Wechsler Memory Scale–Third Edition. San Antonio, TX: The Psychological Corporation.

Weinreich, U. (1963). On the semantic structure of language. *Universals of language*, 1, 142-215.

Yim, O., Bialystok, E. (2012). Degree of conversational code-switching enhances verbal task-switching in Cantonese-English bilinguals. *Bilingualism: Language and Cognition*, 15, 873 – 883.

Zell, E., & Krizan, Z. (2014). Do people have insight into their abilities? A metasynthesis. *Perspectives on Psychological Science*, 9, 111 – 125.

Appendix 1

Table 4 Predominant pattern Insertion

Criteria	Insertion	Alternation	Dense	Wie war denn Euer **holiday** in den Bahamas?	Insertion score	Alternation score	Dense score
single constituent	+	0	0	-	-1	0	0
several constituent	-	+	0	-	1	-1	0
non-constituent	-	-	+	+	-1	-1	1
nested aba	+	-	0	+	1	-1	0
non-nested aba	-	+	+	-	1	-1	-1
DIVERSE SWITCHES	-	0	+	-	1	0	-1
long constituents	-	+	-	-	1	-1	1
complex constituents	-	+	-	-	1	-1	1
content word	+	-	-	+	1	-1	-1
function word	-	-	+	-	1	1	-1
adverb, conjunction	-	+	-	-	1	-1	1
selected element	+	-	+	+	1	-1	1
emblematic or tag	-	+	0	-	1	-1	0
major clause boundary	0	+	0	-	0	-1	0
peripheral	0	+	0	-	0	-1	0
embedding in discourse	0	+	0	-	0	-1	0
flagging	-	+	-	-	1	-1	1
dummy word insertion	+	0	-	-	-1	0	1
BIDIRECTIONAL SWITCHIN	-	+	+	-	1	-1	-1
linear equivalence	0	+	+	+	0	1	1
telegraphic mixing	+	-	-	-	-1	1	1
morphological integratior	+	-	+	+	1	-1	1
doubling	-	+	-	-	1	-1	1
HOMOPHONOUS DIAMO	0	-	+	-	0	1	-1
triggering	0	0	+	-	0	0	-1
mixed collocations	0	-	+	-	0	1	-1
self-corrections	-	+	-	-	1	-1	1
Score					12	-13	4

Table 5 Predominant pattern Alternation

Criteria	Insertion	Alternation	Dense	Danach, **quite by chance,** kam der Nachbar reingeschneit.	Insertion score	Alternation score	Dense score
single constituent	+	0	0	-	-1	0	0
several constituent	-	+	0	-	1	-1	0
non-constituent	-	-	+	+	-1	-1	1
nested aba	+	-	0	-	-1	1	0
non-nested aba	-	+	+	+	-1	1	1
DIVERSE SWITCHES	-	0	+	-	1	0	-1
long constituents	-	+	-	0	0	0	0
complex constituents	-	+	-	0	0	0	0
content word	+	-	-	-	-1	1	1
function word	-	-	+	-	1	1	-1
adverb, conjunction	-	+	-	0	0	0	0
selected element	+	-	+	-	-1	1	-1
emblematic or tag	-	+	0	+	-1	1	0
major clause boundary	0	+	0	-	0	-1	0
peripheral	0	+	0	+	0	1	0
embedding in discourse	0	+	0	+	0	1	0
flagging	-	+	-	+	-1	1	-1
dummy word insertion	+	0	-	-	-1	0	1
BIDIRECTIONAL SWITCHIN	-	+	+	+	-1	1	1
linear equivalence	0	+	+	0	0	0	0
telegraphic mixing	+	-	-	-	-1	1	1
morphological integratior	+	-	+	-	-1	1	-1
doubling	-	+	-	-	1	-1	1
HOMOPHONOUS DIAMO	0	-	+	-	0	1	-1
triggering	0	0	+	-	0	0	-1
mixed collocations	0	-	+	-	0	1	-1
self-corrections	-	+	-	-	1	-1	1
Score					-7	9	0

Table 6 Predominant pattern Dense code-switching

Criteria	Insertion	Alternation	Dense	Der neue „Digger“ kam dann sehr handy.	Insertion score	Alternation score	Dense score
single constituent	+	0	0	-	-1	0	0
several constituent	-	+	0	-	1	-1	0
non-constituent	-	-	+	+	-1	-1	1
nested aba	+	-	0	-	-1	1	0
non-nested aba	-	+	+	-	1	-1	-1
DIVERSE SWITCHES	-	0	+	+	-1	0	1
long constituents	-	+	-	0	0	0	0
complex constituents	-	+	-	0	0	0	0
content word	+	-	-	+	1	-1	-1
function word	-	-	+	+	-1	-1	1
adverb, conjunction	-	+	-	0	0	0	0
selected element	+	-	+	+	1	-1	1
emblematic or tag	-	+	0	-	1	-1	0
major clause boundary	0	+	0	-	0	-1	0
peripheral	0	+	0	-	0	-1	0
embedding in discourse	0	+	0	-	0	-1	0
flagging	-	+	-	+	-1	1	-1
dummy word insertion	+	0	-	-	-1	0	1
BIDIRECTIONAL SWITCHIN	-	+	+	+	-1	1	1
linear equivalence	0	+	+	0	0	0	0
telegraphic mixing	+	-	-	-	-1	1	1
morphological integratior	+	-	+	-	-1	1	-1
doubling	-	+	-	-	1	-1	1
HOMOPHONOUS DIAMO	0	-	+	+	0	-1	1
triggering	0	0	+	+	0	0	1
mixed collocations	0	-	+	+	0	-1	1
self-corrections	-	+	-	-	1	-1	1
Score					-3	-9	8

Appendix 2

Hi XX,

Hi XX,

long time no see (a), aber es tat gut, mal wieder von dir zu hören. Wie war denn euer holiday (i) in den Bahamas? Habt ihr denn auch
long time no see (a), but it was good, once again from you to hear. How was then your holiday (i) in the Bahamas? Have you then also
gesuntanned (d)? Schick doch mal ein paar snapshots (i) von euch auf der beach (d)! My old man (i) und ich haben am weekend (i) im
suntanned (d)? Send do once a few snapshots (i) of you on der beach (d)! My old man (i) and I have at the weekend (i) in the
Garten geschuftet. Der neue „Digger" (i) kam dann sehr handy (d) und verkürzte die Arbeit by half (d). Danach, quite by chance (a),
garden laboured. The new „Digger" (i) came in then very handy (d) and shortened the work by half (d). Then, quite by chance (a),
kam der Nachbar reingeschneit - wollte sich 'nen Spaten leihen, sah den Digger (i) und war blown away mit der neuen technology (d).
came the neighbour wandering in – wanted himself a spade to borrow, saw the Digger (i) and was blown away with the new technology (d).
What happened then? (a) Sure (a), jetzt baggert das Ding bei ihm im Garten und bei uns ist Ebbe! So ein cooles Gerät will ja jeder haben,
What happened then? (a) Sure (a), now digs the thing at his place in the garden and at ours is over! Such a cool device wants everybody to have
not so (a)? XZ geht's so-so (i). Hat schon wieder Kopfschmerzen, like there's no tomorrow (a). Throbbing (a), sagt sie. Oh well (a), was soll
not so (a)? XZ is so-so (i). Has already again headaches, like there's no tomorrow (a). Throbbing (a), says she. Oh well (a), what should
man erwarten wenn sie jede Nacht durch partied (d)? Looks to me als ob die Jugend nie auslernt (i)! Müssen ja alle erst aus Erfahren ihre
one expect if she every night parties through (d)? Looks to me as if young people never stop learning (i)! Have all first from experience their
lessons lernen (d)! Und gibt sie eine helping hand (d) in der Küche? Nichts da. Mama ist ja hands on (i). War ich auch so als teenager (i)?
lessons to learn (d)! And gives she a helping hand (d) in the kitchen? Never ever. Mum is hands on (i). Was I also like that as a teenager (i)?
Mensch haben unsere Eltern uns jobben lassen (d). Weißt du noch? Nichts von wegen all night out (i), und so! Ja, times are changing (a), sag ich dir!
Gosh have our parents us work hard made (d). Know you still? Nothing like all night out (i), and so on! Yes, times are changing (a), say I to you!
All the best (a), Bruderherz und grüß mir dein little wife (i). Deine XY
All the best (a), dear brother and say hello for me to your little wife (i). Yours XY
Coding: (i) Insertion (a) Alternation (d) Dense code-switching

Figure 2 Email by 5th generation bilingual

Hi hun (i),
Hi hun (i),
hab das Gefühl ich hab dich schon seit Monaten nicht mehr gesehen. Bist du aktuell in der city (i) oder mal wieder
have the feeling I have you already for months not any more seen. Are you currently in the city (i) or once again
on holiday (i)? Letzdes Wochenende war XY da, die hätte dich auch gern mal wieder gesehen. War aber auch so ein
on holiday (i)? Last weekend was XY here, she would have you also liked once again seen. Was but also like this a
top Wochenende. Das war mehr oder weniger ein Wochenend-Pub Crawl (i). Freitag waren wir ein bisschen
top weekend. It was more or less a weekend-Pub Crawl (i). Friday were we a bit
sightseeing (i) machen und shoppen (i), abends haben wir uns dann aufgestylt und sind in eine nice Rooftop bar
sightseeing (i) do and shoping (i), in the evening have we us then dressed up and have in a nice Rooftop bar (d)
in Shoreditch gewesen, was ganz praktisch war, weil wir nachts easy und cheap (d) mit einem cab (i) nach Hause konnten.
in Shoreditch been, which quite handy was, because we at night easy und cheap (d) with a cab (i) home could go.
Wird Zeit, dass ab September die tube all night (d) fährt. Samstag kam dann eine alte Freundin von ihr aus Essex, die sie noch
It's time that from september the tube all night (d) runs. Saturday came then an old friend of hers from Essex, whom she still
aus der Boarding School (i) kennt. Ging dann wieder nach Shoreditch. Erst dinner (i), dann drinks (i) und dann in einen alten
from the Boarding School (i) knows. Off then again to Shoreditch. First dinner (i), then drinks (i) and then onto an old
warehouse club (i), coole Atmosphäre. Anyways (a), wollte eigentlich wissen, wann wir uns endlich mal wieder auf urgently
warehouse club (i), cool atmosphere. Anyways (a), wanted actually to know, when we us finally once again for urgently
needed drinks (i) treffen? Catch-up (i) ist Pflicht! Irgendwo in Soho? Falls du noch nicht wieder in der city (i) bist, meld dich
needed drinks (i) meet? Catch-up (i) is duty! Somewhere in Soho? If you yet not again in the city (i) are, get in touch
wenn du back (i) bist!
when you back (i) are!
Kisses xx (i)
Coding: (i) Insertion (a) Alternation (d) Dense code-switching

Figure 3 Email by 1st generation bilingual