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Formulation processes of monolingual, bilingual, and biliterate writers: Effects of biliteracy

ELAINE NG [a]

[a] *The Chinese University of Hong Kong, Hong Kong*
elaine.ng@cuhk.edu.hk

Abstract

By looking beyond their written products into what they do as they write, this mixed methods study offers insights into the writing process of writers who have mastered one language and those who have mastered two. It investigates the cognitive effects of bilingualism and biliteracy on the writing processes of years ten and eleven Sydney high school writers across three groups (N = 30): English monolinguals, Chinese-English bilinguals, and Chinese-English biliterates, focusing on their formulation processes (i.e., how thoughts are converted into language and the written form). Findings indicate distinctive features and patterns of writing behaviours, possibly reflecting specific strengths and weaknesses for each group. The monolinguals demonstrated strategic use of vocabulary, while the biliterates and bilinguals demonstrated prospective and retrospective behaviours when formulating. These findings are discussed in light of studies on the writing process and on the effects of bilingualism.

Keywords: writing processes, formulation processes, problem-solving formulation, bilingualism, biliteracy

Background – The Writing Process and the Effects of Biliteracy

This study bridges writing process research and research on the effects of bilingualism and biliteracy with a focus on the formulation processes of monolingual, bilingual, and biliterate writers. Over the past decades, these processes have been studied extensively (e.g., Chenoweth & Hayes, 2001; Flower & Hayes, 1981; Galbraith & Baaijen, 2019; Koutsoftas, 2018; Lincoln & Ben Idris, 2015; Stapleton, 2010). This body of research has identified the act of writing as involving three distinct sub-processes: planning, formulating, and revising. Planning is widely understood as conceptualisation, structuring, and goal-setting before writing occurs (Flower & Hayes, 1981). Formulating is the actual converting of proposed thoughts and ideas into language and written sentences. Revising is the reviewing or modifying of both proposed and written language (Chenoweth & Hayes, 2001). Reading is also considered a frequent, recurring sub-process, as writers frequently read as they write (Stevenson, 2005).

Data Availability Statement: *All relevant data are within this paper.*

During a writing task these sub-processes are non-linear, dynamic, recursive, and unsystematic (Alamargot & Chanquoy, 2001).

Formulation, which is the main focus of this study, is frequently and particularly a complex sub-process in which writers engage. When writing, the ability to convert multiple ideas into grammatical and meaningful sentences requires conscious effort and time to master. Exercising such an ability, which depends largely on knowledge about writing and the topic, and the integration of thoughts, conceptualisation, and linguistic form, is a complex process. Converting an idea into a sentence when the task is easy may be simple, but this is often not the case. Interruptions to fluent formulation are possible, whether these are related to writing or language problems or to pause or self-reflect. To date, few studies have specifically examined writers' problem-solving formulation (e.g., Roca de Larios *et al*., 1999 & 2006). These studies have identified a small number of formulation behaviours or strategies of second language (L2), or less proficient writers, including backtracking (i.e., continuous eye-movements between already written text and emerging text) to aid further formulating, compensatory strategies to search for linguistic equivalents when writers are unable to produce a precise word or expression, and upgrading strategies to improve an expression.

Moreover, examining bilingualism, biliteracy, and writing is particularly relevant today, as increasing numbers of students in Australia possess diverse linguistic backgrounds. Bilingualism has not always been as valued as it is today. Prior to the 1960s, some migrant parents purposely delayed their children's acquisition of the mother tongue, believing that speaking multiple languages would cause linguistic confusion (Petitto, *et al*., 2001). Over time, views on bilingualism became more positive, and the argument developed that bilingualism could lead to numerous advantages, such as better concept-formulation (Cummins, 1976). Much research has been done to examine potential cognitive advantages. Mixed findings have indicated positive effects, such as heightened metacognitive awareness (i.e., the ability to reflect on one's own thinking processes), and greater linguistic sensitivity as a result of managing multiple languages (Adesope *et al*., 2010). Other studies have reported monolingual advantages in verbal fluency, lexical access, and receptive vocabulary (Bialystok & Luk, 2012; Sandoval *et al*., 2010).

Few studies have examined the effects of biliteracy on the writing processes. Little is known about the writing process in general, and formulation processes in particular, of bilingual and biliterate writers. Biliteracy may be understood as an advanced state of bilingualism, in which a person can speak, read, and write proficiently in two languages (Niyekawa, 1983). Past studies comparing biliterates to monoliterates have largely examined cross-linguistic transfer in reading, i.e., the transfer of literacy skills, such as reading strategies, between biliterates' languages, rather than transfer in writing (e.g., Branum-Martin *et al*., 2012; Jared *et al*., 2011). These studies identified a number of skill-transfer advantages for biliterate readers, including orthographical processing and phonological awareness (e.g., Lyster *et al*., 2013; Schwartz *et al*., 2010). Biliterate reading often enhances the ability to differentiate between different syllables and sounds (Schwartz *et al*., 2010). However, these advantages seem only to occur for biliterates in alphabetic languages rather than in languages with different orthographies, such as English and Chinese.

This study examines the actions of Chinese-English bilinguals (encompassing two sample groups divided by biliteracy proficiency) and English monolinguals during the writing process, by providing a detailed examination on the formulation of: (1) biliterate-bilinguals who speak, read, and write in both languages, (2) mono-literate bilinguals who speak both languages but read and write in English only, and (3) mono-literate monolinguals who speak, read, and write in English only. The groups will be referred to respectively as biliterates, bilinguals, and monolinguals. The literature and relevant studies will be detailed in the following section, followed by this study's aims and research questions.

Formulation

Formulation is a complex integration of conceptual and linguistic resources. Writers need to keep in mind the ideas they want to communicate, while manipulating and structuring words and sentences to express the ideas correctly and appropriately. Researchers have identified two aspects that are closely related to this complex integration of conceptual and linguistic processing while formulating: writers' working memory capacity and writing fluency (Van Gelderen & Oostdam, 2005). When writers formulate, the working memory coordinates and processes relevant task knowledge and transforms developed conceptualisations into sentences (Kellogg *et al*., 2007). Relevant task knowledge involves conceptual knowledge of the subject matter and linguistic knowledge regarding how proper sentences are formed. Juggling conceptual and linguistic resources when formulating is understood to be the main cause of cognitive overload in working memory (Van Gelderen & Oostdam, 2005). When writers face difficulty in converting ideas into writing, extra burden is placed on working memory, hampering fluent, uninterrupted formulation.

Previous studies on formulation that examined the impact of working memory capacity on fluency did not highlight the actual formulation problems that writers encountered (Roca de Larios *et al*., 2006). The fewer the interruptions to the formulation process, the more fluent is the writer at formulating. Thus, the fluency level may be indicative of the writers' problem-solving formulation. Writers' different types of problem-solving behaviours when formulating need closer examination.

Problem-solving formulation

Problem-solving formulation occurs when, due to a writing problem, a writer stops converting thoughts into sentences. There is a need to distinguish between operationalisations of problem-solving formulation and sub-process revision (Roca de Larios *et al*., 2006). Problem-solving formulation is operationalised as any modifications made within a sentence that is still being written, including any instances within an incomplete sentence that indicate the existence of a problem. Revision is operationalised as any modifications made to a completed sentence or text. Moreover, problem-solving formulation begins with identifying a problem. Revision, however, whether or not triggered by a specific problem, must result in change to the text. Problem-solving formulation does not have to result in text changes, and may simply include problem-solving behaviours such as verbalising a meta-comment while formulating.

The Use of L1 (First Language). Formulating in L2 is known to be more problematic than formulating in L1 (Chenoweth & Hayes, 2001; Sasaki, 2004; Wang, 2003). Multiple studies have reported the use of L1, or "language switching," in the L2 formulation processes as a common problem-solving strategy when writers face sentence construction and linguistic problems and have reported mixed results. Wang (2003) reported that switching to L1 for lexical retrieval made it easier to formulate intended meanings in L2. In contrast, Sasaki (2004) reported the resorting to L1 for planning when formulating in L2 led to language problems when writers sought translation equivalents in L2.

Backtracking. Specific problem-solving behaviour that closely relates to formulation, backtracking, has been reported in some studies (e.g., Manchon *et al*., 2000; Smith, 1994). Backtracking is the continuous movement backward and forward between transcribed and emerging text, and includes re-reading. These studies reported that writers used backtracking when formulating mainly to tackle different linguistic problems, to improve matching between ideas, intentions, and appropriate linguistic expressions, and to move forward in formulation, which is often true for L2 writers who re-read the wording of their immediately transcribed texts together with different segments of the transcribed text.

Restructuring. A formulation-specific strategy in L2 writing (Roca de Larios *et al*., 1999), this is understood as the searching for an alternative syntactic plan when the original plan is not working. Restructuring serves two purposes during formulation – to improve expression of meaning and to compensate for L2 limitations, such as searching for an L2 equivalent to replace an L1 word or idea. Writers may employ this strategy using L1 when they come across linguistic, ideational, and textual formulation problems. When solving a linguistic problem, writers engage in restructuring to search for replacement of an L1 word or idea with an L2 equivalent. When solving an ideational problem, writers engage in restructuring to abandon an unsatisfactory message or to further elaborate an idea. When solving a textual problem, writers can change their initial textual expression to a more appropriate one, while saving the initial expression for possible use in forthcoming sentences.

Compensatory and Upgrading Formulation. Roca de Larios *et al*. (2006) closely examined L2 writers' problem-solving formulation processes when searching for linguistic equivalents and improving intended meanings. They reported two explicit types of problem-solving formulation – compensatory and upgrading problems. Compensatory problems are associated with writers' searches for linguistic equivalents. These formulation problems occur when a writer is unable to produce a precise word or phrase to describe an idea, so an alternative is used. When writers do not possess the exact word or expression describing their intentions or original ideas, they may search for alternatives that seem closest in meaning to their original intended expression as a form of compensation. Examples may be "the little star on the keyboard" to mean "asterisk" or "the round, rat-like animal from Australia" to mean "wombat." Compensatory problems may also include replacing a hyponym with a more general word, for example from "scarlet" to "red," or replacing a word with its synonym, for example from "affluent" to "well-off." Upgrading formulation occurs when a writer improves an expression so that meaning and intention in the sentence are better matched. It also means refining an expression or idea in a sentence, for example, the word "mannequin" that is formulated as "plastic doll," becomes "plastic doll that displays clothes at a shopping centre."

The Present Study

This study has two aims. It aims to investigate the effects of biliteracy in terms of the writing process, providing a close examination of the formulation processes in particular of bilingual and biliterate writers. When converting ideas into writing, monolinguals, bilinguals, and biliterates are likely to think, formulate, and engage in formulation processes differently. Secondly, it aims to uncover a wider range of problem-solving formulation processes than previous research has found. This study thus proposes two specific types of problems that can occur during formulation – linguistic formulation and conceptual formulation problems. Linguistic formulation problems are those that relate to aspects of language, such as orthography, grammar, and vocabulary. For instance, a writer may spell out a difficult word several times until the correct spelling is recalled. In contrast, conceptual formulation problems relate to expressing an idea. Writers may add, change, or erase parts of their sentences while formulating, leading to modifications of meaning in the middle of a sentence. This study anticipates the identification of a much wider range of formulation processes of different writers in addition to that examined in previous research.

There are two research questions. Question 1 examines the groups' overall writing processes; question 2 focuses on the groups' formulation.

RQ 1) Is there a difference between the writing processes of monolinguals, bilinguals, and biliterates in a) narrative texts and b) argumentative texts?

RQ 2) Is there a difference between the formulation processes of monolinguals, bilinguals, and

biliterates in a) narrative texts and b) argumentative texts?

Method

Context

This study was conducted at three schools located in middle class suburbs within the Sydney metropolitan area, namely (1) an independent, private high school in the Hills District with a high population of Anglo-Australian families, (2) a partially-selective, government-funded high school in the lower North Shore with a high population of Chinese-speaking immigrant families, and (3) a public, weekend school in the North Shore offering special heritage and language maintenance programmes to students with home languages other than English.

Selection procedure

This study adopted a two-stage selection procedure for each sample group – monolinguals, bilinguals, and biliterates, to ensure that participants had similar levels of English reading and writing proficiency to their sample group peers.

Stage One. Participants attending years ten and eleven were recruited for each sample group ($N = 120$) based on a language background questionnaire (appendix A), an English literacy test, and a Chinese literacy test. The English literacy test was taken from the 2004 School Certificate Examination, a qualification issued by the Board of Studies in New South Wales to year ten students until 2011. The Chinese literacy test was taken from the 2006 Higher School Certificate (HSC). Older versions of the tests were specifically chosen to ensure that the students would not have taken these tests previously at school.

Inter-rater reliability was calculated for the English and Chinese writing tasks and the Chinese reading task from the literacy tests. The English reading task was multiple choice and did not require a second rating. The raters were the author of this paper and an experienced teacher, both literate in English and Chinese. Descriptions for rating these tasks were identical to those used in the original past papers. Significant and positive correlations were found between the scores given by the two raters for all three tasks (English writing task: $r(120) = .91$, $p < .01$, Chinese writing task: $r(120) = .78$, $p < .01$, and Chinese reading task: $r(120) = .81$, $p < .01$).

Table 1 presents the reading and writing task scores for each group. One-way ANOVAs found no significant difference between the groups' level of English writing, $F(2,117) = .64$, $p = .53$, $\eta^2 = .01$ or English reading, $F(2,117) = 1.10$, $p = .34$, $\eta^2 = .02$.

Table 1 *Stage one – group performance in literacy tests (N = 120)*

Group	English reading task (out of 12)	English writing task (out of 20)	Chinese reading task (out of 15)	Chinese writing task (out of 25)
Monolingual *N* = 40	Mean 8.75 SD 2.32	Mean 12.49 SD 3.05		
Bilingual *N* = 40	Mean 8.85 SD 1.76	Mean 13.17 SD 1.88		
Biliterate *N* = 40	Mean 8.13 SD 2.92	Mean 13.14 SD 3.78	Mean 11.46 SD 2.39	Mean 18.22 SD 3.49

Stage Two. Ten participants who achieved one standard deviation above the means in the literacy tests

were identified and selected from within the three larger sample groups (n = 30). Table 2 presents the new groups' levels of reading and writing in the tests. One-way ANOVAs found no significant difference between the groups' English writing, $F(2,27) = .69$, $p = .51$, $\eta^2 = .03$ or English reading, $F(2,27) = 1.09$, $p = .35$, $\eta^2 = .04$.

Table 2 *Stage two – group performance in literacy tests (n = 30)*

Group	English reading task (out of 12)		English writing task (out of 20)		Chinese reading task (out of 15)		Chinese writing task (out of 25)	
Monolingual *n* = 10	Mean	10.00	Mean	14.60				
	SD	1.05	SD	2.02				
Bilingual *n* = 10	Mean	9.30	Mean	13.45				
	SD	1.64	SD	1.34				
Biliterate *n* = 10	Mean	8.90	Mean	13.63	Mean	12.23	Mean	19.88
	SD	2.18	SD	3.30	SD	1.12	SD	1.38

Instrumentation

Writing Tasks. A narrative task and an argumentative task in English were developed to examine the groups' writing processes (appendix B). The narrative task was adapted from the 2005 School Certificate Examination. The argumentative task was developed by the author based on a common text type from past School Certificate examination papers and a topic with which high school students were familiar. Criteria for scoring the two tasks were adapted from the original criteria used in the writing tasks from the selection procedure.

Inter-rater reliability was calculated. Strong significant positive correlations were found between the scores given by the author and the second rater for both tasks (narrative task: $r(30) = .82$, $p < .01$ and argumentative task: $r(30) = .79$, $p < .01$).

Think-aloud Protocols were the individual writers' actual verbalisations of thoughts as they wrote. Instruction on how to talk aloud when writing based on the think aloud method were adapted from Roca de Larios *et al*. (2006) (appendix C).

Procedure

All potential participants from the three schools completed the selection procedure tests during school hours. The think-aloud method was then conducted on a one-to-one basis during school hours on a separate day. The three groups (n = 30) talked aloud while they wrote both tasks. All thinking aloud was audio recorded.

Data analysis

The think-aloud protocols were coded with NVIVO version 10 based on the coding taxonomy developed for the study (appendix D). The major component processes were: Formulation Processes, Other Writing Processes, and Pausing. All component processes, including all main categories and sub-categories were coded and measured in terms of the time devoted to carrying out specific categories in the think-aloud protocols.

Inter-rater reliability was analysed to compare the durations of the component processes identified by

the author and the second rater. A total of six texts (i.e., 10% of the data) were randomly selected to be re-coded by the second rater. Pearson correlation tests were conducted and significant relationships were found between the durations coded by the two raters in all major component processes (Formulation Processes: $r(6) = .81$, $p < .01$; Other Writing Processes: $r(6) = .80$, $p < .01$; Pausing: $r(6) = .80$, $p < .01$).

For quantitative analysis, time devoted to a specific category was expressed as the proportion of time spent engaged in that particular category in relation to total time (e.g., the time spent on Formulation Processes as a proportion of the total time spent on completing the writing task). Orthogonal analyses and One-way ANOVAs were carried out to determine if there was a difference between the groups in how much time they each spent on the Writing Processes and Formulation Processes categories for the two texts. Effect sizes Cohen (1992) were also reported for each category (i.e., small effect size, $\eta^2 = 0.01$; medium effect size, $\eta^2 = 0.06$; and large effect size, $\eta^2 = 0.14$). Differences between the groups that were not significant but those that had large effects were discussed (i.e., $\eta^2 = 0.14$ or $\eta^2 > 0.14$). Question 2 also compared the groups' time spent on the formulation processes' sub-categories, but no sub-category was subjected to statistical analysis; only descriptive statistics were reported.

For the qualitative analysis, Formulation Processes were examined in detail through qualitative description of the think-aloud data in which examples of the groups' formulation and problem-solving formulation were provided and discussed.

Results

Writing processes (RQ 1)

Table 3 presents proportions of time spent by the groups on the overall writing process for each text type (i.e., Formulation Processes, Other Writing Processes, and Pausing). There was no significant difference and no large effect for the groups' time spent on the overall writing process for either text type.

Table 3 *Proportions (P), absolute durations in seconds (D) and standard deviations (SD) of durations for the whole writing process*

	Narrative			Argumentative		
	Monolingual	**Bilingual**	**Biliterate**	**Monolingual**	**Bilingual**	**Biliterate**
Formulation Processes	(P) 70.86% (D) 8113.82 (SD) 346.24	70.92% 5301.03 208.29	70.19% 4563.83 226.85	71.25% 5812.53 213.26	73.61% 4822.29 190.57	79.37% 6139.44 362.89
Other Writing Processes	(P) 16.53% (D) 1893.30 (SD) 320.34	9.77% 730.00 45.79	20.19% 1312.60 235.40	13.46% 1097.60 142.75	15.83% 1037.00 125.19	12.04% 931.60 142.06
Pausing	(P) 12.61% (D) 1443.90 (SD) 228.14	19.31% 1443.30 124.71	9.63% 626.00 30.38	15.29% 1247.40 213.63	10.56% 691.80 74.40	8.58% 663.90 42.49

Table 4 presents the proportions of time spent by the groups on writing sub-processes (i.e., Conceptualising, Revising, Meta-comments unrelated to Formulation, and Global Re-reading) for each text type. No significant difference was found between the time spent on any of the sub-processes for each group for either text type but there were a number of large effects. The monolinguals spent more time Conceptualising than the other groups in both the narrative, $F(2,30) = 2.13$, $p = .18$, $\eta^2 = .32$, and

the argumentative texts, $F(2,30) = 3.56$, $p = .07$, $\eta^2 = .44$. The biliterates spent more time on Global Re-reading than the other groups in both the narrative, $F(2,30) = 1.18$, $p = .36$, $\eta^2 = .25$, and the argumentative texts, $F(2,30) = 0.62$, $p = .59$, $\eta^2 = .29$.

Table 4 *Proportions (P), absolute durations in seconds (D) and standard deviations (SD) of durations for Other Writing Processes*

	Narrative			Argumentative		
	Monolingual	**Bilingual**	**Biliterate**	**Monolingual**	**Bilingual**	**Biliterate**
Conceptualising	(P) 85.05% (D) 1610.30 (SD) 320.50	26.00% 189.80 39.60	24.69% 324.10 65.33	64.74% 710.60 120.33	43.04% 446.30 60.67	17.31% 161.30 37.15
Revising	(P) 0.48% (D) 9.00 (SD) 2.85	2.08% 15.20 4.81	1.20% 15.70 3.71	0.63% 6.90 2.18	3.09% 32.00 6.75	2.35% 21.90 3.20
Meta-comments unrelated to Formulation	(P) 2.58% (D) 48.80 (SD) 7.91	51.12% 373.20 34.72	32.26% 423.50 97.93	17.79% 195.30 24.88	23.90% 247.80 42.36	48.21% 449.10 80.78
Global Re-reading	(P) 8.52% (D) 161.30 (SD) 30.43	15.53% 113.40 16.13	30.89% 405.50 74.22	3.11% 34.10 9.28	1.49% 15.40 4.87	25.05% 233.40 32.93

No other consistent pattern was found across the text types. In the narrative texts, the bilinguals spent more time on Meta-comments unrelated to Formulation, $F(2,30) = 2.74$, $p = .13$, $\eta^2 = .44$, and on Revising than the other groups, $F(2,30) = 0.94$, $p = .51$, $\eta^2 = .48$. In the argumentative texts, the biliterates spent more time on Meta-comments unrelated to Formulation, $F(2,30) = 1.00$, $p = .40$, $\eta^2 = .14$. No significant difference or large effect was found between the groups on Revising.

Formulation processes (RQ 2)

Main Categories. Table 5 presents the proportions of time spent by the groups on specific Formulation sub-processes (i.e., Formulation, Problem-Solving Formulation, Meta-comments related to Formulation, and Local Re-reading) for each text type. No significant difference between the time spent on any of the sub-processes for either text type was found but there were a number of large effects. The only large effect that was consistent across the text types was that the biliterates spent more time on Local Re-reading in both narrative $F(2,30) = 0.88$, $p = .48$, $\eta^2 = .31$ and argumentative texts, $F(2,30) = 0.67$, $p = .56$, $\eta^2 = .25$.

No other consistent pattern was found. In the narrative texts, the biliterates spent more time than the others on Problem-Solving Formulation, $F(2,30) = 1.42$, $p = .27$, $\eta^2 = .15$, and the monolinguals spent more time than the others on Meta-comments related to Formulation, $F(2,30) = 0.88$, $p = .48$, $\eta^2 = .31$. In the argumentative texts, the bilinguals spent more time than the others on Meta-comments related to Formulation, $F(2,30) = 0.67$, $p = .56$, $\eta^2 = .25$. No other significant difference or large effect was found.

Sub-categories. Table 6 presents the groups' time spent on the sub-categories of the category Formulation for each text type (i.e., Formulation with Transcribing, Formulation without Transcribing, and Transcribing Only). One consistent pattern across the text types was found. All groups spent the largest proportions of time on sub-process Formulation with Transcribing.

Table 5 *Proportions (P), absolute durations in seconds (D) and standard deviations (SD) of durations for Formulation Processes*

	Narrative			Argumentative		
	Monolingual	**Bilingual**	**Biliterate**	**Monolingual**	**Bilingual**	**Biliterate**
Formulation	(P) 61.49% (D) 7041.52 (SD) 304.67	65.53% 4897.83 166.18	59.68% 3880.53 195.43	61.30% 5000.33 176.69	66.84% 4378.79 177.02	69.61% 5384.64 289.07
Problem-Solving Formulation	(P) 6.58% (D) 753.50 (SD) 92.45	3.19% 238.50 33.42	7.61% 494.90 47.42	5.95% 485.00 55.42	3.82% 250.00 23.58	6.36% 491.70 40.60
Meta-comment related to Formulation	(P) 1.29% (D) 148.10 (SD) 39.83	1.18% 88.00 11.32	1.22% 79.30 25.08	1.70% 138.90 26.80	2.52% 165.00 16.41	0.72% 55.40 17.52
Local Re-reading	(P) 1.49% (D) 170.70 (SD) 25.82	1.03% 76.70 13.15	1.68% 109.10 25.57	2.31% 188.30 35.20	0.44% 28.50 4.12	2.69% 207.50 52.67

Table 6 *Proportions (P), absolute durations in seconds (D) and standard deviations (SD) of durations for Formulation sub-processes*

	Narrative			Argumentative		
	Monolingual	**Bilingual**	**Biliterate**	**Monolingual**	**Bilingual**	**Biliterate**
Formulation with Transcribing	(P) 98.64% (D) 6945.82 (SD) 309.73	99.26% 4861.73 170.35	78.02% 3027.63 151.12	98.51% 4925.93 172.44	98.05% 4293.19 180.04	81.19% 4371.94 309.60
Formulation without Transcribing	(P) 0.69% (D) 48.40 (SD) 10.27	0.21% 10.40 2.19	0.00% 0.00 0.00	1.00% 50.10 11.32	1.60% 70.10 14.70	0.03% 1.50 0.47
Transcribing Only	(P) 0.67% (D) 47.30 (SD) 14.96	0.52% 25.70 8.13	21.98% 852.90 269.70	0.49% 24.30 7.68	0.35% 15.50 3.27	18.78% 1011.20 260.77

Tables 7, 8, and 9 present the groups' time spent on the sub-categories of the Problem-Solving Formulation category for each text type. Table 7 presents the groups' time spent on the two main sub-categories of Problem-Solving Formulation (i.e., Linguistic Problem-Solving Formulation and Conceptual Problem-Solving Formulation). One consistent pattern across the text types was found. The monolinguals spent more time on Linguistic Problem-Solving Formulation, and the biliterates spent more time on Conceptual Problem-Solving Formulation than the other groups did.

Table 8 presents the groups' time spent on the sub-categories of Linguistic Problem-Solving Formulation (i.e., Spelling/Orthography and Punctuation, Grammar, Adding, Changing, Eliminating, and Searching for Vocabulary). One consistent pattern across the text types was found. The monolinguals spent more time on Changing Vocabulary across the narrative (i.e., 38.88%) and the argumentative texts (i.e., 54.32%), while the bilinguals spent more time on Searching for Vocabulary across the narrative (i.e., 16.66%) and argumentative texts (i.e., 14.41%) than the other groups did.

Table 9 presents the groups' time spent on the sub-categories of Conceptual Problem-Solving Formulation (i.e., Adding, Changing, and Eliminating Part of a Sentence). One consistent pattern across the text types was found. The bilinguals spent more time than the other groups on Adding Part

of a Sentence across the narrative (i.e., 43.40%) and the argumentative texts (i.e., 56.78%). Although there was no other consistent pattern found across the text types, the biliterates spent more time than the other groups on Changing Part of a Sentence in the narrative texts (i.e. 70.21%), while the monolinguals spent more time on this in the argumentative texts (i.e. 66.58%). This shows that the monolinguals and the biliterates spent similar proportions of time changing parts of sentences in the English texts.

Table 7 *Proportions (P), absolute durations in seconds (D) and standard deviations (SD) of durations for Problem-Solving Formulation processes*

	Narrative			**Argumentative**		
	Monolingual	**Bilingual**	**Biliterate**	**Monolingual**	**Bilingual**	**Biliterate**
Linguistic Problem-Solving Formulation	(P) 74.89% (D) 564.30 (SD) 77.57	68.22% 162.70 20.65	65.06% 322.00 27.87	83.96% 407.20 44.08	79.32% 198.30 23.39	65.22% 320.70 20.23
Conceptual Problem-Solving Formulation	(P) 25.11% (D) 189.20 (SD) 22.70	31.78% 75.80 14.14	34.94% 172.90 35.53	16.04% 77.80 13.43	20.68% 51.70 8.81	34.78% 171.00 26.41

Table 8 *Proportions (P), absolute durations in seconds (D) and standard deviations (SD) of durations for Linguistic Problem-Solving Formulation processes*

	Narrative			**Argumentative**		
	Monolingual	**Bilingual**	**Biliterate**	**Monolingual**	**Bilingual**	**Biliterate**
Spelling/ Orthography and Punctuation	(P) 6.45% (D) 36.40 (SD) 5.01	15.80% 25.70 3.83	31.55% 101.60 15.96	12.57% 51.20 6.31	36.70% 72.78 8.46	29.25% 93.80 8.11
Grammar	(P) 24.42% (D) 137.80 (SD) 36.46	1.91% 3.10 0.98	12.64% 40.70 6.19	1.47% 6.00 1.90	3.62% 7.18 2.56	0.94% 3.00 0.95
Adding Vocabulary	(P) 2.60% (D) 14.70 (SD) 4.65	21.08% 34.30 5.97	6.83% 22.00 4.34	10.73% 43.70 7.73	3.07% 6.08 3.19	13.53% 43.40 6.12
Changing Vocabulary	(P) 38.88% (D) 219.40 (SD) 23.44	26.37% 42.90 9.91	29.35% 94.50 11.18	54.32% 221.20 32.14	37.96% 75.28 12.78	36.89% 118.30 9.16
Eliminating Vocabulary	(P) 19.63% (D) 110.80 (SD) 20.85	18.19% 29.60 7.05	15.84% 51.00 6.68	3.63% 14.80 2.77	4.23% 8.38 3.92	11.41% 36.60 5.10
Searching for Vocabulary	(P) 8.01% (D) 45.20 (SD) 10.74	16.66% 27.10 5.72	3.79% 12.20 5.25	17.26% 70.30 16.03	14.41% 28.58 7.21	7.98% 25.60 8.10

Qualitative Description. Qualitative description of the think aloud protocols was able to illuminate distinctive features of the groups' formulation sub-processes. These protocols will be reported based on three themes – Formulation with Transcribing, Linguistic Problem-Solving Formulation, and Conceptual Problem-Solving Formulation.

Table 9 *Proportions (P), absolute durations in seconds (D) and standard deviations (SD) of durations for Conceptual Problem-Solving Formulation processes*

	Narrative			Argumentative		
	Monolingual	**Bilingual**	**Biliterate**	**Monolingual**	**Bilingual**	**Biliterate**
Adding Part of a Sentence	(P) 21.30% (D) 40.30 (SD) 0.00	43.40% 32.90 7.09	12.09% 20.90 0.00	6.94% 5.40 0.00	56.78% 29.35 7.14	18.25% 31.20 6.03
Changing Part of a Sentence	(P) 25.58% (D) 48.40 (SD) 11.15	26.65% 20.20 6.39	70.21% 121.40 15.14	66.58% 51.80 12.28	0.00% 0.00 0.00	48.30% 82.60 11.84
Eliminating Part of a Sentence	(P) 53.12% (D) 100.50 (SD) 14.40	29.95% 22.70 7.18	17.70% 30.60 3.07	26.48% 20.60 6.51	43.22% 22.34 6.64	33.45% 57.20 9.22

Formulation with Transcribing. First, all groups tended to formulate and transcribe at the same time (Table 6). Examining the data qualitatively revealed that the monolinguals and bilinguals appeared to be more fluent and to compose longer text blocks without interruption than the biliterates. The following examples illustrate this formulation behaviour.

Example 1: monolingual – argumentative
"… The Internet is a recent development in technology that has revolutionized the ways teenagers live. It has many uses with educational, communication, informational and entertainment purposes. While spending our free time surfing the Internet may seem a waste of time for some, it can be helpful and have positive impacts on the ways we think and live…"

Example 2: bilingual – narrative
"… As soon as I left, swarms of people gathered around me, shoving questions in my face. I was overwhelmed by the attention and told everyone I would discuss details later. Upon saying this, I rushed into my house and slept under my covers. Now, I would have no more nightmare…"

In contrast, the biliterates, who spent more time on both global and local re-reading (table 4 and 5), re-read both their finished and partially finished sentences more than the other groups. They appeared to use re-reading as a strategy to solve a problem while formulating. The following example illustrates this formulation strategy in a biliterate. The bracketed words indicate what the biliterate may have been doing while formulating the sentence.

Example 3: biliterate – argumentative
"… In essence, although surfing the Internet may be seen as detrimental as it is a main source of entertainment, nevertheless (← formulating)*... although surfing the Internet may be seen as detrimental as it is a main source of entertainment nevertheless* (← pausing and locally re-reading) *it is a good way to* (← formulating)*... one's act of seeking entertainment is not a waste of time because individuals have the rights to decide what to do in their spare time* (← pausing and globally re-reading from previous paragraph)*... is a good way to* (← pausing and locally re-reading) *develop and maintain important social networks* (← formulating)*..."*

The completed sentence: *"In essence, although surfing the Internet may be seen as detrimental as it is a main source of entertainment, nevertheless, it is a good way to develop and maintain important social networks."*

Linguistic Problem-Solving Formulation. Examining the data closely revealed that the monolinguals tended to solve linguistic formulation problems – changing words and searching for words differently from the bilinguals and biliterates (tables 7 and 8). The bilinguals and the biliterates were observed to

make changes to words with more concrete meanings while formulating. The monolinguals, in contrast, were observed to make changes to words with more abstract and complex meanings. Examples that illustrate these problem-solving behaviours follow. The texts in *italics* indicate fluent formulation with transcription, the texts in **bold** indicate thinking aloud without writing and the asterisks indicate where the word changes occurred.

Example 1: bilingual – argumentative
"Forms of entertainment for the teens include Karaoke, watching the television, going on the Internet, shopping and ***eating* I mean** **dining* with friends."*

The completed sentence: *"Forms of entertainment for the teens include Karaoke, watching the television, going on the Internet, shopping and dining with friends."*

Example 2: biliterate – narrative
"At that ***right*** **exact* moment, my face turned pale stricken white and my whole body was numb."*

The completed sentence: *"At that exact moment, my face turned pale stricken white and my whole body was numb."*

Example 3: monolingual – narrative
"His breath smelt of cigarettes and he spoke with ***rough* *gruff* is a better word** **gruff* words."*

The completed sentence: *"His breath smelt of cigarettes and he spoke with gruff words."*

Moreover, the bilinguals and biliterates were observed to verbalise meta-comments when searching for a word. The monolinguals, in contrast, were observed to directly verbalise lists of related words available in their mental lexicon when choosing a word. The following examples illustrate these behaviours. The texts in *italics* indicate fluent formulation with transcription, the texts in **bold** indicate thinking aloud without writing and the asterisks indicate where the word choices occurred.

Example 1: bilingual – narrative
"I never get to live life like **a typical is there a better word, how about ordinary, okay ordinary sounds right** *an *ordinary* child."*

The completed sentence: *"I never get to live life like an ordinary child."*

Example 2: biliterate – argumentative
"Watching videos online provides **wider or more? Wider, or more? I think it should be** **wider* options for the viewers."*

The completed sentence: *"Watching videos online provides wider options for the viewers."*

Example 3: monolingual – narrative
"It was a highly **bad, naughty, evil, cruel, psychotic, dangerous, destructive** **destructive* event that had cost two thousand people their lives."*

The completed sentence: *"It was a highly destructive event that had cost two thousand people their lives."*

Conceptual Problem-Solving Formulation. Examining the data closely revealed that when all groups added extra parts to their sentences, the primary ideas were modified and enriched. Thus, although the bilinguals added more supplementary parts to their sentences than the other groups did (table 9), qualitatively all groups were similar. The following examples illustrate this similarity between the groups. The texts in *italics* indicate fluent formulation with transcription, the texts in **bold** indicate thinking aloud without writing, and the asterisks indicate where the adding of supplementary parts occurred.

Example 1: bilingual – argumentative
"Although surfing the Internet may be time-wasting, but it is **but** **at the same time, it is one of my favourite things to do so** **it is** *not completely useless."*

The completed sentence: *"Although surfing the Internet may be time-wasting, but at the same time, it is one of my favourite things to do so it is not completely useless."*

Example 2: monolingual – argumentative
"Surfing the Internet is a waste of time because it is addictive **because** **students never end up doing what they first intended to do and** **it is addictive***."*

The completed sentence: *"Surfing the Internet is a waste of time because students never end up doing what they first intended to do and it is addictive."*

Example 3: biliterate – argumentative
"Besides surfing the Internet, there are other forms of entertainment to choose from **there are other forms of entertainment** **just as equally entertaining but more meaningful** **to choose from***, such as meeting up with friends and learning to play an instrument."*

The completed sentence: *"Besides surfing the Internet, there are other forms of entertainment just as equally entertaining but more meaningful to choose from, such as meeting up with friends and learning to play an instrument."*

Finally, the biliterates and monolinguals appeared to change parts of their sentences (table 9). However, the types of changes made by the two groups were qualitatively different. The biliterates changed parts of their sentences to modify ideas within them, whereas the monolinguals made such changes only to improve their sentence structure and fine-tune meanings, as illustrated below. The texts in *italics* indicate fluent formulation with transcription, the texts in **bold** indicate thinking aloud without writing, the bracketed words indicate what the writer may have been doing while formulating, and the asterisks indicate where the changes occurred.

Example 1: biliterate – narrative
"I clenched my fists and **planned to escape** **and** *thought of revenge* but my mind was blank."*

The modified sentence: *"I clenched my fists and thought of revenge but my mind was blank."*

Example 2: monolingual – argumentative
*"The Internet has become *the next big thing** (crossing out 'the next big thing') *the new trend* and those who think it is a waste of time are probably just cynical."*

The modified sentence: *"The Internet has become the new trend and those who think it is a waste of time are probably just cynical."*

Discussion

Writing processes

Findings indicated more similarities than differences between the overall writing processes of the groups. No difference was found between the groups in the three main writing processes – formulation processes, other writing processes, and pausing, but some differences were found in the sub-processes.

All groups spent most of their time formulating when writing. This finding is largely consistent with previous findings suggesting formulation as a dominant sub-process in both L1 and L2 writing (e.g., Levy & Ransdell, 1995; Wang & Wen, 2002). Levy and Ransdell (1995) found that over 45% total composition time was spent on formulating by L1 writers. In this study, the groups spent an even higher proportion of time formulating (i.e., approximately 70% total composition time). Similarly, Wang and Wen (2002) found that two thirds of their L2 writers' composition time and attention was devoted to formulation and sentence construction. Therefore, it may be concluded that formulation was a dominant sub-process in the groups' overall writing process.

In contrast, differences were found between the writing sub-processes of the groups. The monolinguals spent more time conceptualising and the biliterates spent more time globally re-reading their texts than the other groups did. Referring to the results of the literacy tests in the selection procedure, all groups had similar levels of text quality in English. Thus, this difference between the monolinguals and the biliterates may reflect different approaches that the two groups had to writing, particularly in the ways they planned and wrote. The monolinguals appeared to be pre-task planners who conceptualised before they wrote, and who, according to the protocols, wrote relatively fluently, with few interruptions and hesitations. In contrast, the biliterates appeared to be online planners who conceptualised while they wrote, and consequently were less fluent in their writing. The bilinguals may be in an intermediate position between the monolinguals and the biliterates. The bilinguals, who according to the protocols also wrote relatively fluently, did not spend as much time conceptualising as did the monolinguals or as much time globally re-reading their texts as the biliterates did.

Previous research investigating the effects of planning reported significant gains in people's writing or speaking fluency in pre-task planning situations where planning occurred before a writing or speech event (Ellis & Yuan, 2003). Findings from these studies suggested two reasons why pre-task planning tends to promote writing fluency. Firstly, it facilitates the good levels of organisation and processing of content, information, and ideas that are necessary before writing takes place. Secondly, it helps to free writers from excessively monitoring their texts as they write. In this study, the increased time that the monolinguals spent on conceptualising compared with the other groups appears to support suggestions from these previous studies on the benefits to fluency of pre-task planning.

The increased time spent by the biliterates on global re-reading appeared to be a strategy used for conceptualising while writing. Re-reading is a type of backtracking behaviour that involves writers looking back and forth through the written text to consider ideas (Manchon *et al*., 2000). Writers are said to re-read for two broad sets of prospective and retrospective purposes (Manchon *et al*., 2000 & 2009). Re-reading for prospective purposes leads to idea generation and formulation. This type of re-reading encourages the use of the already produced text as a basis for further formulation in order to reduce the pressure of handling both the lower level text demands (e.g., a language problem) and higher level text demands (e.g., a conceptual problem) when writing. Re-reading for retrospective purposes, on the other hand, is mainly associated with editing and revision (Manchon *et al*., 2000). In this study, the biliterates appeared to globally re-read their written texts for prospective purposes, that is, to conceptualise and formulate at the same time. They appeared to engage in frequent re-reading

processes in the middle of a sentence that was still being formulated and subsequently completed the sentence.

Furthermore, the biliterates' global re-reading of their already produced texts to conceptualise and formulate may be understood as online planning. As opposed to the pre-task planning in which the monolinguals engaged, online planning is defined as planning that occurs during a writing event, which is also understood as the kind of planning that is interwoven with text production (i.e., formulation) (Ellis & Yuan, 2003). Writers may plan during a writing event in two ways. They may plan and formulate at the same time. They may also formulate, pause to plan, and then continue to formulate. In contrast to pre-task planning, which frees writers from frequently monitoring their texts, online planning encourages constant monitoring and re-reading of the written text as a basis for further formulation. Consequently, online planning may have a detrimental effect on writing fluency but it may also ensure accuracy or precision of ideas, expression, and language use as the result of constant monitoring. Pre-task planning, on the other hand, aids fluency but not necessarily precision in ideas and expression while formulating.

Some studies investigating the types of writers who re-read their texts when writing observed that it was proficient writers, not poor writers, who made extensive use of re-reading as a strategy for conceptualisation (Sommers, 1980). Consequently, it may be said that the biliterates and the monolinguals in this study had different approaches to conceptualising. The biliterates engaged in global re-reading as a means of planning online, while the monolinguals engaged in pre-task planning and consequently wrote more fluently than the biliterates. The literature suggests that both conceptualisation methods have benefits. The three groups' similarities in text quality also appear to provide supporting evidence that pre-task planning and online planning are equally effective.

Formulation processes

Findings indicate distinctive features for each group in the ways they formulated sentences and solved formulation problems. The monolinguals appeared to be fluent formulators who made strategic use of vocabulary and demonstrated knowledge of a range of semantically related words. The biliterates, in contrast, appeared to be more reflective (but less fluent) formulators who engaged in both prospective behaviours (i.e., local re-reading to formulate) and retrospective behaviours (i.e., making meta-comments to reflect on specific formulation problems) as they wrote. The bilinguals appeared to be in an intermediate position, formulating sentences in ways similar to the monolinguals (i.e., fluent formulators), but also solving formulation problems in ways similar to the biliterates (i.e., engaging in retrospective behaviours).

Differences in time spent on specific formulation processes appeared to reflect the types of formulation problems that the groups encountered as they wrote. The longer time spent on linguistic formulation problems by the monolinguals was mainly directed towards vocabulary use, particularly in word substitution. On the other hand, the longer time spent by the biliterates on formulation problems was mainly directed towards solving conceptual formulation problems. This involved changing parts of sentences, adding extra details to the middle of sentences, and deleting parts of sentences as they wrote. These conceptual problem-solving formulation behaviours all had the effect of changing meaning by modifying an idea in a sentence that was still being formulated. The biliterates appeared to engage more often than the other two types in changing parts of their sentences as they wrote. These changes made to ideas in partially completed sentences appeared to be re-conceptualisations of ideas that took place while formulating, i.e., a form of online planning. As the monolinguals and the biliterates made changes as they wrote to their partially formulated sentences, the monolinguals changed words more

than the other groups, whereas the biliterates changed parts of their sentences more than the other groups.

The biliterates also spent more time on local re-reading than the other groups. The biliterates' local re-reading of their partially written sentences confirms suggestions from previous research that writers re-read for prospective purposes (e.g., Manchon *et al*., 2009). In this study, the biliterates locally re-read their partially formulated sentences and subsequently completed them. This re-reading process may be understood as a springboard for further formulation (Roca de Larios *et al*., 2001). It may therefore be argued that the biliterates frequently engaged in two types of re-reading while formulating for prospective purposes – locally re-reading the partially formulated sentences, and globally re-reading the already written texts, as previously discussed.

The qualitative analysis findings indicate a number of important differences between the groups. It was largely the monolinguals and the biliterates who appeared to differ from one another. Firstly, the monolinguals' strategic use of vocabulary when changing or searching for words while formulating appears to agree with findings from previous studies that reported monolingual advantages in receptive vocabulary (Hoff *et al*., 2012). Productive vocabulary is understood as vocabulary that people use appropriately in writing and in speech, while receptive vocabulary is understood as vocabulary that people comprehend in reading and in listening (Nation, 2001). These previous studies found that monolinguals had greater knowledge and understanding of a wider range of related words and performed better on tasks that required word generation than bilinguals. In this study, the monolinguals not only appeared to perform better than the other groups in terms of their understanding of a wider range of vocabulary, that is, receptive vocabulary, but also in terms of productive vocabulary, i.e., the generation, selection, and use of vocabulary while formulating.

Finally, the use of meta-comments to help solve a specific formulation problem, such as searching for a word, appear to be a skill common to both the biliterates and the bilinguals. These meta-comments that demonstrated reflection on the thinking processes mainly involved questions that these writers asked themselves about problems they encountered while formulating. These retrospective behaviours of both groups are consistent with suggestions from the literature that bilinguals tend to possess better metacognitive awareness than monolinguals (Adesope *et al*., 2010).

Conclusion and Future Research

The study findings indicate that writers with one and two languages do not think, formulate, and solve writing problems in the same ways. These findings also indicate a possible need for educators to look beyond writing scores into what students actually do as they write. Monolinguals may be strategic with their vocabulary knowledge and use but may or may not be as alert and reflective as biliterates. Likewise, students with two or more languages may or may not be as fluent and strategic as monolinguals in their writing in general.

Lastly, future research may include some analyses of social, contextual, and cultural factors mediating biliterate writers' writing processes across languages. Writing in a language other than one's mother tongue is a complex, socially-bound process affected by the quantity and quality of a person's previous literacy experiences (Carson *et al*., 1990). Do biliterates have specific cultural assumptions and pragmatic attitudes that may affect their writing process in the two languages? Future researchers may consider examining and comparing culturally preferred patterns of writing in different languages and the texts writers of these languages produce.

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Author biodata

Dr. Elaine Ng is a Lecturer in the English Language Teaching Unit at The Chinese University of Hong Kong. Growing up in Sydney, she began pursuing an area of specialty in education and research for bilinguals, biliterates, and ESL learners from high school to tertiary levels since 2007. Her recent publications include a review paper on the effects of bilingualism, and two research articles on metacognition, biliteracy, and the writing process.

Appendixes

Appendix A. Language background questionnaire (main items only)

- Do you speak English? Not at all / A little / Reasonably well / Well
- Do you read in English? Not at all / A little / Reasonably well / Well
- Do you write in English? Not at all / A little / Reasonably well / Well
- Do you speak a language other than English? Yes / No

- If you answered 'Yes', did you learn the language: at home? / at school? / both at home and at school?

If you answered 'No' in the previous question, you do not need to complete any further questions in this questionnaire.

- If you speak a language other than English, what language is that? _____
- If you speak a language other than English, how well do you speak this language? A little / Reasonably well / Well

If the language other than English you speak is not Chinese or a Chinese dialect, you do not need to complete any further questions in this questionnaire.

- If you speak Chinese, do you speak Mandarin/Pu Tong Hua? Yes / No

- If you answered 'No', which type of Chinese do you speak? _____

- Do you read in Chinese? Not at all / A little / Reasonably well / Well
- Do you write in Chinese? Not at all / A little / Reasonably well / Well

Appendix B. Writing tasks

Narrative Text

I only caught a glimpse through the window. The face was everything they said it would be – wicked eyes, cigarette-stained broken teeth, and a scar that drew my gaze towards those thin, cruel lips.

Yet, this was the person I had to meet.

Continue writing the story using the above opening.

Argumentative Text
Convince your reader by arguing either for or against the statement *"Surfing the Internet for entertainment is a waste of time."*

Appendix C. Instruction for think-aloud method

How to "Think-aloud" a Writing Task
You've been given two writing tasks, attempt both tasks by saying out loud everything that comes into your mind. Do everything that you would normally do when writing a composition with the only difference being that you are going to do this talking aloud today. Here's a mock composition to practise talking aloud with first.

Mock Composition
Reply to an email from a friend from overseas who is coming to Sydney for a holiday. In the reply, recommend a few exciting places that your friend may visit.

Appendix D. Coding taxonomy – A coding scheme for writing and formulation processes

	MAIN CATEGORY	SUBCATEGORY
FORMULATION PROCESSES	**Formulation**	Formulating with Transcribing Formulating without Transcribing Transcribing Only
	Problem-Solving Formulation	**Linguistic Problem-Solving Formulation** • Spelling/Orthography and Punctuation • Grammar • Adding Vocabulary • Changing Vocabulary • Searching for Vocabulary • Eliminating Vocabulary
		Conceptual Problem-Solving Formulation • Adding Part of a Sentence • Changing Part of a Sentence • Eliminating Part of a Sentence
	Meta-comments related to Formulation	
	Local Re-reading	
OTHER WRITING PROCESSES	**Writing sub-processes**	Conceptualising Revising Meta-comments unrelated to Formulation Global Re-reading
PAUSING		