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## The Effects of Early Biliteracy on Thought Organisation and Syntactic Complexity in Written Production by 11-Year-Old Children

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### Abstract

The study investigates the effects of bilingualism and biliteracy on thought organisation, and syntactic complexity in the written production in a group of fifty 11-year-old children ( $M = 10.7$ ) enrolled in 5<sup>th</sup> and 6<sup>th</sup> grades in a bilingual school in the south of Brazil. The children's home and community language is Portuguese, and they have been exposed to English at school for 10 hours a week for at least five years. Participants were asked to create a narrative based on a sequence of five images (Cambridge Assessment, 2018), being one in English and one in Portuguese, in a counterbalanced order. Thought organisation (connectivity) was measured through the analysis of graph trajectories performed with the computational tool Speech Graphs (Mota et al., 2014, 2016, 2019) and the analysis of syntactic complexity involved the assessment of T-Units (Hunt, 1965). Results indicated a moderate positive correlation in the attributes of thought connectivity and the levels of syntactic complexity in both languages, demonstrating that, as children advance in the development of more complex writing strategies in Portuguese, they progress in their written production in English to the same extent.

**Keywords:** *Bilingualism, Biliteracy, Writing, Thought Organization, Syntactic Complexity*

### Introduction

Estimates suggest that the majority of the world's population is bilingual (García & Cepeda, 2016; Kroll & Dussias, 2017). In Brazil, even though Portuguese is the only official language,

the country possesses enormous language diversity, with around 330 languages being used daily, among which 274 indigenous languages (according to IBGE Census, 2012) and 56 immigration languages (Altenhöfen, 2013), in addition to Brazilian Sign Language (LIBRAS), recognised as one of the Brazilian languages since 2002.

In recent years, the number of bilingual schools has significantly increased in the country, most of them offering content classes being taught in English in addition to the regular curricula developed in Portuguese. There is, however, a critical lack of legislation regulating such an offer and a relevant scarcity of studies that investigate language processing and teaching methods considering the Brazilian context, in which children are first exposed to a prestigious language at the moment they enter school and need to develop reading and writing skills in a language they are not familiar with.

Within this context, it becomes imperative to better understand bilingual children's reading and writing development in order to design instructional pedagogies that contribute to supporting their growth as readers and writers considering the Brazilian bilingual schools' context. To fill out this empirical gap, the present study aimed at investigating the effects of biliteracy on the levels of thought organisation (connectivity measures) and syntactic complexity in the written production in Portuguese and English in a group of children enrolled at a bilingual school located in the south of Brazil.

### **Biliteracy**

In many bilingual schools in Brazil, the situation is similar to the one described by Petitto et al. (2013), since children enter school and may find themselves in a situation where they struggle to learn how to read and write in a language that they do not speak or use. In the case of these Brazilian kids, it is not known if the results regarding their abilities in reading and writing in both languages are as good as those of children who are only exposed to Portuguese, which fosters doubts as to whether schools should have children learn to read and write in their L1 first and subsequently in their L2, or if it is not detrimental to have them develop reading and writing in both languages at the same time.

Regarding the discussion related to whether children should learn to read and write in two languages simultaneously or in sequence, the evidence in the previous literature is mixed. In one vision of sequential literacy, it is postulated that the development of literacy in the second language should not start before the child has developed the ability to speak, read and write in the L1 (Wong et al., 1986). On the other hand, there are some researchers who argue in favour of schools promoting the simultaneous development of reading and writing skills in the two languages of the children, even in situations in which children have not yet fully developed their L2 oral skills (García, 2006). This position is also defended by authors such as Edelsky (1986), Hudelson (1984) and Dworin (2003), among others. In his work, Dworin (2003) heightens the bidirectionality of the development of literacy, in which children's transactions with two written languages helps mediate their learning in both languages in a flexible and dynamic way, meaning

that what is held in one language impacts the other, according to the author. From this perspective, what is learned in L1 impacts L2 and what is learned in L2 impacts L1.

A few studies can be taken as evidence of the bidirectionality of literacy development in bilingual children. The longitudinal study developed by Soltero-González et al. (2016), for example, compared two models of instruction for emerging bilingual students in the United States, one promoting simultaneous literacy (paired-literacy) and the other fostering sequential literacy. The simultaneous literacy model consisted of providing instruction in English and Spanish from the beginning of schooling, based on the assumption that the individual's languages develop together. The main goal of this approach is to promote bilingualism and biliteracy, avoiding the transition of students from the instruction given in Spanish to instruction only in English. In the United States, however, the most common approach in dual-language programs is sequential, not simultaneous. For instance, in a study carried out with 358 Spanish/English speakers, from the third grade of 13 schools in Salem, Oregon, Francis et al. (2006) show that the group that followed the simultaneous program had better results in writing and reading, corroborating the idea that simultaneous and planned literacy leads to better development of both languages. In addition, it also confirmed that simultaneous instruction in English and Spanish did not inhibit the children's development of written English nor Spanish; on the contrary: it showed signs of strengthening English literacy while developing Spanish literacy. Dressler and Kamil (2006) also call attention to the evidence of cross-language transfer of reading comprehension skills in bilingual children across typologically distinct languages, throughout the time and bidirectionally, that is, from L1 to L2, as well as from L2 to L1.

Ahmadi and Mohammadi (2019) researched biliteracy instruction in young learners, analysing the effect of prior L2 literacy (English) on L1 (Persian) literacy. The results indicated that young learners who gained functional literacy in L2 prior to L1 were more fluent and accurate L1 readers. Other studies by the same authors concluded that students (first graders) that were exposed to both L1 and L2 literacy outperformed the monolingual students. Also, research in the field of psycholinguistics has brought data that confirm that phonological and syntactic awareness knowledge may be transferred between their linguistic systems (Fu, 2003; Kabuto, 2011; Kuo & Anderson, 2007).

Cummins (1981, 2017), in his Interdependence Hypothesis, provides a framework for the transferring of knowledge and skills between the two of the speaker's languages. The author proposes a common underlying proficiency construct that supports the interaction between the bilingual languages, enhancing the development of literacy-related skills. According to him, transfer across languages is bidirectional, and instruction based on only one of the students' languages will minimise the contexts in which language development occurs.

Within the discussion regarding biliteracy development, other aspects may also have a noteworthy impact on the process, such as the linguistic distance between the languages that are being developed, whether they involve similar or distinct writing systems and their levels of linguistic transparency. These aspects may affect the way children process and develop language; therefore, they should be taken into consideration in the design of instruction

methodologies. Languages that possess transparent orthographies, such as Portuguese, Finnish and Spanish, for example, have a direct one-to-one mapping between print and sound, whereas languages with more opaque orthography, such as English and French, have an irregular mapping between print and sound, which is also the case of logographic languages, such as Chinese. For instance, the study by Petitto et al. (2013), which was designed considering opacity between the children's languages, provided evidence that exposure to a language with a less opaque orthography, such as Spanish, helped children develop reading skills in English, a language that has a more opaque form of orthography. The authors came to the conclusion that instruction in both the children's languages during the same developmental period can bring reading advantages, not only reinforcing the importance of explicit exposure to both languages but also of providing phonological training in the two of the child's languages in the early school years.

Williams and Lowrance-Faulhaber (2018) analysed 35 peer-reviewed studies on writing in bilingual children and showed that the development of literacy abilities in one language reinforces literacy knowledge and skills in the other of the children's language. The authors also emphasised that bilingual writing may progress in a similar way to what happens in the case of monolingual English speakers, even though bilinguals may follow distinct paths due to their unique language experience. According to the authors, the children were not confused; on the contrary, they used their linguistic knowledge bidirectionally with competence. These results reinforce the idea that developing literacy-related skills in more than one language does not bring any harmful effects to children but, on the contrary, helps them develop reading and writing abilities more fully.

Many different studies have provided data showing that bilingual children often surpass monolingual children on tasks that assess literacy-related abilities when their both languages overlap in their writing system (Friedenberg, 1984; Da Fontoura & Seigel, 1995; Abu-Rabia & Siegel, 2002). Along the same lines, Bialystok et al. (2005) argue, for example, that the extent to which bilingualism affects literacy acquisition may depend on the similarity between the two language systems involved. But whether these results apply to contexts in which one of the children's language is not present in their everyday lives at home, that is, when they are learning a second language solely at school, is still an open question.

Along the same lines, Groff & Bellamy (2020) conducted a study with fourth-graders, speakers of P'urhepecha and Spanish. Not only did the results show that students produced better and longer texts in their L1, P'urhepecha, but they also demonstrated that children used richer vocabulary and a larger variety of verbal tenses. In addition, the study revealed that they found creative ways to represent both languages in both oral and written texts, reinforcing the advantage of providing opportunities for simultaneous development of both languages in educational contexts.

Finally, in the past few years, a large group of biliteracy researchers have been emphasising the need for strategies that assess emerging bilingual children's biliteracy skills in a more holistic

form, instead of adopting monolingual reading and writing assessments to design guidelines for literacy instruction. The Literacy Squared Biliterate Writing Assessment (Escamilla et al., 2014) was designed to fill out this gap and aims at capturing what bilingual students actually know in terms of literacy, assessing what they can do across and within languages in their two languages. According to this perspective, the language knowledge and abilities of bilingual children can never be appropriately measured or understood if these children are not assessed bilingually (Gort, 2006; Butvilofsky et al., 2017). Escamilla et al. (2014), for instance, present evidence that when students' languages are assessed from a holistic perspective, it is possible for teachers to better understand the way children operate with their two languages, contributing to leading children to greater outcomes in terms of biliteracy development.

In a very recent study, Butvilofsky et al. (2021) documented and analysed the writing production of 29 second-grade bilingual students in Spanish and English. The authors qualitatively analysed three sets of writing samples from students who had been identified as having poor or very poor reading scores in a traditional assessment. However, a holistic analysis of these students' productions revealed a better understanding of the complexity of their biliteracy development and showed that the knowledge that students had in one language was often applied across languages or bidirectionally.

Taking into consideration the extensive research on biliteracy in other countries and the lack of research taking into consideration the Brazilian bilingual education context, we set out to investigate the development of writing skills in bilingual children from a specific context in Brazil, a bilingual school in which they go through the process of biliteracy, being Portuguese their L1, which is fully developed before they arrive at school, and English their emergent L2.

### **Graph Analysis**

Recently, network science and graph theory have gained increasing attention in the fields of neuroscience (Mota et al., 2012, 2014), psycholinguistics (Luz, 2018) and education (Mota et al., 2016, 2019). Mota et al. (2016, 2019) have conducted a series of experiments relying on graph analysis in order to explain cognitive development in healthy children as they progressed in their educational path through elementary school. Results showed that children whose oral memory reports generated graphs with more unique nodes (that denotes a larger vocabulary), more connections and fewer repetitions were the ones who scored higher in the cognitive and academic assessments, thus demonstrating the predictive power of graph analysis.

Graph attributes, particularly the Largest Connected Component (LCC) and the Largest Strongest Connected Component (LSCC) have been used to demonstrate patterns in oral and written texts which successfully distinguish between groups and evidence lack of connectedness as a strong indicator of cognitive development (Mota et al., 2016, 2019). According to Mota et al. (2016), the largest set of nodes directly or indirectly linked by some path is defined as the LCC, and the largest set of nodes directly or indirectly linked by reciprocal paths, in a way that all the nodes in the component are mutually reachable, is characterised as the LSC. In this sense,

the LSC tends to be a stricter and more powerful predictor of connectivity since it closes a long-range word repetition cycle.

In the case of written language, one study of particular interest is the one developed by Luz (2018), who employed graph analysis to investigate patterns of connectedness in texts produced by good, bad, and dyslexic readers. The writing task required children to produce a story based on a comic strip without time or length constraints. The author compared graph parameters of texts to confirm that graph attributes were effective in sorting out good, bad and dyslexic readers, revealing patterns of textual connectedness, measured by a number of nodes and edges, LCC and text density.

It is relevant to note the innovative character of the present study, which is the first to adopt graph analysis in the investigation of writing development in bilingual children. It is argued here that such analysis, which makes use of low-cost, feasible and ecological assessment tools, may help provide important information regarding the development of second language oral and written production in bilingual children, which, in turn, can be used to design better intervention strategies in the near future.

## **Methods**

The main goal of this study was to investigate the effects of bilingualism and biliteracy on the levels of thought organisation (connectivity measures) and syntactic complexity in the written production in Portuguese and English in a group of fifty students, around 11 years old ( $M=10.7$ ), enrolled in a bilingual school in the south of Brazil.

### *Specific Objectives*

The specific objectives of the present study are as follows:

- (1) To verify whether there is a difference in the L1 and L2 connectivity attributes (LCC and LSC), generated by the children's written production;
- (2) To verify whether there is a difference in the L1 and L2 syntactic complexity measures (T-Units), generated by the children's written production;
- (3) To explore the correlation between connectivity attributes and syntactic complexity measures in an attempt to verify whether graph analysis can serve as a potential tool to assess bilingual linguistic proficiency.

### *Hypotheses*

In order to pursue the specific objectives, the following hypotheses were formulated:

- (1A) We expected to find a significant difference in the L1 and L2 connectivity attributes generated by the children's written production, with an advantage towards the participants' first language. In other words, connectivity measures were expected to be higher in Portuguese than in English texts.
- (1B) Despite the L1 advantage in the written production, we expected to find a positive correlation between the connectivity attributes (LCC and LSC) in L1 and L2, signalling a parallel between thought organisation expressed in the written production in the two languages.

(2A) We expected to find a difference in the L1 and L2 syntactic complexity measures (T-Units), generated by the children's written production, with an advantage towards the children's first language.

(2B) Despite the L1 advantage in the written production, we expected to find a positive correlation between measures of syntactic complexity (T-Units) in L1 and L2 texts, indicating that linguistic development occurs in a parallel fashion in the two languages of the bilingual children.

(3) We expected to find a positive correlation between the connectivity attributes (LSC) and syntactic complexity (T-units) in the L1 and L2 written productions, indicating that graph analysis can serve as a potential tool to assess bilingual linguistic proficiency.

#### *Participants*

A total of 50 typically developing children (19 male and 31 female, 10-11 yo in 2020, mean age 10.7) enrolled in 5th and 6th grades in a bilingual school located in the south of Brazil were invited to take part in the study. The children's home language is Portuguese, but they have been taught classes both in English and in Portuguese for at least five years and had already been screened for proficiency when they were in 4th grade (Cambridge Starters Exam). At the time the data was collected, the participants had had at least five years of bilingual education, with 10 hours of English per week (out of a total of 33 class hours), including English lessons and also lessons taught in English. English is not spoken in the community, even though it is present in social media, video games, songs, etc. In this case, it is a second language being added to the students' repertoire. The language students use to interact with each other is Portuguese. During English lessons, however, there is substantial use of the L2, which increases according to the students' progress.

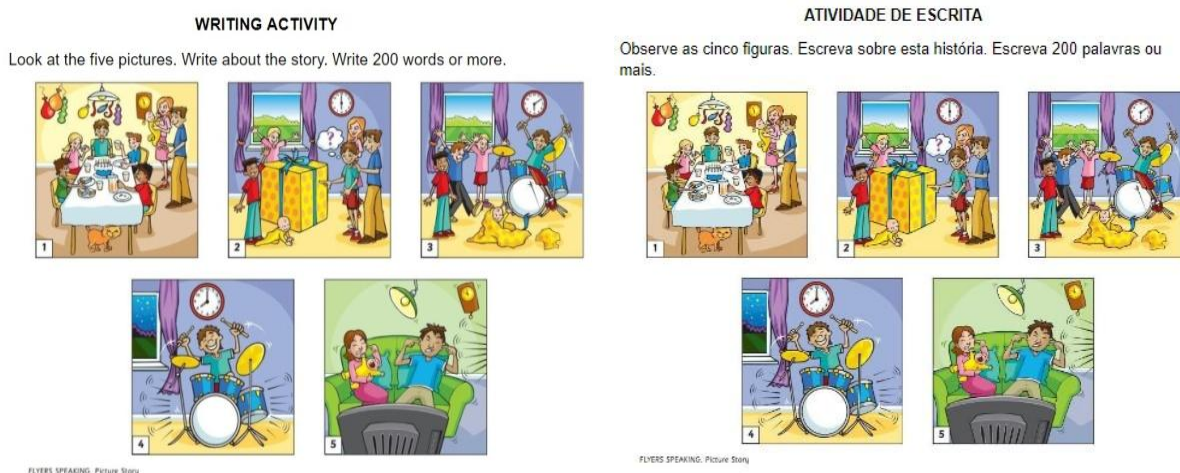
#### *Data Collection*

Data were collected in August of 2020, during online classes, in two different moments, two weeks apart. There were three groups participating: one class of 6th graders and two of fifth graders. During their regular classes, each group was divided into two groups in alphabetical order. Participants were asked to create a narrative based on a sequence of five images (Cambridge Assessment, 2018), one in English and one in Portuguese, in a counterbalanced order. The first group of students received the English version of the writing production, whereas the second group received the Portuguese version of the task. After two weeks, the same groups were kept but received the task in the other language, that is, the ones who had gotten the English version then got the Portuguese one, and vice-versa.

Students were asked to write a narrative (at least 200 words) based on a sequence of five images. The teacher (one of the researchers) started the class on the Google Meet platform by greeting the students. After that, she explained to students that they would not be evaluated but that they were expected to write the text according to the instructions given. The teacher reminded students that the story needed to be written according to the images and that they could create elements to enrich their stories. They needed to follow the sequence and facts of the images presented, though.

As participants had to write at least 200 words, an explanation of how to use the word counting tool was given to them. Students opened their work in the Google Classroom and carried out their activity in silence, with the camera on. The teacher observed students during the task and answered questions. Examples of the picture sequences are shown in Figure 1 below.

**Figure 1**  
*Cambridge Assessment, 2018*



## Data Analysis

The analysis of thought connectivity in both languages was performed considering the connectivity attributes generated by the computational tool Speech Graphs (Mota et al., 2014, 2016, 2019), and syntactic complexity was measured considering T-Units (Hunt, 1965). Both procedures are detailed below.

### Graph Analysis

The students' original narratives were saved to a text file in which no changes were made. The free software Speech Graphs (Mota et al., 2014, available at <http://neuro.ufrn.br/software/speechgraphs>) was used to analyse the texts, representing each text in a distinct graph. A speech graph is a graphic representation of the sequential relationship of words in a verbal text, in which each word constitutes a node and the sequence between successive words constitutes what is called a direct edge. The software is also able to calculate several attributes per text file, including nodes (N) and edges (E), which represent the number of elements; repetitions of links between nodes and cycles of nodes that appear in the graphs, such as parallel edges (PE), repeated edges (RE), loops of one, two and three nodes (L1, L2 and L3); connectivity measures (LCC= largest connected component, LSC= largest strongly connected component) and others.



### *T-Units Analysis*

Hunt (1965) first came up with the definition of a T-Unit, explaining it as the junction of a dominant clause and its dependent clauses. As the author points out, a T-Unit is the main clause and all subordinate clauses that are attached to it. T-Unit analyses have been mainly used in the areas of discourse, involving both written and spoken language, for example, in studies analysing second language writing errors (Palmer, 2006; Ströbel et al., 2020; Myllari, 2020). In the present study, the T-Units analyses provided us with linguistic information and are related to the graph analysis data with the goal of potentialising the use of graphs to investigate the students' written production in both languages. These measures were compared to the graphs' characteristics in order to assess their correlations.

### **Results**

The results are presented below, taking into consideration our initial hypotheses stated in the Methods section. Table 1 displays the descriptive data which were analysed in the comparison of the levels of syntactic complexity and thought organisation in written production in Portuguese and in English by the children in our sample.

**Table 1**

*Descriptive Statistics of Measures of Connectivity and Syntactic Complexity*

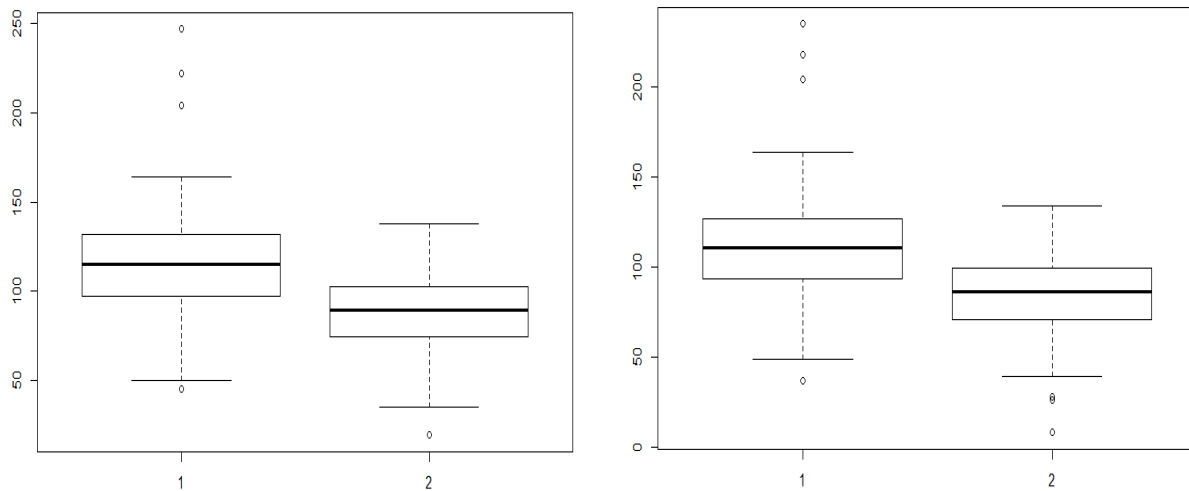
	L1 Portuguese			L2 English	
	<i>n</i>	M	SD	M	SD
LSC	50	111.52	38.07849	84.42	25.91871
LCC	50	116.0	37.9121	88.23	25.59035
T-units	50	21.80	9.30657	18.6	6.298688

*Note:* *n* = number of participants; M = mean; SD = standard deviation; LCC= Largest Connected Component; LSC = Largest Strongest Connected Component; T-units = measure of syntactic complexity

In order to address our first hypothesis, Figure 2 displays the results from the Wilcoxon analysis comparing connectivity measures (LCC and LSC) in L1 and L2. As expected, there was a significant advantage for the texts written in Portuguese, the children's native language (LSC =  $W = 1193.5$ ,  $p$ -value =  $4.094e-06$ ; and LCC=  $W = 1231$ ,  $p$ -value =  $5.195e-06$ ). In other words, connectivity measures were higher in Portuguese, as expected.

**Figure 2**

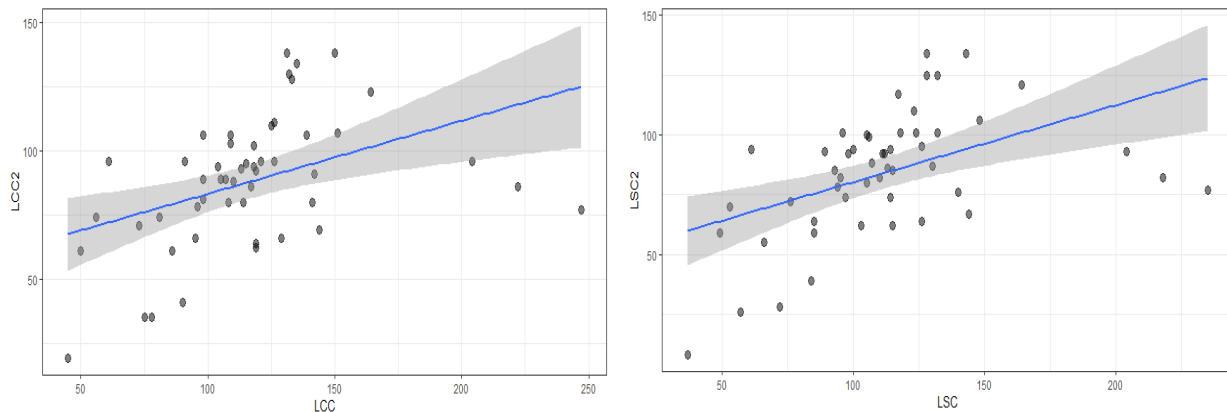
*Connectivity Measures (LCC and LSC, respectively) in L1 (1) and L2 (2)*



Our next step was to explore the correlation between connectivity measures (LCC and LSC) in L1 and L2. As displayed in Figure 3, a significant positive correlation between connectivity measures (LCC=  $\rho = 0.5171688$ ,  $p$ -value = 0.000102, and LSC=  $\rho = 0.5511402$ ,  $p$ -value =  $2.775e-05$ ) in L1 and L2 was found, indicating that linguistic development seems to occur in parallel and in the same proportion in the two languages of the bilingual child, as we expected.

**Figure 3**

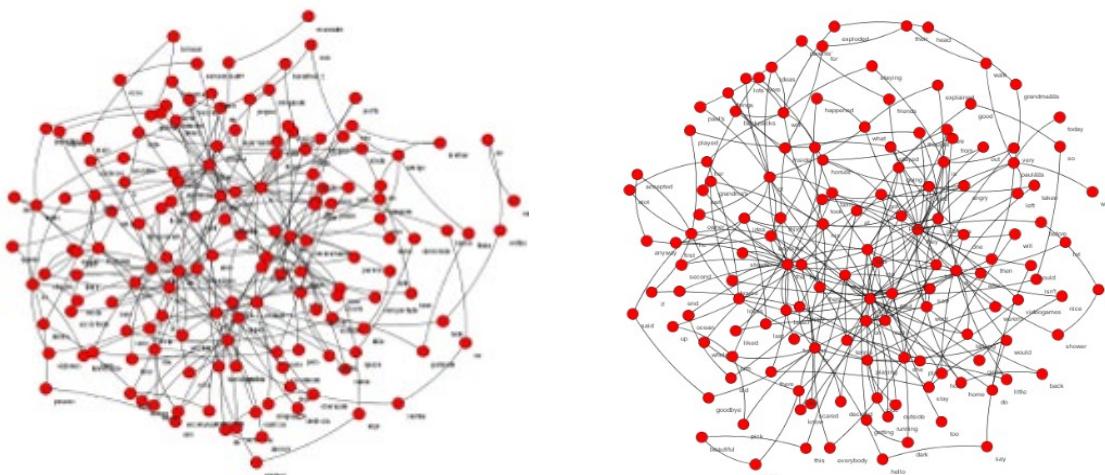
*Correlation between Connectivity Measures (LCC and LSC) in L1 and L2*



In order to illustrate the correlations that we have just reported, we bring the two graphs in Figure 4, which respectively show the high connectivity scores (LSC) of a participants' written text in L1 and in L2.

**Figure 4**

*Connectivity Scores (LSC) of High-connected Texts in L1 and L2 of the Same Participant*

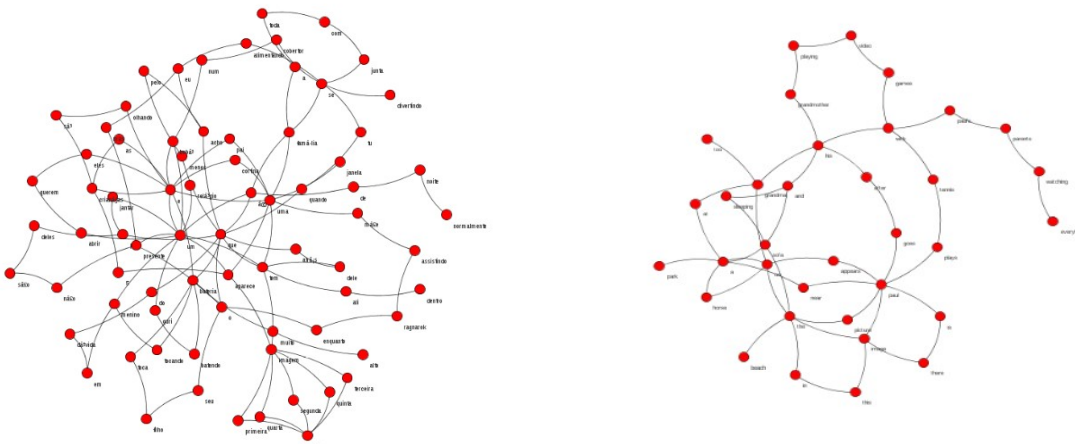


*L1 = 150 L2 = 138*

Conversely, the graphs shown in Figure 5 represent the results of a participant whose connectivity levels (LSC) were low both in Portuguese and in English.

**Figure 5**

*Connectivity Scores (LSC) of Low-connected Texts in L1 and L2 of the Same Participant*



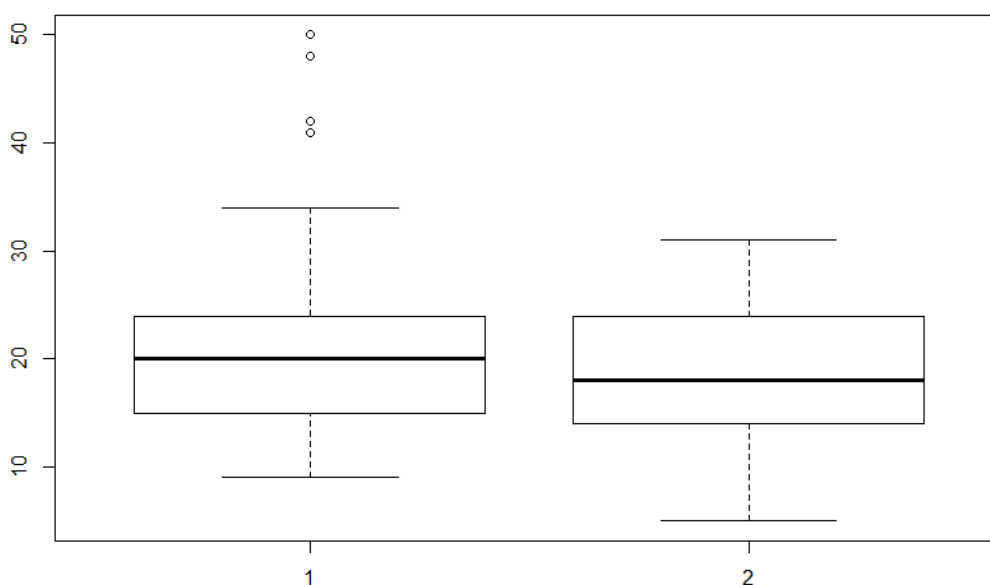
*L1 = 90 L2 = 41*

The graphs in Figures 4 and 5 show the analysis of a participant with high connectivity in L1 who also displayed high connectivity in L2. On the other hand, a student with low connectivity in L1 also showed low connectivity in L2. An analysis of the participants' graphs indicates that the students' connectivity measures occur in the same proportion in both languages, with an advantage for their L1. These results are similar to the ones shown in previous investigations that demonstrate that L1 and L2 seem to develop together, in parallel, without hindering any of the

languages and transferring linguistic skills from one language to the other bidirectionally (Dworin, 2003; Cummins, 2017).

Our second set of hypotheses (2A and 2B) dealt with the comparison between the means of syntactic complexity measures, and differences between the textual productions in the two languages were expected, with a significant advantage for the texts written in Portuguese children's native language. In other words, it was expected that Wilcoxon test results comparing the two means returned a significant difference, with a greater number of T-Units in the Portuguese texts, compared to the English productions, since it is the children's home and community language. This hypothesis was also confirmed, with a greater number of T-Units in Portuguese (T-Units =  $W = 738.5$ ,  $p=0.03266$ ), as Figure 6 shows. Again, the fact that their scores in L1 were higher than in their L2 does not alarm us, as their overall exposure to English (L2) is much lower than to Portuguese (L1).

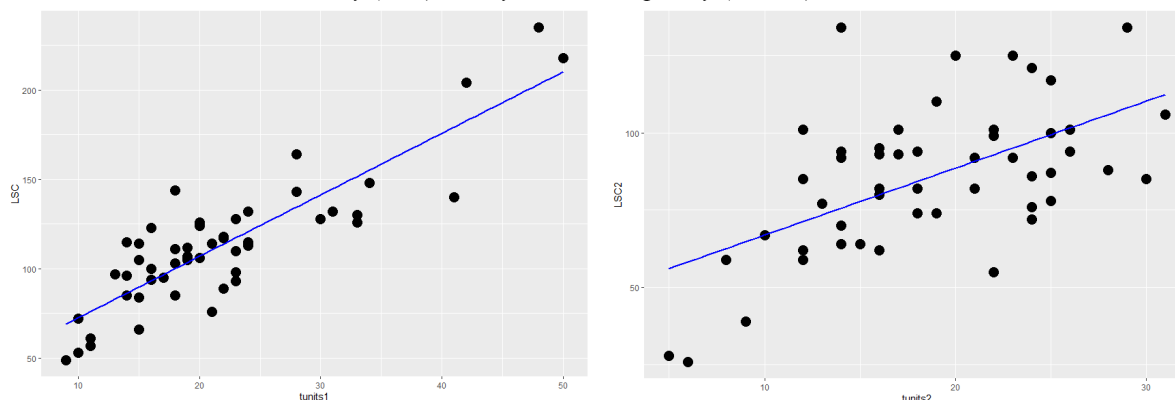
**Figure 6**  
*Syntactic Complexity Measures in L1(1) and L2(2)*



Our final hypothesis predicted a significant positive correlation between the measures of connectivity (LSC) and syntactic complexity (T-Units) in the participants' production in both L1 and L2. The positive correlations found between graph connectivity and complexity measures in L1 ( $S=4657.4$ ,  $\rho = 0.7763569$ ,  $p\text{-value}=3.479e-11$ ) and L2 ( $S=10278$ ,  $\rho = 0.5064645$ ,  $p\text{-value}=0.0001749$ ), displayed in Figure 7, indicate that, in the present study, graph analysis served as a potential tool to assess the level of syntactic complexity of children in L1 and L2.

**Figure 7**

*Correlation between Connectivity (LSC) and Syntactic Complexity (T-units) Measures in L1 and in L2*



## Discussion

The results from both analyses – graph analyses and T-Units –revealed an advantage for the L1 Portuguese written production, as expected, with children obtaining higher connectivity measures and a larger count of T-Units in their mother tongue. Our first hypothesis was confirmed, with higher connectivity measures in the Portuguese texts, which we interpret in terms of the children’s greater exposure to Portuguese compared to English. It is the language they use to communicate daily, at home, with their friends and family. Even though there was a difference between the two languages, we do not interpret it as a negative impact of their L2 on their L1. In addition, as expected, we found a positive correlation between the connectivity attributes (LCC and LSC) in L1 and L2, signalling a parallel between thought organisation expressed in the written production in the two languages.

Regarding our second hypothesis, related to the syntactic complexity (T-Units measures), our findings indicate that linguistic development appears to occur in parallel and in the same proportion in the two languages of the bilingual. This could be taken as an indication that, as proposed by Bialystok et al. (2005), bilinguals may transfer writing skills acquired in one language to writing production in the other. This is in line with other authors who suggest that skills related to literacy development possibly transfer across languages as bilingual children progress through the school years (Cummins, 2017).

The third hypothesis was also confirmed since we found a positive correlation between connectivity measures and syntactic complexity measures. These results are particularly relevant in the growing context of bilingual education curricula and programs, which has brought concern related to finding more efficient ways to assess the development of bilingual children’s reading and writing skills and the effect language instruction and exposure have on such complex development. Therefore, in this paper, we argue for the adoption of naturalistic, low-cost and large-scale measures, such as graph analysis, which may have a particular value in assessing oral and written production in young bilingual children. The design of more appropriate instructional practices can immensely benefit from this kind of evidence.

These results confirm the more consistent development in the participants' dominant language, which is the one they use at home and in the community and also the one in which they have received most instruction. Interestingly, despite the predicted L1 advantage in written production, a direct relationship between thought connectivity measures and syntactic complexity in both languages was found. These results are interpreted as evidence that, as children advance in the development of more complex writing strategies in Portuguese, they seem to progress in their written production in English to the same extent. In addition, our results data reinforce the importance of teachers assessing students' written production in their two languages considering their bilingual experience, since the two languages of the bilingual are constantly active and in competition (Kroll & Bialystok, 2013).

### **Conclusions**

The current study aimed at investigating the effects of bilingualism and biliteracy on the levels of thought organisation (connectivity measures) and syntactic complexity in the written production in Portuguese and English in a sample of 11-year-old children enrolled in a bilingual school in the south of Brazil. Following Escamilla et al. (2014), we argue that only by assessing children's reading and writing skills in both languages and considering their knowledge and use of two languages we are able to reach a better understanding of their real development toward biliteracy. Besides, analysing children's trajectories across languages allows us to better help teachers to design teaching pedagogies that foster the development of students' full biliteracy.

Also, what we believe to be a great contribution to the area is the use of Speech Graphs as a tool to naturalistically assess cognitive and linguistic performance in the case of kids being taught in two languages at the same time. The opportunity to get to know so much about the way students write and to be able to analyse their writing in order to establish new goals for improvement seems to be fascinating. Besides, understanding how a fast, simple, and noninvasive evaluation of speech connectedness relates to cognitive and academic performance may contribute to developing better intervention strategies in naturalistic settings. In addition, there is a clear gap in the literature, which points to the need to continue investigating biliteracy development and indicates that perhaps conducting longitudinal studies can be more informative. We also know that this study needs to be expanded so that we can compare, for example, the students' writings throughout different school years. By doing so, we can analyse the way their writing progresses in both languages. One of the limitations of the study is the fact that data were collected during online classes due to the pandemics, which made it impossible to guarantee that participants were fully engaged in the tasks. Also, we consider it is relevant to replicate the study in different schools, with students from other contexts of language instruction, in order to analyse the possible effects of distinct kinds of intervention strategies and different amounts of L2 exposure in writing performance.

Our next steps include analysing not only the students' written production but also their oral texts in order to compare their levels of thought organisation and syntactic complexity in oral

and written language. Besides, analyses of random graphs of each participant will be done so that we can compare them to their actual graphs as a way to validate the results.

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### **Ethics Declarations**

#### **Competing Interests**

No, there are no conflicting interests.

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