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FLUENCY AND ITS RELATIONSHIP WITH TYPOLOGY, EXPOSURE AND LEXICAL RETRIEVAL IN BILINGUAL BISCRIPITAL PERSIAN-SWEDISH CHILDREN'S WRITING

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Abstract

Bilingual literacy not only supports academic success it also contributes to bilingual children's development of identity. However, not all contexts allow children to develop their writing fluency in their first language (L1) to the same degree as in their school language, their second language (L2). Few studies have explored bilingual children's writing fluency in two languages and most studies to date have focussed on Latin scripts, in particular English. The present paper fills this gap by exploring writing fluency of bilingual biscriptal children in the typologically different languages Swedish (official language and main medium of instruction) and Persian (home language). Twenty-three bilingual biscriptal children between the ages of 10-15 wrote four texts each by hand using Eye & Pen, descriptive and narrative, in Persian and Swedish respectively. The final texts and temporal information were used to compute product and process writing fluency. In order to explore writing fluency further, the role of language exposure and lexical retrieval was investigated. A survey was used to explore the participants' exposure at home and participants' lexical retrieval was measured by standardized tasks in each language. An additional qualitative study of three writers focused on what may have caused interruptions in fluency in the two languages. Results show that the children produced more characters, words and clauses and wrote faster, produced longer and more complex bursts in their L2 as compared with their L1. Exposure in L1 was connected with writing fluency in both languages while lexical retrieval was mildly related with fluency in L1. Typological characteristics such as diacritics created pauses and hence interrupted writing fluency in both languages.

Keywords: Writing Fluency, Handwriting, Eye and Pen, Burst, Pause, Different Typologies

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1. INTRODUCTION

Early initial development of literacy in a first language (L1) supports the development of literacy in a second language (L2) (Bialystok, 2001). Equally important, though, is that the use of multilingual literacy can endorse and encourage children's diverse backgrounds and facilitate their development of self and identity (Cummins & Persad, 2014). Even so, opportunities to develop both a home language and a school language can be limited due to, for example, language educational policies (Eisenchlas, Schalley & Guillemin, 2015). A study in France with nine-year-old children speaking Moroccan Arabic at home, showed that their orthographic development in their home language was highly influenced by French and their writing through French was stronger than that in their home language (Weth, 2015). Language education policy stated that the medium of instruction in school was French but that children could attend optional mother tongue classes for two hours a week for two years, resulting in limited opportunity for practise literacy in their home language. Similarly, in the Swedish context, the medium of instruction in school is generally Swedish but every child with a parent who speaks another language than Swedish is entitled to mother tongue instruction for around one hour per week (Ganuza & Hedman, 2017).

One way to explore how the current language policy situation may, or may not, affect multilingual children's literacy development in their two languages is to investigate their writing fluency. Writing fluency has been described as "the end product of all the writing processes" (Olive et al., 2009: 305). This means that it can be viewed as a measure that comprises aspects that writers struggle with and aspects that they manage with ease when writing. For example, if writers are confident and experienced in writing a particular genre and a particular language, their writing fluency would be high. On the other hand, if they would be unfamiliar with a keyboard, a language, or not fully master the motor skills to form letters with pen and paper, their fluency would be hampered.

To our knowledge, the majority of writing fluency studies that investigate children's writing have included monolingual children (e.g., Alves & Limpo, 2015) and studies where bilinguals are included mainly focus on adults (e.g., Chenoweth & Hayes, 2001). In addition, studies where different scripts are included typically focus on Latin-scripts with English as either L1 or L2 (e.g., Spelman Miller et al., 2008), an exception being Kobayashi & Rinnert (2013), who analysed adult writers using L1 (Japanese) than L2 (English). We have not found any studies that investigate the writing fluency of bilingual and biscriptal children with languages from different alphabet systems.

Against this backdrop, the aim of this paper is to explore the writing fluency of Swedish-Persian bilingual and biscriptal children in their two typologically different languages Swedish and Persian. In order to shed light on how language use in and outside school may interplay with children's writing, we also explore how children's familiarity with the two languages, in terms of exposure and lexical retrieval may or

may not impact on their writing fluency, the following research questions are addressed:

- 1) How does writing through Persian and Swedish affect the writing fluency of bilingual children?
- 2) What relation can be found between children's exposure at home and their writing fluency in both languages?
- 3) What relation can be found between children's lexical retrieval skills and their writing fluency in the two languages?
- 4) What typological characteristics of Persian and Swedish can affect writing fluency?

Different terms such as mother tongue, home language and heritage language are used in the literature to refer to the first language one learns. Other terms such as foreign language, additional language and school language have been used to describe the second language one acquires. In the current paper, Persian is considered as participants' L1 as it was the first language they acquired, and Swedish is considered as their L2. To be consistent, L1 and L2 are also used in the literature review.

2. LITERATURE REVIEW

2.1 *Writing fluency*

A writing activity can be explained as a group of unique thinking processes which writers plan or arrange during text production (Flower & Hayes, 1981). Cognitive models of writing explain how four main cognitive processes underlie writing: a *planning processes* that set goals and build a mental representation of the information which will be utilised later, a *translating processes* that transform ideas into linguistic forms, a *transcription processes* which involve handwriting or typing ideas into a written language and a *revising processes* that observe, assess and alter the written text (Hayes & Flower, 1980; Hayes, 2000; Kellogg, 1996; Chenoweth & Hayes, 2001; Berninger & Winn, 2006).

During a writing activity, writing fluency is particularly connected with the translation and the revision processes (Chenoweth & Hayes, 2001). A fluent writer with great resources and linguistic experience has acquired complex grammatical structures and rapid access to words in the mental lexicon (i.e., lexical retrieval skills). During the translation process these resources can be accessed quickly and writers swiftly translate their ideas into words and structures that reflect their intended meaning. As a result, longer chunks of words, i.e., bursts, are transcribed before writers stop to revisit the text produced so far or plan ahead, and revisions occur less often (Chenoweth & Hayes, 2001). Fluency has also been connected with writing proficiency, indicating that the more familiar a writer becomes with writing, the more fluent they become. Wagner et al. (2011) found that the strength of associations between handwriting speed and productivity (assessed by total number of words and lexical diversity) of English monolingual children almost doubled from the

first to the fourth grades. They concluded that an individual with great handwriting fluency can dedicate more attentional capacity to high-level skills such as planning and composing a text as compared with somebody who still struggles with motoric aspects of writing. As a result of the higher cognitive constraints when using L2, children and teenagers have shown higher writing fluency, measured by number of words per minute, and longer bursts in their L1 as compared with L2 (Schoonen et al., 2009; Spelman Miller et al., 2008). In a study of teenage students' writing fluency in Swedish as L1 and English as L2, students' fluency in both languages increased across school years, which the authors explain as a result of their greater linguistic experience (Lindgren et al., 2008). With linguistic experience follows automatization of low-level skills, such as spelling and punctuation, or vocabulary and grammar in an L2, and writers are less frequently slowed down by having to think about the spelling of a word, what the word translates into the L2, or to try out different options before deciding on a written version that represents their ideas.

2.2 *Measuring writing fluency*

Fluency in writing has been measured in a number of different ways. One way to assess writing fluency has been to compute length and speed of production units (Wolfe-Quintero et al., 1998). For examples, some have analysed final texts by counting number of words (Christensen, 2004; Graham et al., 1998; Johnson et al., 2012; Alves et al., 2012; Kent et al., 2014; Grewal & Williams, 2018), ideas and sentences (Johnson et al., 2012; Kent et al., 2014; Grewal & Williams, 2018) produced by both adults and children (up to age 15) in a variety of Latin-based scripts such as English, German, Dutch, and Portuguese. Others have examined the process, the temporal aspects of fluency, (Wolfe-Quintero et al., 1998) by measuring the number of characters, words or syllables in a specific amount of time in both Latin-based orthographies as in English (Chenoweth & Hayes, 2001; Chandler, 2003; Spelman Miller, et al., 2008; Kobayashi & Rinnert, 2013), Portuguese (Alves & Limpo, 2015) Swedish (Lindgren et al., 2008), Italian (Stievano et al., 2016), French (Olive et al., 2009) and non-Latin based orthographies such as Turkish (Babayigit & Stainthorp, 2010) and non-alphabetic languages, for example Japanese (Kobayashi & Rinnert, 2013) and Chinese (Ellis & Yuan, 2004) in adults' and children's writing. In addition, Chenoweth and Hayes (2001: 88) divided bursts into two categories defined as "segments terminated by pauses as P-bursts and segments terminated by revisions as R-bursts". These were counted as the number of words before pauses or revisions. Among all the measures mentioned above, "number of words per minute" is considered one of the most common measures to explore writing fluency (Waes & Leijten, 2015: 81).

Characteristics of the script(s) of the analysis have been considered when determining suitable fluency measures. For instance, Lindgren et al. (2008) investigated the longitudinal development of fluency and revision of children in grade 8 and 9 (ages 14 and 15) in L1 (Swedish) and L2 (English). These languages are both Latin scripts but vary in their construction of words; in Swedish more words are

compounded than in English leaving fewer but longer words in Swedish. Thus, they used *number of characters per minute* and *number of characters per burst* as measures of writing fluency instead of number of words per minute or per burst (Lindgren et al., 2008: 139).

2.3 Tools to explore writing fluency

The development of technologies has created opportunities for researchers to study writing fluency both through typing and handwriting. Writing fluency can be captured by digital technologies such as keystroke logging using a keyboard (Sullivan & Lindgren, 2006; Lindgren & Sullivan, 2019) and handwriting tools as in Eye and Pen (Alamargot et al., 2006), HandSpy (Alves & Limpo, 2015; Alves, Leal & Limpo, 2019), or OpenHandWrite, a set of programs for the capturing and analysis of handwriting (Simpson, 2020). Handwriting tools such as the Eye and Pen device allow researchers to record and study a person's handwriting with a digitizing tablet. Participants write with a pen on a piece of paper, which is attached to the tablet and the tablet is connected to a computer. The written text is shown simultaneously on the computer screen (Alamargot et al., 2006). Participants' experiences with different writing tools when collecting the writing data is another factor to take into account when selecting writing tools in fluency studies. For instance, it is not suitable to examine writing fluency via typing in case the participants are not acquainted with the keyboards' functions of that specific script.

2.4 Children's writing fluency

Children's writing fluency has been studied from different perspectives. For instance, the impact of genre on children's writing fluency has been analysed, showing that genre (narrative vs argumentative) did not affect the writing fluency of French monolingual children grades 5 (10.7 years) and 9 (14.10 years) (Olive et al., 2009). A study of monolingual Portuguese children (Alves & Limpo, 2015) showed that regardless of genre, more experienced writers in grade 7 (12.5 years) had greater writing fluency and produced three times more words per minute than inexperienced writers in grades 2 (7.6 years). Moreover, children with more proficient transcription skills produced longer bursts and shorter pauses which led to greater writing fluency measured by number of words per minute (Alves & Limpo, 2015). Olinghouse & Graham (2009) similarly found that English monolingual children's handwriting speed and spelling skills, as well as their knowledge about the role of motivation, uniquely predicted their writing fluency.

A limited number of papers have examined bilingual children's writing fluency. For example, Lindgren et al. (2008) used keystroke logging to investigate the development of fluency and revision of children in grade 8 and 9 (ages 14 and 15). Each year, the children wrote descriptive/persuasive essays in their L1, Swedish, and in their L2, English. During the course of the project, the children became more fluent

in writing. In other words, they wrote at a higher speed and stopped less frequently to pause and revise. The writers' fluency in Swedish was greater than their English which the authors explained by the fact that writing in L1 demands lower cognitive capacity than writing in L2.

2.5 Lexical retrieval and writing fluency

Lexical retrieval refers to the process of gaining access to concepts in the mental lexicon and translating them into linguistic form (Levelt & JM, 1989; Field, 2003). Lexical retrieval is connected with the translation element in writing process models (e.g., Flower & Hayes, 1981; Hayes, 2012) and considered a complex process that tends to slow writers down during writing (Kellogg, 1994). However, since lexical retrieval affects writers' working memory it can also assist writers by reducing cognitive load leaving more resources for writers to focus on other elements of a writing task (McCutchen et al., 1994; Kellogg, 1999).

Writers are generally not as familiar with their L2 as they are with their L1, e.g., they would not know as many words in the L2 as in their L1. This would affect their speed of lexical retrieval when they have to translate concepts into linguistic form, thus their lexical retrieval would not be automatized in the L2 (Schoonen et al., 2009). In a study including 14-15 years old L1 Dutch speakers, Snellings et al. (2004) established a connection between lexical retrieval and production in L2 and showed that familiarity with words and practise of speedy retrieval of the words transferred into their writing.

Grewal & Williams (2018) used the Eye and Pen tool to analyse the relationship between lexical retrieval skills and writing process measures i.e., execution speed, bursts size as well as writing products as in number of words, sentences and text quality in handwritten texts of children (10-13 years old) writing through English as L2. The analysis demonstrated significant correlations between lexical retrieval skills and the product fluency measures number of words and sentences, and the process fluency measures execution speed and burst length, and with lexical richness and writing quality. Further, hierarchical regression models revealed that lexical retrieval was important for various aspect of writing, but indirectly: "lexical retrieval was shown to have a significant and indirect relationship to the number of words, lexical richness, number of sentences, and writing quality in writing product for EAL children" (p. 812).

Even though lexical retrieval seems to be an important aspect of L2 writing fluency, evidence for its impact on L1 writing is less conclusive. In a study including monolingual Turkish children, Babayiğit & Stainthorp (2010) found no association between writing fluency, number of words per minute, and lexical retrieval skills. Similarly, Williams & Larkin (2013) did not find a relationship between writing fluency, number of words, and lexical retrieval, RAN letters, in a group of English monolingual children.

2.6 *Exposure, L2 development, and fluency*

When developing a second language, exposure to the target language is a positive factor. In a study of young learners' development of English as L2, Lindgren & Muñoz (2013) found that next to linguistic distance between L1 and L2, exposure to the target L2 outside school was the strongest predictor of both listening and reading comprehension. Similarly, in Peters et al. study of 145 learners between the ages of 12-21 (2019) in the Flemish parts of Belgium, exposure to the L2 (English) was positively connected with children's vocabulary knowledge.

Writing fluency in L2 can also be enhanced by childhood exposure to the target language (Arecco & Ransdell, 2002), but does not have to be, as shown by Mikulski & Elola (2011). In their study of Spanish speaking university students in the USA, they found that students were less fluent when writing through Spanish (L1) as compared with English (L2). The fact that students grew up speaking Spanish in their homes but had only been taught writing through the medium of instruction, English, was brought to the fore as an explanation of the higher fluency in English (Mikulski & Elola, 2011). Somewhat contradictory results are presented in Bulté and Housen (2019), who found only limited effects of English (L2) as a medium of instruction in a high exposure CLIL (Content and Language Integrated Learning) program on 11-13 years-old children's L2 written complexity. Thus, even though exposure to the L2 target language has an effect on children and adults' L2 proficiency, evidence seems more consistent regarding aspects of reading, listening and vocabulary, than speaking and indeed, writing. To the best of our knowledge, no previous research has studied children's exposure and writing fluency in Persian, nor compared bilingual biscriptal children's exposure and writing fluency in two different alphabets.

3. MOTHER TONGUE INSTRUCTION AND LINGUISTIC CONTEXT

According to Swedish statistics, 138 916 people who lived in Sweden in 2019 were born in Iran or in Afghanistan (Befolkning Efter Födelseland, Ålder Och Kön. År 2000 - 2019, 2020). Persian is among the top ten largest minority languages in Sweden and 60% of the children who have the right to attend Persian mother tongue instruction choose to participate in those classes (SOU, 2019). During the academic year 2017-18 a total of 9682 children from grades 1-9 participated in Persian mother tongue instruction classes in Sweden (SOU, 2019). The majority of these children attended Swedish schools with Swedish as the language of instruction.

Mother tongue instruction classes are usually organized after school during afternoons or evenings, they are held once a week and last less than 60 minutes (Ganuza & Hedman, 2017). The syllabus is dense and includes oracy, literacy and culture, and is difficult to follow given the time limits. Ganuza and Hedman (2015) observations showed that there was more focus on reading than writing in mother tongue classes in Sweden. During lectures, the only writing activities were limited to writing the text that was written on the whiteboard or there were some questions in the

textbooks and the students were required to write down some short answers. Other writing activities were restricted to homework assignments.

A mother-tongue teacher's educational background varies (SOU, 2019) and there is no formal teacher education specifically aimed at mother tongue instruction. Some of these teachers might have teacher training backgrounds from their home countries, some might study the teacher training program in Sweden and the rest might just know the language and/or have other educational backgrounds. For example, one of the mother tongue teachers in this project had studied Art at a university in Iran.

3.1 Linguistic context

Persian has an alphabetic orthography with a modified version of the Arabic script and is written from right to left (Khanlari, 1979). There are six vowels in Persian: three short vowels and three long vowels. The short vowels are indicated orthographically by diacritics which are connected to the preceding letter and they are only used in early literacy education (Baluch & Besner, 1991). Long vowels are always written out in Persian and have their own graphemes (Baluch, 2006). Persian orthography has 32 letters. These letters are constructed by a total of 19 characters, of which 17 create different letters by placing dots above or below the characters or by omitting them (Sadeghi, 2013), for example, ب /b/, ت /t/, ث /s/, ج /dʒ/, چ /tʃ/, خ /X/, ح /h/. Thus, the number of dots (one to three) and their placement (above or below the letters) are highly critical for interpreting which letter they form. In addition, there are two letters that can be distinguished by adding or omitting a line above the letter ک /k/ گ /g/ (Sadeghi, 2013). Another typical characteristic of Persian orthography is emphasis (tashdid), which is indicated by a diacritic instead of writing a consonant twice (Versteegh, 1997).

Swedish is a Latin-based script and the letters are written from left to right. There are 29 letters, 26 Latin based and three letters ä, å, ö with diacritics (Håkansson & Norrby, 2010). These three characters have distinct phonological characteristics and can be perceived by L2 learners of Swedish as confusing, as they are visually similar to the a and o characters (Olofsson, 2003). These characters can also be difficult for Swedish young learners when they start to read and write (Olofsson, 2003). In addition, compound words are frequent in Swedish (Hedlund, Pirkola, & Järvelin, 2001) and there are no restrictions as to a compounds' length (Olofsson, 2003). For example, the Swedish word for "nail polish remover" is *nagellackborttagningsmedel*, a compound of the words *nagellack*, *borttagning*, and *medel*.

In order to find suitable measures for writing fluency that would allow for comparison between Persian and Swedish, a small study was conducted with a focus on three measures of text length: number of characters, words, and clauses. Ten texts were chosen from the Swedish immigration office website. The texts were in Swedish with their corresponding official translations in Persian. Number of words and characters were computed using Microsoft Word. Paired-sample t-tests showed that

there was a significantly higher number of characters in the Swedish texts ($M = 4333.90$, $SD = 2103.93$) as compared with the Persian texts ($M = 4031.80$, $SD = 1978.36$), $t(5.22) =$, $p < .01$), with a large effect size (0.75). Further, there were significantly fewer words in the Swedish texts ($M = 834.20$, $SD = 396.39$) as compared with the Persian texts ($M = 960.90$, $SD = 490.57$), $t(-3.67) =$, $p < .01$), again with a large effect size (0.60). As for the number of clauses, there was no significant difference between the languages.

These results are in agreement with the main characteristics of these two orthographies. Short vowels are not written in Persian, but they are always written in Swedish. Therefore, we found more characters in Swedish than Persian in the immigration office texts. In addition, we had assumed that compound words would be more frequent in Swedish than in Persian. This was also verified by the comparison between the two versions of the immigration office texts. Our third measure, number of clauses, did not turn out to be different between the languages, indicating that the syntactic structure of the languages is similar.

4. MATERIAL AND METHODS

In this study, we employ a mixed methods approach (Creswell, 2003) using a sequential explanatory model. First, we focus on the relationship between exposure, lexical retrieval and writing fluency through statistical analyses. Secondly, we conduct a small qualitative analysis of three participants' text production in order to go into depth with the question of how typology can affect writing fluency in these two scripts. Lastly, we combine the results in the concluding discussion. The data was collected within the framework of a larger project with the aim to investigate bilingual children's reading and writing competencies.

4.1 Participants

Participants were recruited via social media and via advertisements in Persian radio channels in Sweden. The procedure of the project was explained to the children and their parents. If they showed an interest in participating in the project, an information letter and a letter of consent was sent to them in both Persian and in Swedish and they were asked to fill in the forms in the language they felt most comfortable with.

In order to participate, children were required to be able to understand, speak, read, and write both Persian (Farsi/Dari) and Swedish. They were expected to speak Persian (Farsi/Dari) at home and both their parents should be Persian (Farsi/Dari) native speakers. In addition, the children should have been in the Swedish school system for at least the past three years. The three-year criteria was used to ensure that the children had had enough time to acquire basic knowledge in Swedish and thus be able to perform the tasks (Hedman, 2009). On average, the participants had been in Sweden for 8.5 years and had participated in the Swedish school systems for

5.6 years at the time of the study. The children came from different Swedish cities with Persian communities where the children had the opportunity to hear and speak Persian in society and receive mother-tongue education at school. There were 26 children who participated in the project. Two of them were diagnosed with dyslexia and therefore not included in the present study. One additional participant was excluded from the analysis as he did not write about the assigned topic but chose one of his own. The remaining 23 children were at grades 4-9, between 10 and 15 years of age, with a mean age of 12.6 years. The participants attended Swedish schools with Swedish as a medium of instruction and all the courses except those in languages (e.g. English, German, French) were in Swedish. They used Persian during mother tongue classes.

Table 1. Distribution of participants across grades

Grades	<i>N</i>
Grade 4	6
Grade 5	4
Grade 6	2
Grade 7	5
Grade 8	3
Grade 9	3

Participants and their parents were asked to choose the time and the place for the meetings. They were asked to find a place that was suitable for them and quiet, in order to avoid distractions. The places that were chosen were meeting rooms, classrooms at schools, homes, and libraries.

Children respond differently to performing tasks like the ones in this study. If a participant showed signs of tiredness, sadness, or discomfort, in particular the youngest ones, we ended the session and resumed it at a later occasion. Most of the participants finished all the tasks during two or three sessions. The order of tasks and languages was counterbalanced. A few of the older participants could only meet once. In these cases, we made sure that the meeting took place on a day when they did not go to school nor participated in any other school activities. Even though the data collection varied in time between participants, we believe that by paying close attention to their individual preferences and needs we also allowed them to perform the tasks to the best of their abilities.

We are aware that the sample size is small and that the age span between children is large and we acknowledge the limitations it brings to the study. Even though a full year was spent recruiting participants with the explicit aim to result in a more balanced group, the Persian community in Sweden was not large enough for us to find participants that met the criteria for the study, i.e., could read and write in both Persian and Swedish, and that were willing to participate in the study.

4.2 Material and procedures

4.2.1 Questionnaire

In the frame of the larger project, a questionnaire was developed to obtain information about participants' background, language use and attitudes. For the purpose of the current study, we used the questions that related specifically to their interactions and their literacy. The first set of questions related to how often participants speak Persian and Swedish with their parents, siblings, grandparents/babysitters and family's friends. They could choose between the options never (0), rarely (1), sometimes (2), often (3) and always (4). The second set of questions related to their reading and how often they read something such as books, journals, newspapers, comic books in Persian and Swedish at home. The options for these questions were never (0), once a year (1), once a month (2), at least once a week (3) and every day (4). The mean of participants' responses (0-4) can be found in Table 4. One participant did not have time to answer the questionnaire. Therefore, the responses and corresponding analysis include 22 participants.

4.2.2 Lexical retrieval

Two standardised measures of lexical retrieval skills were used: *phonological fluency* and *semantic fluency* in Persian (Kormi-Nouri & Moradi, 2009) and in Swedish (Carlsson, 2009). The phonological fluency tasks in Persian consisted of three letters *m*, *a*, and *n*. Each of these letters was written on a separate card that was shown to the participants and read out aloud. Participants were then asked to produce as many words as they could within one minute starting with that letter. The Persian semantic fluency task included six categories (*fruit, girl's name, boy's name, body parts, colours, kitchen appliances*). The participants were given one minute to produce as many words as they could in each of the categories.

In the phonological word fluency task in Swedish, children were asked to produce as many words as they could that started with *f*, *a* and *s*, in one minute per letter. For the semantic fluency task, participants were given one minute to produce as many words as they could for the category "animals".

One of the strengths of the current paper is that we used standardized tests in both languages. However, because the tests were constructed in different countries, it was impossible to find identical tests. We tried to find tests that were as similar as possible in the two languages, but they are still slightly different in their designs. For example, the semantic fluency test contained more categories in the Persian test than in the Swedish one.

In order to compare the results between languages, we divided the number of produced words by time (s) and created one composite score for phonological and semantic retrieval fluency per second in each language which we define as participants' *lexical retrieval*. In doing so we first converted the raw scores of phonological

and semantic fluency per second to z-scores, then added the z-scores in each language and divided them by two. The mean and standard deviation of the phonological and semantic fluency per second in each language prior to converting them to z-scores and making composite measures are presented in Table 4. In the paired-sample t-test and correlation analysis, the composite scores of these two measures in each language are used in order to investigate lexical retrieval skills.

The Cronbach's alpha for the phonological and semantic word fluency per second in Swedish was 0.41 (mean inter-item correlation .26). The Cronbach's alpha for the phonological and semantic fluency per second in Persian was 0.81 (mean inter-item correlation .69).

4.2.3 *Writing tasks*

Each participant wrote four texts: one narrative and one descriptive text in each language. Two genres were included in order to account for the fact that writing may differ between genres, even though these differences seem less prominent with children below 15 years of age (Berman and Nir-Sagiv, 2007).

In general, bilingual bicultural children who attend Persian mother tongue instruction classes in Sweden are used to writing by hand. They do not use the Persian keyboard and thus are not familiar with its functions. Therefore, we decided to choose the Eye and Pen tool (Alamargot et al., 2006) to collect and analyse the texts.

For the narrative writing tasks, two frog stories with similar content, *Frog where are you?* (Mayer, 1969) and *A boy, a dog and a frog* (Mayer, 1967) were used. Before initiating the main study, a pilot study was conducted where one participant wrote about all the pictures in the narrative tasks in both languages. The pilot study revealed that the frog stories contained too many pictures which made the participant tired. Therefore, seven key pictures were chosen from each frog story and the tasks were piloted again, together with two descriptive tasks, their *dream house* and their *dream present*. For the narrative tasks, the participants were asked to write about the pictures and for the descriptive tasks, they were asked to write about their dream house and their dream present. After the pilot study, an approximate writing time of 30 minutes was established for each narrative task and 15 minutes for each descriptive task. All children finished within the time limits. In case children's handwriting was unclear, they were asked to read their texts aloud after completing it. The audio recordings were used as a backup.

4.2.4 *Fluency measures*

Fluency was divided into product fluency (text length) and process fluency (writing speed). Both product and process fluency were divided into total number of characters, words, and clauses in order to account for differences in typology reported in section 3.1. Number of characters, words and clauses were counted manually using the final texts in Eye & Pen. The total writing time was retracted from Eye and Pen

and computed from the time the participant started writing until they lifted the pen for the last time.

A word was defined as a number of characters such as *hello* between two spaces (Alamargot et al., 2010). Words were counted according to how they were written. For example, if a participant wrote a compound word as two words, it was counted as two words. The clauses were divided into main and subordinate clauses. In cases where the children did not include a main verb, text before or after that sentence were analysed in order to decide if it could be considered an elliptical main clause. For example, in a Persian text, the last sentence in one participant's text was "*I want to a parking space, two toilets and one bathroom*". The participant had left out the word "*have*" after "*to*". The prior sentences were "*I want to have white and black walls. I like to have six rooms and one kitchen*". Therefore, in parallel with these sentences, we considered the sentence without "*have*" as an elliptical main clause.

4.2.5 Reliability of measures

One Persian native speaker and one Swedish native speaker counted the number of characters and words in 8.7% of the texts (equivalent to eight texts). In addition, a Persian mother tongue teacher and a Swedish language teacher counted the number of clauses in the respective languages in 8.7% of the texts (equivalent to eight texts). The interrater reliability was ($k = 0.80, p < 0.001$) in both genres and languages, which can be considered as a substantial agreement (Landis & Koch, 1977). In addition, the first author counted the product measures of each text three times. The fourth time she counted all three product fluency measures; number of characters, words and clauses in the same texts that were examined by external raters. The intrarater reliability between ratings was found to be ($k = 1.00, p < 0.001$) in both genres and languages, which can be considered almost perfect agreement (Landis & Koch, 1977).

4.2.6 Statistical analysis

In order to decide which statistical method would be appropriate to use, we first assessed the normality distribution of data by examining the z-skewness and z-kurtosis of the variables (Field, 2017). The analysis showed that the data was not normally distributed. In order to be able to use robust parametric methods, we transformed the data. First, we used the square root transformation which was not a successful method. Instead, a log 10 transformation was applied to the data. The data was normally distributed and all the variables' z-skewness and z-kurtosis were between -1.96 and 1.96 (Field, 2017).

Paired-samples t-tests were conducted to evaluate the difference between writing fluency (both temporal and length) measures across genres and languages and effect sizes were computed and interpreted according to Cohen (1988). Pearson correlation analysis was used to ascertain relationships between writing fluency and exposure, and between writing fluency and lexical retrieval.

4.2.7 Qualitative analysis

Three children with the highest writing process fluency in Persian in grades 4, 7 and 9 were selected for a close analysis of their writing fluency, with a focus on typological differences between languages. Our main focus of the analysis was to explore the long bursts and what eventually interrupted them. Long bursts exhibit passages in the text that the writer produced particularly fluently. Burst was defined as text produced between pauses and a pause was defined “as a period of handwriting interruption” (Alves & Limpo, 2015: 379). We used a pause threshold of two seconds, which is a commonly used threshold in writing process research (Chenoweth & Hayes, 2001; Strömqvist et al., 2006; Alves & Limpo, 2015). The two-second threshold assumes that mechanical interruptions in the writing fluency would be shorter than two seconds, thus be filtered out from the analysis leaving pauses that are more likely to be due to cognitive activities, such as word choice, spelling insecurity, or changes of ideas.

5. RESULTS

5.1 Product and process fluency

The descriptive statistics are presented in Table 2 and the results of the t-test in Table 3. In the narrative texts all three measures of product fluency (text length) showed the same result. The number of characters, words, and clauses were higher in the Swedish as compared with the Persian texts ($t(8.85) =, p < .001, d = 1.49$; $t(7.14) =, p < .001, d = 1.16$; and $t(3.40) =, p < .01, d = .73$ respectively). The effects were large for characters and words and moderate for clauses. The descriptive texts showed nearly identical results to those of the narrative texts, with the number of characters, words and clauses being higher in Swedish than in Persian, with large effect sizes for characters and words but moderate for clauses ($t(7.20) =, p < .001, d = 1.56$; $t(6.92) =, p < .001, d = 1.38$; and $t(3.39) =, p < .01, d = 0.76$ respectively).

As for process fluency, the narrative texts were written with higher fluency in Swedish than in Persian in all three fluency measures characters/second, words/second and clauses/second, with large effect sizes ($t(11.60) =, p < .001, d = 2.58$; $t(9.79) =, p < .001, d = 2.12$; and $t(6.21) =, p < .001, d = 1.63$). Similarly, fluency in the descriptive texts was higher in Swedish than in Persian in all three measures, again with large effect sizes ($t(11.77) =, p < .001, d = 2.52$; $t(10.83) =, p < .001, d = 2.27$; and $t(6.82) =, p < .001, d = 1.68$ respectively).

In summary, the results show that the participants produced more characters, words and clauses in Swedish than in Persian in both genres. Furthermore, they wrote faster in Swedish in both genres. All these differences across languages were statistically significant with mainly high effect sizes.

Table 2. Descriptive statistics for product and process fluency measures across languages, mean (M) and standard deviation (SD).

Variables	Persian		Swedish	
	M	SD	M	SD
Nar Ch	233.17	106.13	422.35	151.21
Nar W	65.78	29.80	104	36.54
Nar Cl	13.52	6.33	17.09	5.24
Nar Ch/s	0.36	0.19	0.86	0.26
Nar W/s	0.10	0.06	0.21	0.06
Nar Cl/s	0.02	0.01	0.04	0.01
Des Ch	189.87	92.30	388.61	163.76
Des W	53.09	25.59	97.74	40.14
Des Cl	10.09	3.60	15.22	7.85
Des Ch/s	0.32	0.16	0.82	0.29
Des W/s	0.09	0.05	0.21	0.07
Des Cl/s	0.02	0.01	0.03	0.01

Note. Nar= narrative; Des= descriptive; Ch= number of characters; W= number of words; Cl= number of clauses; Ch/s= characters per second; W/s= words per second; Cl/s= clauses per second

Table 3. Paired-samples t-test for product and process fluency across languages.

		M	SD	t(23)	P	Cohen's d
Pair 1	Nar Ch	0.27	0.15	8.85	0.000	1.49
Pair 2	Nar W	0.21	0.14	7.14	0.000	1.16
Pair 3	Nar Cl	0.13	0.18	3.4	0.003	0.73
Pair 4	Nar Ch/s	0.41	0.17	11.6	0.000	2.58
Pair 5	Nar W/s	0.35	0.17	9.79	0.000	2.12
Pair 6	Nar Cl/s	0.31	0.24	6.21	0.000	1.63
Pair 7	Des Ch	0.32	0.21	7.2	0.000	1.56
Pair 8	Des W	0.27	0.19	6.92	0.000	1.38
Pair 9	Des Cl	0.15	0.22	3.39	0.003	0.76
Pair 10	Des Ch/s	0.42	0.17	11.77	0.000	2.52
Pair 11	Des W/s	0.38	0.17	10.83	0.000	2.27
Pair 12	Des Cl/s	0.26	0.18	6.82	0.000	1.68

5.2 Exposure at home, lexical retrieval and writing fluency

The analysis of the questionnaire (see Table 4) demonstrated that the participants almost always spoke Persian with their parents and with friends of their families. However, they spoke both Persian and Swedish with their siblings. As for reading, they frequently read in Swedish and a couple of times a month they also read something in Persian. Their phonological fluency was similar in Persian and Swedish, while their semantic fluency was slightly lower in Persian, i.e., retrieving words took longer in Persian than in Swedish. Their lexical retrieval measure, the composite score for phonological and semantic fluency, was thus higher in Swedish than in Persian.

Table 4. Descriptive statistics for exposure and the lexical retrieval, mean (*M*) and standard deviation (*SD*).

	<i>N</i>	<i>M</i>	<i>SD</i>
Speak PER with mom	22	3.68	0.72
Speak SWE with mom	22	1.50	1.23
Speak PER with dad	19	3.37	0.50
Speak SWE with dad	19	1.95	0.91
Speak PER with sibling	18	2.56	1.04
Speak SWE with sibling	18	2.89	1.02
Speak PER with family's friends	22	3.55	0.60
Speak SWE with family's friends	22	1.91	1.31
Read PER	22	2.05	1.25
Read SWE	22	3.45	0.74
Phonological fluency PER per second	23	.12	.03
Semantic fluency PER per second	23	.20	.04
Phonological fluency SWE per second	23	.12	.04
Semantic fluency SWE per second	23	.28	.07

In Table 5, we present the results of the Pearson correlation analysis between writing fluency measures, exposure, and lexical retrieval. Exposure to Swedish at home did not correlate with any of the fluency measures, nor did it correlate with exposure to Persian or lexical retrieval. However, speaking and reading in Persian correlated strongly and positively with one another ($r = .70$, $n = 23$, $p < 0.001$). Thus, those who speak Persian at home frequently also read in Persian. Speaking and reading in Persian further correlated with some of the writing fluency measures in Persian and some in Swedish. More specifically, speaking Persian at home moderately and positively correlated with both number of clauses and number of clauses per second in the Swedish descriptive texts ($r = .46$, $n = 22$, $p < 0.05$; and $r = .48$, $n = 22$, $p < 0.05$). In addition, speaking Persian at home was positively and strongly associated with the number of words and clauses in the Persian descriptive text and number of clauses per second in the Persian narrative text ($r = .43$, $n = 22$, $p < 0.05$; $r = .56$, $n = 22$, $p < 0.01$; $r = .56$, $n = 22$, $p < 0.01$). Reading Persian at home was positively and strongly associated with the number of characters, words, clauses and number of clauses per second in the Swedish descriptive text ($r = .46$, $n = 22$, $p < 0.05$; $r = .54$, $n = 22$, $p < 0.01$; $r = .63$, $n = 22$, $p < 0.01$; $r = .52$, $n = 22$, $p < 0.05$).

Lexical retrieval in Swedish did not correlate with any writing fluency measures, nor with lexical retrieval in Persian or with exposure in any language. However, lexical retrieval in Persian correlated positively and moderately with number of characters per second in the Persian descriptive task and number of clauses per second in the Persian narrative task ($r = .43$, $n = 23$, $p < 0.05$; $r = .42$, $n = 23$, $p < 0.05$).

5.3 A close look at three bilingual bicultural children's writing fluency

Three children that we call Roxana, Sara and Fariba were the most fluent writers (considering Persian writing process measures) in their respective age groups. In the

following we present them, their background, their exposure to Persian and Swedish outside school, and their writing fluency, with a particular focus on contextualising fluent passages, what may have interrupted them and the potential role of typology.

Table 5. Pearson correlation between writing fluency, exposure and lexical retrieval across languages.

	LexRet PER	LexRet SWE	Speak PER	Speak SWE	Read PER	Read SWE
LexRet SWE	0.27					
Speak PER	0.30	-0.27				
Speak SWE	-0.39	0.02	-0.33			
Read PER	0.10	-0.10	0.70***	-0.13		
Read SWE	0.11	0.35	0.28	0.02	0.27	
Nar SWE Ch	0.04	0.07	-0.00	-0.21	0.23	0.15
Nar SWE W	0.03	0.02	0.05	-0.21	0.29	0.17
Nar SWE Cl	-0.08	-0.08	0.12	-0.11	0.36	0.18
Nar SWE Ch/s	0.24	0.36	0.05	-0.12	-0.01	0.06
Nar SWE W/s	0.23	0.29	0.12	-0.11	0.07	0.09
Nar SWE Cl/s	0.11	0.18	0.19	0.04	0.08	0.07
Des SWE Ch	0.14	0.00	0.26	0.03	0.46*	0.40
Des SWE W	0.14	0.00	0.35	-0.01	0.54**	0.43
Des SWE Cl	0.20	-0.10	0.46*	-0.09	0.63**	0.36
Des SWE Ch/s	0.30	0.16	0.13	-0.08	0.16	0.10
Des SWE W/s	0.31	0.18	0.25	-0.15	0.27	0.11
Des SWE Cl/s	0.39	-0.01	0.48*	-0.26	0.52*	0.10
Nar PER Ch	0.30	0.00	0.21	-0.32	0.03	0.06
Nar PER W	0.29	-0.03	0.25	-0.33	0.10	0.07
Nar PER Cl	0.29	0.03	0.35	-0.24	0.13	0.25
Nar PER Ch/s	0.41	0.06	0.26	-0.32	0.12	-0.24
Nar PER W/s	0.39	0.03	0.31	-0.32	0.20	-0.23
Nar PER Cl/s	0.42*	0.07	0.56**	-0.25	0.33	0.04
Des PER Ch	0.39	0.05	0.41	-0.32	0.21	0.11
Des PER W	0.36	0.02	0.43*	-0.34	0.27	0.07
Des PER Cl	0.36	0.01	0.56**	-0.26	0.35	0.16
Des PER Ch/s	0.43*	-0.02	0.27	-0.37	0.04	-0.22
Des PER W/s	0.36	-0.05	0.26	-0.37	0.09	-0.27
Des PER Cl/s	0.35	-0.08	0.34	-0.28	0.13	-0.26

Note. LexRet = Lexical retrieval * $p < .05$. ** $p < .01$. *** $p < .001$

5.3.1 Roxana

Roxana is an 11-year-old female participant in grade 4. She has been in Sweden for the past four years. She mainly speaks Persian with her parents, siblings and family's friends. She seldom communicates in Swedish in the home environment, but she reads mostly in Swedish. Generally, Roxana is most comfortable with Swedish. Considering her lexical retrieval in each language, Roxana produced more words per second in the phonological fluency task in Persian than Swedish (0.13; 0.11) and more words per second in the semantic fluency task in Swedish than Persian (0.42; 0.23) respectively. In both narrative and descriptive texts, she wrote more characters and

words in Swedish (647, 160; 315, 77) than Persian (223, 65; 175, 54). Comparing the narrative texts, she wrote more clauses in Swedish (19) than Persian (11) whereas the number of clauses were similar, 11 in Persian and 10 in Swedish. Her longest bursts in the Swedish narrative and descriptive texts contained more words (20, 26.5) than her longest bursts in the Persian narrative and descriptive texts (7, 10).

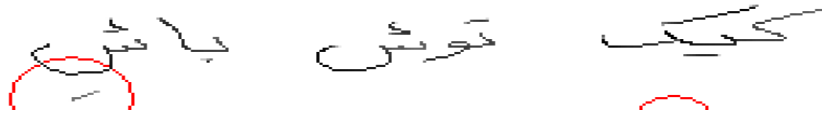
In both of her descriptive texts, in Persian and Swedish, Roxana showed her great interest in pets, in particular in dogs though her Swedish descriptive text contained more information and details. In a long burst in Persian, she wrote one subordinate clause describing possession *“and that I have five dogs”* while in one of the long bursts in the Swedish text she explained why she wanted to have many dogs which seemed to spark her to continue writing about another thing she wished to have, using two main clauses and two subordinate clauses *“because I have a dog and I want them to get puppies. I want an iPhone vision that will come out this summer instead of the iPhone eight”*. The same pattern was observed in the narrative texts. She explained the pictures in Swedish using longer bursts and more details as compared with the Persian text. In Swedish, one of the long bursts in the frog story contained one main and two subordinate clauses describing an emotion as well as an activity that was the consequence of that emotion *“Later the frog began to think it was sad to just sit on a rock all alone so he started to follow the boy and the dog’s tracks”* whereas in one of the long bursts in the narrative text in Persian, she wrote *“had a dog and a frog”*. In the Swedish example she unpacked thoughts and feelings behind an action that one of the main characters performed, i.e., why the frog started to follow the boy and the dog, while in Persian she described a state of fact, that the boy had two pets.

Figure 1. Writing a compound work in Swedish, Pauses are indicated by red circles

The image shows a handwritten Swedish sentence: "deras vardagsrum sedan in i". There are three red circles drawn around the letters 'd' in "deras", 'g' in "vardagsrum", and 'i' in "in i", indicating pauses in writing.

In the Swedish texts, fluency was interrupted by long pauses mostly in relation to punctuation marks (full stop) at the end of sentences, or at the end of words. However, in one example (shown in Figure 1) Roxana’s writing fluency was interrupted between words in the compound word *vardagsrum* (dining-room) in Swedish. In Persian, the disruption of writing fluency occurred mainly when she wrote dots for different graphemes such as پ (*p*), ش (*sh*), ت (*t*). In one example, the fluency was discontinued when she marked a short vowel *e* in Persian (Figure 2).

Figure 2. Writing a short vowel in Persian. Pauses are indicated by red circles.



5.3.2 Sara

Sara is a 14-years-old girl in grade 7 who was born in Sweden. She mostly speaks Persian with family members and family’s friends. Every day she reads something in Swedish. Sara is more comfortable speaking Persian than Swedish though she is more used to writing through Swedish. However, Sara produced more words per second in both phonological and semantic fluency in Swedish than Persian (0.18, 0.28; 0.14, 0.27). She also wrote more characters and words in the Swedish narrative and descriptive texts (355, 81; 322, 79) than in the Persian (261, 73; 231, 63) texts, but generated slightly more clauses in the Persian texts than in the Swedish ones (16, 12; 15, 10). Sara’s longest bursts were found in her Swedish narrative and descriptive texts (17, 11) which were considerably longer than the longest bursts in the Persian narrative and descriptive texts (5, 5). Similarly to Roxana, Sara’s longest bursts were more detailed in her Swedish texts as compared with her Persian texts, especially in the narrative genre. For example, in the Persian frog story, she wrote “he searched everywhere”, one main clause describing an activity, while in the Swedish narrative text a long burst contained one main clause and two subclauses including an emotional consequence of an action “When they left, the frog felt sad as he had no-one to play with”.

Figure 3. Writing dots for some Persian graphemes. Pauses are indicated by red circles.



Also similar to Roxana, Sara’s writing fluency in the Swedish texts was primarily discontinued at the end of words or when writing punctuation marks, full stops, at the end of sentences. In Persian, her fluency was also interrupted when writing full stops at the end of sentences but also in relation to dots for some graphemes such as ز (z), ن (n), ش (sh), ک (k) and گ (g), in Persian script are rather similar. The only difference between them is the adding/omitting of a line on the letter (Sadeghi, 2013). In two examples, the

writing fluency was interrupted when Sara wrote the diacritic line on گ (g) (see Figure 4).

Figure 4. Writing a diacritic in Persian. Pauses are indicated by red circles.



5.3.3 Fariba

Fariba came to Sweden when she was in grade 4, when she was ten years old. At the time of the study, she was fifteen years old and in grade 9. She primarily communicates in Persian at home with family members and she sometimes reads books in Persian and in Swedish. She is generally more comfortable with Swedish, which is reflected in the phonological and semantic fluency tasks where she produced more words per second in Swedish than in Persian (0.14, 0.30 ; 0.13, 0.26 respectively). Fariba produced more characters, words and clauses in the Swedish narrative and descriptive (604, 153, 19 ; 640, 151, 28) tasks than in the Persian texts (364, 103, 14; 377, 119, 15), but she produced long bursts in both languages. In the narrative texts, her longest burst was longer in Persian (20.5 words) than in Swedish (12.5 words) while her longest burst in the descriptive task was longer in Swedish than in Persian (33.5 vs. 18 words). Her bursts were thus rather similar across languages. In a long burst in Swedish, she wrote two main clauses and four sub clauses describing the future consequences of a present action "I can save all the pictures I take and be able to look at them when I get older and be able to show my children how my life was". In a long Persian burst she wrote two main clauses and one subordinate clause describing what the inside of her dream house would look like "one gets to the living room and kitchen. There is another floor upstairs. There are three rooms there and a tao".

Figure 5. Writing the dot on "å" in Swedish. Pauses are indicated by red circles.



Similarly to Roxana and Sara, Fariba's writing fluency in Swedish was interrupted when writing punctuation marks (full stop) and sometimes at the end of words. In two cases, the interruption occurred when Fariba wanted to put the diacritics on two of the Swedish characters å and ö in the words så (so) and överraskatt (surprised) which is illustrated in Figure 5. In Persian, the interruptions frequently occurred when writing dots in graphemes such as ب (b), ت (t), ق (gh), ی (y), at the end of words

and when writing full stops. Once the interruption also occurred when she wrote an emphasis (tashdid) (see Figure 6) which is a typical characteristic of Persian orthography.

Figure 6. Writing an emphasis in Persian. Pauses are indicated by red circles.



The analyses of these three children's texts provided some additional input as to their writing fluency in the two languages. There were similarities between their fluency in the two languages, for example, they tended to stop at the end of the syntactic units, words and sentences. Their fluency was also interrupted in relation to typological characteristics in both languages, even if these interruptions were more common when writing through Persian. In Persian, typology interrupted their writing mainly in relation to the addition of diacritics (dots and lines) to some letters, short vowels, and emphasis, whereas in Swedish, compound words and diacritics added to the letters *a* and *o* were the main typological causes for interruptions. The main differences in fluency between the children were found in text length (product fluency), writing speed, burst length, semantic information included in the bursts, and syntactic complexity of burst, which were all more developed in the children's Swedish writing.

6. DISCUSSION

The languages Persian and Swedish are typologically different in many respects, which impact on text length between languages in terms of number of characters (higher in Swedish) and words (higher in Persian), but not in number of clauses. However, the results showed that the participants wrote statistically more characters, words and clauses in their Swedish texts as compared with their Persian ones. In addition, the analysis of process measures displayed that they wrote significantly faster in Swedish than Persian. Thus, we conclude that the bilingual children in this project were more fluent writing both narrative and descriptive texts in Swedish than Persian. Similar pattern was observed among monolingual children in grades 4 to 9 where no difference between writing fluency of narrative versus argumentative in grades 4 and 9 (Olive et al., 2009) and narrative versus expository (Berman & Nir-Sagiv, 2007) texts in grades 4 and 7 were found. The qualitative analysis confirmed that the participants were more fluent writing through Swedish than Persian; results showed how the three selected children wrote longer bursts that were also more complex both semantically and syntactically in their Swedish texts.

These results are in contrast with some studies of bilingual adults (Chenoweth & Hayes, 2001; Kobayashi & Rinnert, 2013) and children (Schoonen et al., 2009; Spelman Miller et al., 2008) who found that their participants had greater writing fluency

in their L1 than in their L2. The children in the present study were bilingual speakers of Persian and Swedish, who used Persian at home on a daily basis. Thus, even though Persian cannot be considered their L2, our participants' fluency patterns were similar to those of L2 writers; their L2 required lower cognitive capacity while writing than did their L1. An explanation may be that their exposure to L2 (Swedish) is high both at school and in society. In addition, most homework, assignments, and exams were in Swedish, thus our participants were more used to both reading and writing in their L2 (Swedish) than in their L1 (Persian). This was also found in adults by Mikulski & Elola (2011), who were more fluent writing English (L2) than Spanish (L1). Adding our younger writers to their result highlights how strongly an L2 school language impacts on bilinguals' writing across ages.

The result that exposure in Persian was positively related to fluency measures in Swedish is similar to results found in Lindgren & Stevenson (2013). They concluded that children (11 years old) could make use of their knowledge about writing across Swedish (L1) and English (L2), which was explained using the framework of multi-competence (Cook, 2002; Kobayashi & Rinnert, 2013). Rinnert et al (2015) used the term dynamic transfer to explain how writers under certain conditions are able to transfer knowledge about writing between languages. In our study, participants' fluency was significantly higher in Swedish. Even so, participants' exposure to Persian outside school was associated with writing fluency in both languages. Thus, they seemed able to transfer knowledge that was relevant to their writing between languages and make use of exposure to Persian while writing, regardless of language. Literacy in their L1 supported literacy in their L2 (Bialystok, 2001).

Lexical retrieval in L1 (Persian) only correlated with two process fluency measures, number of characters per second in the Persian descriptive texts and number of clauses per second in the Persian narrative texts. This is surprising considering that studies of monolingual L1 children's writing did not find a relationship between lexical retrieval and writing fluency (Babayigit & Stainthorp, 2010; Williams & Larkin, 2013). In fact, the results of our L1 analyses are more similar to those of L2 writers in Grewal & Williams (2018) that showed significant correlations between lexical retrieval and for example length of bursts, and number of words and sentences. Similarly, our lack of correlation between lexical retrieval and fluency in L2 are similar to the results from studies with monolingual children (Babayigit & Stainthorp, 2010; Williams & Larkin, 2013). Taken together with our other results, showing that our participants were more fluent when writing through L2 Swedish, their L1 Persian seemed to function more like an L2 when using it for writing. More research in this area should be conducted to analyse the role of lexical retrieval and writing fluency among both languages of bilingual children.

Typology and punctuation affected our participants' writing fluency. The qualitative analysis of three children with high process writing fluency across grades 4, 7 and 9 showed that some of the typological characteristics of Persian (diacritics), such as short vowel *e*, emphasis, writing dots for some graphemes such as ز (*z*), ن (*n*), ش (*sh*) and adding a line on a character گ (*g*) caused interruption in the writing fluency.

Similarly, in Swedish, compound words and the diacritics added to the letters a and o (å, ä, ö) caused our three writers to pause and interrupt their fluency. These typological characters have been known to cause confusion among Swedish second language learners (Olofsson, 2003). Further our writer's fluency was interrupted by pauses at the end of sentences in relation with punctuation marks. Pauses are positions in writing where writers stop for planning, translating or revision purposes (Hayes, 2012) and they are common at sentence boundaries. Pauses are also known to increase with syntactic boundaries; pauses are typically shorter between words than between sentences or paragraphs (Wengelin et al., 2009; Medimorec & Risko, 2017). Thus, our writers fall into a common pause pattern while writing regardless of which language they use.

Finally, we would like to discuss some implications of our results. The fact that Persian is a modified version of the Arabic script implies that the typological characteristics that were found to interrupt writing fluency in Persian can also be found in Arabic. Therefore, all these characteristics are useful to consider for writing education by both Persian and Arabic mother tongue teachers as well as for Swedish language teachers of bilingual children with these backgrounds. With a limited lesson time and a comprehensive syllabus, there is not nearly as much time for practising writing through Persian as there is for writing through Swedish. It is likely to assume that the gap between fluency in writing in Persian and in Swedish would even widen with years of schooling, as children are increasingly exposed to writing through Swedish. The children in our study will continue to practise writing through Swedish across genres and subjects, building a repertoire of L2, or vertical discourse (Bernstein, 1999), as well as building their lexical skills by getting more exposure to Swedish, while their Persian writing will likely be limited to some homework and out-of-school literacy practises, such as social media, notes and journals (Norlund Shaswar, 2014). The results of this paper highlight the fact that the mother tongue instruction that our participants had received was not enough for them to develop similar writing skills in L1 as in L2. Therefore, one conclusion may be that schools should invest more in mother tongue instruction and provide more lessons every week with more focus on reading and writing.

The significant association between exposure to Persian at home with writing fluency measures in both Persian and Swedish shows that it is crucial for parents to provide opportunities for language use and encourage their children to speak, read and write in Persian at home and in their leisure time. In larger cities, it may be possible to join Persian communities and participate in activities in order to increase exposure to the L1. There are also applications and websites available in which children can listen to stories in their L1. The results also demonstrated a significant relationship between lexical retrieval and writing fluency measures in Persian. Listening and reading in Persian can help children to improve their lexical knowledge and subsequently become more efficient writers in this language.

One limitation of our study is the large age span between the participants due to difficulties in recruiting bilingual and biliterate participants. Even though this could

have affected the result, we believe that the fact that our main finding (participants' writing was stronger in their L2 as compared with their L1) was confirmed repeatedly across all measures provides stability to the results. Future studies should aim to confirm, or contradict, the results in more balanced designs.

7. CONCLUSIONS

In this study we set out to explore writing fluency among bilingual and biscriptal children. Our findings highlight the role of typology when analysing writing fluency, that exposure to some degree can relate to writing fluency across languages, and that the role of lexical retrieval for writing fluency has potential but needs further investigation. The findings also shed light on the fact that the bilingual children in our study did not perform writing similarly in their two languages. As a group they wrote more and faster in their L2 (Swedish) than in their L1 (Persian). Our three cases also demonstrated that they stopped less often, included more information and emotions, and created more complex syntactic structures when writing through their L2 as compared with their L1. We would like to conclude by bringing to the fore, again, the fact that writing is not only a powerful tool for academic success, but also for the development of identity. Cummins and Persad (2014) showed how multilingual writing practises, where Canadian bilingual children wrote books in multiple languages and read them out loud, empowered them and supported their development of identity and self. Similarly, Hornberger and Skilton Sylvester (2000) describe how literacy instruction, practises, and policies, can become more balanced in terms of for example, medium of instruction, contents, focus on literacy, and meaning-making in both languages. In our study children's writing was not balanced between L1 and L2 their writing fluency was higher in Swedish indicating that their literacy was stronger in L2 (Swedish) even though their home language was L1 (Persian). Being able to write in several languages is a right, an identity, and an advantage, and children should be encouraged to develop their abilities and get the chance to practice towards balanced biliteracy.

REFERENCES

- Alamargot, D., Chesnet, D., Dansac, C., & Ros, C. (2006). Eye and pen: A new device for studying reading during writing. *Behavior Research Methods*, 38(2), 287–299. <https://doi.org/10.3758/BF03192780>
- Alamargot, D., Plane, S., Lambert, E., & Chesnet, D. (2010). Using eye and pen movements to trace the development of writing expertise: Case studies of a 7th, 9th and 12th grader, graduate student, and professional writer. *Reading and Writing: An Interdisciplinary Journal*, 23(7), 853–888. <https://doi.org/10.1007/s11145-009-9191-9>
- Alves, R., Branco, M., Castro, S. L., & Olive, T. (2012). Effects of handwriting skill, output modes, and gender on fourth graders' pauses, language bursts, fluency, and quality. In V. W. Berninger (Eds.), *Past, Present, and Future Contributions of Cognitive Writing Research to Cognitive Psychology* (pp.389-402). Taylor & Francis Group.

- Alves, R. A., & Limpo, T. (2015). Progress in written language bursts, pauses, transcription, and written composition across schooling. *Scientific Studies of Reading, 19*(5), 374–391. <https://doi.org/10.1080/10888438.2015.1059838>
- Alves, R., Leal, J.P., & Limpo, T. (2019). Using HandSpy to study writing in real time: A comparison between low- and high-quality texts in grade 2. In E. Lindgren & K.P.H. Sullivan (Eds.), *Observing writing: Insights from keystroke logging and hand-writing* (pp. 50–70). Brill. https://doi.org/10.1163/9789004392526_004
- Arecco, M. R., & Ransdell, S. (2002). Early exposure to an L2 predicts good L1 as well as good L2 writing. In *New directions for research in L2 writing* (pp. 123–131). Springer. https://doi.org/10.1007/978-94-010-0363-6_6
- Babayiğit, S., & Stainthorp, R. (2010). Component processes of early reading, spelling, and narrative writing skills in Turkish: A longitudinal study. *Reading and Writing: An Interdisciplinary Journal, 23*(5), 539–568. <https://doi.org/10.1007/s11145-009-9173-y>
- Baluch, B., & Besner, D. (1991). Visual word recognition: Evidence for strategic control of lexical and non-lexical routines in oral reading. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 17*, 644–652. <https://doi.org/10.1037/0278-7393.17.4.644>
- Baluch, B. (2006). Persian orthography and its relation to literacy. In R. M. Joshi & P. G. Aaron (Eds.), *Handbook of Orthography and literacy*. (pp. 365–376). Erlbaum.
- Befolkning efter födelseland, ålder och kön. År 2000–2019. (2020). Statistikdatabasen. http://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START_BE_BE0101_BE0101E/FodelselandArK/ [Population by country of birth, age and sex. Year 2000–2019. (2020). Statistical database.]
- Berman, R. A., & Nir-Sagiv, B. (2007). Comparing narrative and expository text construction across adolescence: A developmental paradox. *Discourse Processes, 43*(2), 79–120. <https://doi.org/10.1080/01638530709336894>
- Berninger, V. W., & Winn, W. (2006). Implications of advancements in brain research and technology for writing development, writing instruction, and educational evolution. In C.A. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 96–114). Guilford.
- Berman, R. A., & Nir-Sagiv, B. (2007). Comparing narrative and expository text construction across adolescence: A developmental paradox. *Discourse Processes, 43*(2), 79–120. <https://doi.org/10.1080/01638530709336894>
- Bernstein, B. (1999). Vertical and horizontal discourse: An essay. *British Journal of Sociology of Education, 20*(2), 157–173. <https://doi.org/10.1080/01425699995380>
- Bialystok, E. (2001). *Bilingualism in development: Language, literacy, and cognition*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511605963>
- Bulté, B., & Housen, A. (2019). Beginning L2 complexity development in CLIL and non-CLIL secondary education. *Instructed Second Language Acquisition, 3*(2), 153–180. <https://doi.org/10.1558/isla.38247>
- Carlsson, S. (2009). *Barn och ungdomars prestationer och svarsmönster på ordflödestest*. Examensarbete Från Logopedprogrammet. Karolinska Institutet, Institutionen För Klinisk Vetenskap, Intervention Och Teknik. *Logopedi, 171*, 77. [Children and adolescents' performance and response patterns on word flow test. Degree Project From The Speech Program. Karolinska Institutet, Department of Clinical Science, Intervention and Technology]
- Chandler, J. (2003). The efficacy of various kinds of error feedback for improvement in the accuracy and fluency of L2 student writing. *Journal of Second Language Writing, 12*(3), 267–296. [https://doi.org/10.1016/S1060-3743\(03\)00038-9](https://doi.org/10.1016/S1060-3743(03)00038-9)
- Chenoweth, N. A., & Hayes, J. R. (2001). Fluency in writing: Generating text in L1 and L2. *Written Communication, 18*(1), 80–98. <https://doi.org/10.1177/0741088301018001004>
- Christensen, C. A. (2004). Relationship between orthographic-motor integration and computer use for the production of creative and well-structured written text. *British Journal of Educational Psychology, 74*(4), 551–564. <https://doi.org/10.1348/0007099042376373>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. 2nd ed. Lawrence Erlbaum Associates.
- Cook, V. J. (2002). Background to the L2 user. In V. Cook (Ed.), *Portraits of the L2 user* (pp. 1–28). Multilingual Matters. <https://doi.org/10.21832/9781853595851-003>

- Creswell, J. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches* (2nd ed). Sage.
- Cummins, J., & Persad, R. (2014). Teaching through a multilingual lens: The evolution of EAL policy and practice in Canada. *Education Matters*, 2(1), 3–40.
- Ellis, R., & Yuan, F. (2004). The effects of planning on fluency, complexity, and accuracy in second language narrative writing. *Studies in Second Language Acquisition*, 26(01), 59–84. <https://doi.org/10.1017/S0272263104261034>
- Eisenclas, S., Schalley, A & Guillemin, D. (2015). Multilingualism and literacy: attitudes and policies. *International Journal of Multilingualism*, 12(2), 151-161, <https://doi.org/10.1080/14790718.2015.1009371>
- Field, J. (2003). *Psycholinguistics: A resource book for students*. Routledge.
- Field, A. (2017). *Discovering statistics using IBM SPSS statistics: North American Edition*, fifth ed. Sage Publication.
- Flower, L., & Hayes, J. R. (1981). A cognitive process theory of writing. *College Composition and Communication*, 32(4), 365–387. <https://doi.org/10.2307/356600>
- Ganuza, N., & Hedman, C. (2015). Struggles for legitimacy in mother tongue instruction in Sweden. *Language and Education*, 29(2), 125–139. <https://doi.org/10.1080/09500782.2014.978871>
- Ganuza, N., & Hedman, C. (2017). Ideology vs. Practice: Is there a space for pedagogical translanguaging in mother tongue instruction? In B. Paulsrud, J. Rosén, B. Straszer & Å. Wedin (Eds.), *New perspectives on translanguaging and education* (pp.208-225). Clevedon: Multilingual Matters. <https://doi.org/10.21832/9781783097821-014>
- Graham, S., Berninger, V., Weintraub, N., & Schafer, W. (1998). Development of handwriting speed and legibility in grades 1–9. *The Journal of Educational Research*, 92(1), 42–52. <https://doi.org/10.1080/00220679809597574>
- Grewal, S., & Williams, G. J. (2018). Writing product and process in children with English as an additional language. *Journal of Cognitive Psychology*, 30(8), 803–815. <https://doi.org/10.1080/20445911.2018.1518326>
- Hayes, J. R., & Flower, L. (1980). Identifying the organization of writing processes. In L. W. Gregg & E. R. Steinberg (Eds.), *Cognitive processes in writing* (pp. 3–30). Erlbaum.
- Hayes, J. R. (2000). A New Framework for Understanding Cognition and affect in writing. In R. Indrisano & J.R. Squire (Eds.), *Perspectives on writing: Research, theory, and practice* (pp. 6–43). Taylor & Francis.
- Hayes, J. R. (2012). Modeling and remodeling writing. *Written Communication*, 29(3), 369-388. <https://doi.org/10.1177/0741088312451260>
- Hedlund, T., Pirkola, A., & Järvelin, K. (2001). Aspects of Swedish morphology and semantics from the perspective of mono-and cross-language information retrieval. *Information Processing & Management*, 37(1), 147–161. [https://doi.org/10.1016/S0306-4573\(00\)00024-8](https://doi.org/10.1016/S0306-4573(00)00024-8)
- Hedman, C. (2009). *Dyslexi på två språk. En multipel fallstudie av spansk svensktalande ungdomar med läs- och skrivsvårigheter*. [Dyslexia in two languages: A multiple case study of Spanish-Swedish speaking young people with reading and writing difficulties.] Doktorsavhandling. Stockholms universitet.
- Hornberger, N. H., & Skilton-Sylvester, E. (2000). Revisiting the continua of biliteracy: International and critical perspectives. *Language and Education*, 14(2), 96–122. <https://doi.org/10.1080/09500780008666781>
- Håkansson, G., & Norrby, C. (2010). Environmental influence on language acquisition: comparing second and foreign language acquisition of Swedish. *Language Learning*, 60(3), 628–650. <https://doi.org/10.1111/j.1467-9922.2010.00569.x>
- Johnson, M. D., Mercado, L., & Acevedo, A. (2012). The effect of planning sub-processes on L2 writing fluency, grammatical complexity, and lexical complexity. *Journal of Second Language Writing*, 21(3), 264–282. <https://doi.org/10.1016/j.jslw.2012.05.011>
- Kellogg R. T. (1994). *The psychology of writing*. Oxford University Press.
- Kellogg, R. T. (1996). A model of working memory in writing. In M. C. Levy, & S. E. Ransdell (Eds.), *The science of writing: Theories, methods, individual differences and applications* (pp. 57–71). Laurence Erlbaum Associates.

- Kellogg, R. T. (1999). Components of working memory in text production. In M. Torrance & G. Jeffrey (Eds.), *The cognitive demands of writing: Processing capacity and working memory effects in text production* (pp. 143-161). Amsterdam University Press.
- Kent, S., Wanzek, J., Petscher, Y., Al Otaiba, S., & Kim, Y.-S. (2014). Writing fluency and quality in kindergarten and first grade: The role of attention, reading, transcription, and oral language. *Reading and Writing: An Interdisciplinary Journal*, 27(7), 1163–1188. <https://doi.org/10.1007/s11145-013-9480-1>
- Khanlari, P. (1979). *The history of the Persian language (vol. 1)*. New Delhi Press.
- Kobayashi, H., & Rinnert, C. (2013). L1/L2/L3 writing development: Longitudinal case study of a Japanese multicompetent writer. *Journal of Second Language Writing*, 22(1), 4–33. <https://doi.org/10.1016/j.jslw.2012.11.001>
- Kormi-Nouri, R., & Moradi, A. (2009). *Reading and dyslexia test*. Jahad University Teacher Education Branch, Tehran.
- Landis, J. R., & Koch, G. G. (1977). An application of hierarchical kappa-type statistics in the assessment of majority agreement among multiple observers. *Biometrics*, 33(2), 363–374. <https://doi.org/10.2307/2529786>
- Levelt, W. J., & JM, W. (1989). *Speaking: From intention to articulation*. MIT Press.
- Lindgren, E. & Muñoz, C. (2013). The influence of exposure, parents, and linguistic distance on young European learners' foreign language comprehension. *International Journal of Multilingualism* 10(1), 105-129. [10.1080/14790718.2012.679275](https://doi.org/10.1080/14790718.2012.679275)
- Lindgren, E., & Stevenson, M. (2013). Interactional resources in the letters of young writers in Swedish and English. *Journal of Second Language Writing*, 22(4), 390-405. <https://doi.org/10.1016/j.jslw.2013.09.001>
- Lindgren, E & Sullivan, K.P.H. (Eds.). (2019). *Observing writing: insights from keystroke logging and handwriting*. *Studies in Writing*. Brill.
- Lindgren, E., Sullivan, K.P.H., & Spelman Miller, K. (2008). Development of fluency and revision in L1 and L2 writing in Swedish high school years 8 and 9. *ITL- International Journal of Applied Linguistics*, 156, 133-151.
- Mayer, M. (1967). *A boy, a dog, and a frog*. Pied Piper Books.
- Mayer, M. (1969). *Frog where are you?* Pied Piper Books.
- McCutchen, D., Covill, A., Hoyne, S. H., & Mildes, K. (1994). Individual differences in writing: Implications of translating fluency. *Journal of Educational Psychology*, 86(2), 256. <https://doi.org/10.1037/0022-0663.86.2.256>
- Medimorec, S., & Risko, E.F. (2017). Pauses in written composition: on the importance of where writers pause. *Reading and Writing: An Interdisciplinary Journal*, 30(6), 1267–1285. <https://doi.org/10.1007/s11145-017-9723-7>
- Mikulski, A., & Elola, I. (2011). Spanish heritage language learners' allocation of time to writing processes in English and Spanish. *Hispania* 94(4), 715-733. <https://www.muse.jhu.edu/article/461903>
- Norlund Shaswar, A. (2014). *Skriptbruk i vardagsliv och i sfi-utbildning: En studie av fem kurdiska sfi-studerandes skriptbrukshistoria och skriptpraktiker* [Writing in everyday life and in SFI education: A study of five Kurdish SFI students' writing history and writing practices]. Doctoral dissertation. Umeå University, Sweden. Retrieved from <http://urn.kb.se/resolve?urn=urn:nbn:se:umu:diva-95745>
- Olofsson, Å. (2003). The dyslexic reader and the Swedish language. In N. Goulandris (Ed.), *Dyslexia: Cross-linguistic comparisons* (pp. 137–156). Whurr.
- Ong, J., & Zhang, L. J. (2010). Effects of task complexity on the fluency and lexical complexity in EFL students' argumentative writing. *Journal of Second Language Writing*, 19(4), 218–233. <https://doi.org/10.1016/j.jslw.2010.10.003>
- Olinghouse, N. G., & Graham, S. (2009). The relationship between the discourse knowledge and the writing performance of elementary-grade students. *Journal of Educational Psychology*, 101(1), 37. <https://doi.org/10.1037/a0013462>
- Olive, T., Favart, M., Beauvais, C., & Beauvais, L. (2009). Children's cognitive effort and fluency in writing: Effects of genre and of handwriting automatisations. *Learning and Instruction*, 19(4), 299–308. <https://doi.org/10.1016/j.learninstruc.2008.05.005>
- Olofsson, Å. (2003). The dyslexic reader and the Swedish language. In N. Goulandris (Ed.), *Dyslexia: Cross-linguistic comparisons* (pp. 137–156). Whurr.

- Peters, E., Noreillie, A.-S., Heylen, K., Bulté, B., & Desmet, P. (2019). The impact of instruction and out-of-school exposure to foreign language input on learners' vocabulary knowledge in two languages. *Language Learning*, 69, 747-782. <https://doi.org/10.1111/lang.12351>
- Rinnert, C., Kobayashi, H., & Katayama, A. (2015). Argumentation text construction by Japanese as a foreign language writers: a dynamic view of transfer. *The Modern Language Journal*, 99, 213-245. <https://doi.org/10.1111/modl.12210>
- Sadeghi, A. (2013). *Towards a universal model of reading investigations into Persian monolingual and English-Persian bilingual speakers*. Doctoral dissertation. University of Canterbury, New Zealand.
- Schoonen, R., Snellings, P., Stevenson, M., & Van Gelderen, A. (2009). Towards a blueprint of the foreign language writer: The linguistic and cognitive demands of foreign language writing. *Writing in Foreign Language Contexts: Learning, Teaching, and Research*, 77-101. <https://doi.org/10.21832/9781847691859-007>
- Simpson, S. (2020). *Isolver/OpenHandWrite* [Python]. Retrieved June 28, 2020, from <https://github.com/isolver/OpenHandWrite>
- Skolverket. 2016. *Läroplan för grundskolan, förskoleklassen och fritidshemmet 2011: reviderad 2016* [Curriculum for the Compulsory School System, the Pre-school Class and the Leisure-time Centre 2011: Revised 2016]. Skolverket.
- Snellings, P., van Gelderen, A., & de Gloppe, K. (2004). The effect of enhanced lexical retrieval on second language writing: A classroom experiment. *Applied Psycholinguistics*, 25(2), 175-200. <https://doi.org/10.1017/S0142716404001092>
- SOU (2019). *För flerspråkighet, kunskapsutveckling och inkludering. Modersmålsundervisning och studiehandledning på modersmål. Betänkande av Utredningen om modersmål och studiehandledning på modersmål i grundskolan och motsvarande skolformer* [For multilingualism, knowledge development and inclusion. Native language teaching and study guidance in native language. Report of the Inquiry into mother tongue and study guide in mother tongue in primary school and corresponding school forms]. SOU 2019:18, Utbildningsdepartementet.
- Spelman Miller, K., Lindgren, E., & Sullivan, K.P.H. (2008). The psycholinguistic dimension in second language writing: opportunities for research and pedagogy. *TESOL Quarterly*, 42(3), 433-454.
- Stievano, P., Michetti, S., McClintock, S. M., Levi, G., & Scalisi, T. G. (2016). Handwriting fluency and visuospatial generativity at primary school. *Reading and Writing: An Interdisciplinary Journal*, 29(7), 1497-1510. <https://doi.org/10.1007/s11145-016-9648-6>
- Strömqvist, S., Holmqvist, K., Johansson, V., Karlsson, H., & Wengelin, A. (2006). What key-logging can reveal about writing. In K. P. H. Sullivan & E. Lindgren (Eds.), *Computer keystroke logging and writing: Methods and applications* (pp. 45-72). Elsevier.
- Sullivan, K.P.H. & Lindgren, E. (Eds.). (2006). *Computer keystroke logging: methods and applications* Elsevier
- Van Waes, L., & Leijten, M. (2015). Fluency in writing: A multidimensional perspective on writing fluency applied to L1 and L2. *Computers and Composition*, 38, 79-95. <https://doi.org/10.1016/j.compcom.2015.09.012>
- Versteegh, K. 1997. *The Arabic language*. Edinburgh University Press.
- Wagner, R. K., Puranik, C. S., Foorman, B., Foster, E., Wilson, L. G., Tschinkel, E., & Kantor, P. T. (2011). Modeling the development of written language. *Reading and Writing: An Interdisciplinary Journal*, 24(2), 203-220. <https://doi.org/10.1007/s11145-010-9266-7>
- Wengelin, Å., Torrance, M., Holmqvist, K., Simpson, S., Galbraith, D., Johansson, V., et al. (2009). Combined eye tracking and keystroke-logging methods for studying cognitive processes in text production. *Behavior Research Methods*, 41, 337-351. <https://doi.org/10.3758/BRM.41.2.337>
- Weth, C. (2015) Orthographic competence among multilingual school children: Writing Moroccan Arabic in France. *International Journal of Multilingualism*, 12(2), 196-209. <https://doi.org/10.1080/14790718.2015.1009374>
- Williams, G. J., & Larkin, R. F. (2013). Narrative writing, reading and cognitive processes in middle childhood: What are the links? *Learning and Individual Differences*, 28, 142-150. <https://doi.org/10.1016/j.lindif.2012.08.003>
- Wolfe-Quintero, K., Inagaki, S., & Kim, H. Y. (1998). *Second language development in writing: Measures of fluency, accuracy, & complexity*. University of Hawaii Press.