



1. PUBLISHABLE SUMMARY

I. Summary description of the project objectives

The objectives of the BIRD as mentioned in Part B of the original proposal are the following:

Objective #1 - Assessing whether the contribution of visual and phonological cognitive skills on reading acquisition is differentially modulated based upon the degree of orthographic transparency of the language(s) learned.

Objective #2 - Assessing whether the specific features of two languages learned simultaneously interact and influence reading development.

Objective #3 – Identifying the impact of languages interactions on developmental reading disorders in Basque bilinguals, and the potential positive/negative effect of orthographic transparency on the manifestations and causes of reading developmental disorders.

Objective #4 - Identifying L2 orthographic transparency impacts on the characteristics of ERPs indexing reading strategies in the linguistic context of Basque bilingualism.

II. Description of the work performed since the beginning of the project

During the first year, we went to 3 Spanish-Basque bilingual schools and 6 French-Basque bilingual schools. We have collected behavioral data of from 180 Spanish-Basque bilingual children (attending Grade 2 or Grade 5), and 50 French-Basque bilingual children (attending Grade 2 and attending Grade 5) on a series of 14 tasks assessing their reading skills and the reading cognitive subprocesses in Basque (but also in French/Spanish). The experimental sessions took place in the children's schools and were spread out over 6 sessions of 30 min each.

During the second year, we went to the same 9 bilingual schools. We collected data using electroencephalogram (EEG technique) on a lexical decision task in Basque and on 8 behavioral tasks in Basque (most of them being the same as the year before to track developmental changes in reading skills and reading subprocesses in Basque). In the French region, we evaluated 26 bilingual children attending Grade 3 (same children as Year 1) and in the Spanish region, we evaluated more than 100 bilingual children (about 30 children attending Grade 6 and 70 children attending Grade 3, most of them having been tested in Year 1). All the testing took place in the children's schools and was spread over 4 testing sessions of 30 minutes each. The EEG session lasted 2 hours (setting up the EEG cap and doing the task).

III. Description of the main results achieved so far

The main hypothesis that drove the experiments conducted in the BIRD project was that learning to read in a transparent orthography (Spanish) in addition to Basque would enhance phonological awareness skills and Basque sublexical reading strategies as compared to learning to read in an opaque orthography (French) in addition to Basque, which would rather enhance visual attention span skills required for whole word processing and lexical reading strategies. The following results respond to the original Objectives #1, #2 and #4.

Phonemic awareness skills: (Fig. 1). We found a significant difference between the French and Spanish groups at Grade 5 only, showing that the Basque children learning to read in Basque and Spanish (transparent) were better at manipulating the sounds of the Basque language than children learning to read in Basque and French (opaque). We attribute this difference to a boost of phonological awareness development along reading acquisition in the Spanish-Basque group, compared to the French-Basque group. Potential differences could also be due to the higher similarity between Basque and Spanish phonemes than Basque and French phonemes (cf "Reading in Basque" section below).

Visual attention span skills: (Fig. 2). We found a significant difference between the two groups of children at Grade 2 only, showing that the French (opaque orthography) children were better than the Spanish (transparent orthography) children (Fig. 3). We interpret the difference observed as the fact that visual attention span skills necessary to process words as whole are enhanced in Basque children who learn to reading simultaneously in an opaque orthography like French (because of compensation strategies used by those children to cope with irregular orthographic chunks, e.g., grapheme cluster "au" → phoneme /o/ versus grapheme "o" → phoneme /o/). The absence of difference between the French and Spanish groups at Grade 5 suggests that at the end of reading acquisition, older children exhibit similar lexical reading strategies (i.e., use to read words fluently, using "whole word" knowledge).

Reading in Basque: (Fig. 4). At the behavioral level, we showed that regardless of the age of the children, French-Basque children



were worse at reading Basque pseudowords (generally read using the sublexical strategy) than Spanish-Basque children, but were marginally better at reading Basque words (generally read using the lexical strategy). The analyses also revealed greater lexical effects (differences in reading accuracy between words and pseudowords) in French-Basque children than Spanish-Basque children. We interpret this result as an indication of the use of two reading strategies more distinct in French-Basque children than the ones used by Spanish-Basque children: French-Basque children seem to preferentially use a lexical procedure when they read in Basque (beneficial for words reading essentially), possibly because of the influence of the opaque French orthography. Spanish children seem to favor the use of a sublexical reading procedure when they read in Basque (beneficial for pseudoword essentially) possibly because they only know transparent languages. Moreover, French-Basque children were generally slower at reading than Spanish-Basque children. This effect was thought to be due to the higher similarity between Basque and Spanish grapheme-to-phoneme conversion rules than between French and Basque.

We therefore conducted a lexical decision task in Basque (Fig. 5) under EEG recording in order to verify this hypothesis. Results showed that graphemic clusters which convert to different phonemes in French and Basque (i.e., “au” converts to the sound [o] in French but to the sound [a] followed by [u] in Basque) but not between Spanish and Basque (in both cases: [a]+[u]) affected the ERPs specific to orthographic processing (N1 component locked to Basque words and pseudowords) only in French-Basque children (Fig. 6, green and red lines, “inconsistent” conditions). This preliminary result indicates that similar grapheme-to-phoneme conversion rules between two languages may affect the strategies used to read in this language.

IV. Description of the expected final results and their potential impact and use.

Other final results are expected:

1. Reading disorders in Basque (Objective #3): we will extract outlier participants who exhibit a significant reading deficit as compared to the whole group of children, in order to study how their reading profile is modulated by the language(s) they know. Based on the results already obtained, we hope to show that sublexical reading disorders (pseudo-word reading deficits) should be compensated for Basque-Spanish children with poor reading skills as compared to Basque-French children with poor reading skills. On the contrary, lexical reading disorders (real word reading deficits) should be compensated for Basque-French children with poor reading skills as compared to Basque-Spanish children with poor reading skills.

2. Causal modeling of reading development in Basque (out of original Objectives): our longitudinal design will allow testing causal hypotheses regarding the differential contribution of phonological and visual skills to Basque reading development in the French and the Spanish Basque regions (predictors: phonological and visual skills, at Grade 2 and 5; Dependant variables: Basque reading speed and reading accuracy at Grade 3 and 6). We expect to show that visual skills will play a greater role for Basque reading development in French-Basque children whereas phonological skills should play a greater role in reading acquisition in Basque-Spanish children.

3. Impact of bilingualism’s type on Basque and Spanish reading level of Spanish-Basque children (out of original Objectives): the amount of children evaluated in the Spanish region, and the variability of their linguistic backgrounds will allow testing the hypothesis of differential benefits for Basque reading development of certain types of bilingualism (cf, “simultaneous”: two languages learned from birth; “sequential”: one language is learned later, when the child enters a formal Basque teaching program at school, at 3 or 7 years old). Linguistic backgrounds may indeed affect the way reading develops and the BIRD project will offer the first step towards a better understanding of this issue in the Basque country.

Potential impact and use of these expected final results:

Together with the results described in point III., those further expected results will have concrete applications which will be fed back into society. We are already preparing the Basque reading battery based on the collection of reading measures (speed and accuracy average measures together with standard deviation scores per age groups) in the two Basque regions. We will offer these reading batteries to professional cores interested. Speech and language therapists and teachers working with the Basque language will have the opportunity to use this normative set for the evaluation of reading delays and/or disorders in Basque. Results on reading subprocesses should give to the professional cores some clues and hints on how to optimize Basque reading teaching methods (i.e., sublexical, or lexical strategies) and how to remediate reading disorders (e.g., focusing on visual or phonological skills). Therefore, with a theoretically-based approach, the BIRD project is offering the opportunity to assess, be aware, prevent or remediate literacy developmental difficulties in Basque. By coordinating efforts on a Europe-wide scale (Spain and France) the fellowship has helped at better understanding literacy development which is essential for well-being and psychological health. Importantly, it will be possible to reintegrate the knowledge brought by BIRD to future research programs on literacy acquisition in other European bilingual communities (e.g., Welsh, Breton, Catalan and Galician).



Figures. BIRD: PUBLISHABLE SUMMARY

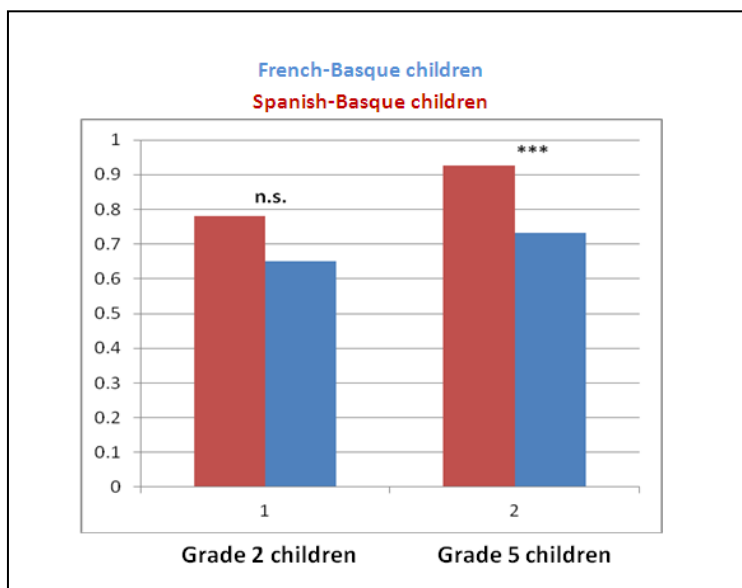


Figure 1: Performance of the four groups of children on the phonemic deletion task.

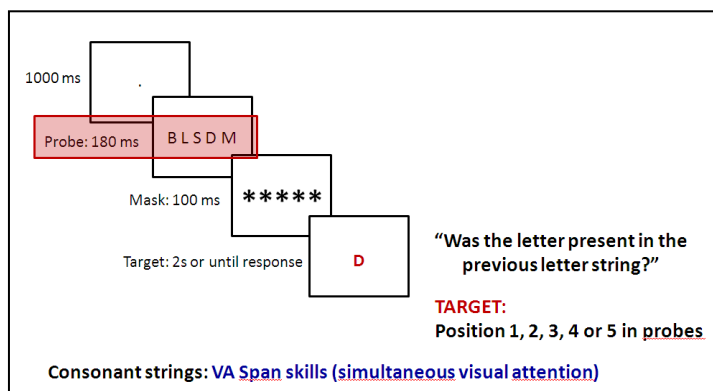


Figure 2: Visual attention span task presented to the children.

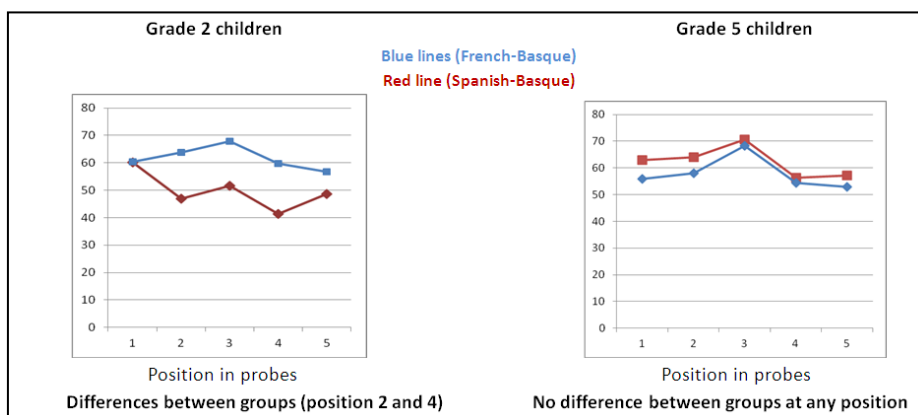




Figure 3: Performance of the four groups of children on the visual attention span task.

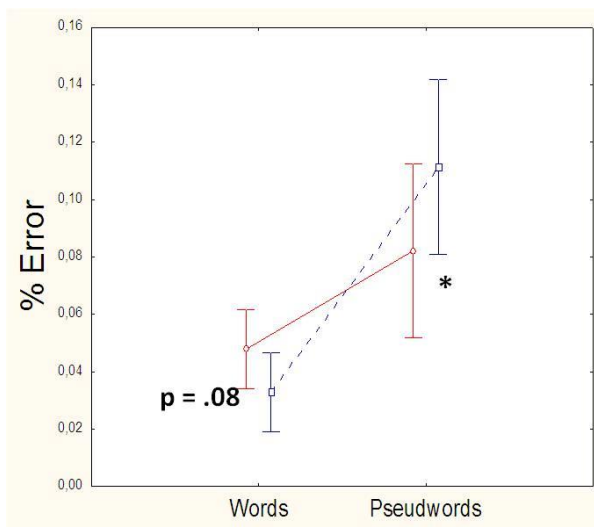


Figure 4: Basque reading accuracy Basque-French (blue line) and Basque-Spanish (red line) children.

LEXICAL DECISION TASK: Is it a Basque words of a Basque word that does not exist? Press button 1 for “Word” and button 2 for “Nonword”.

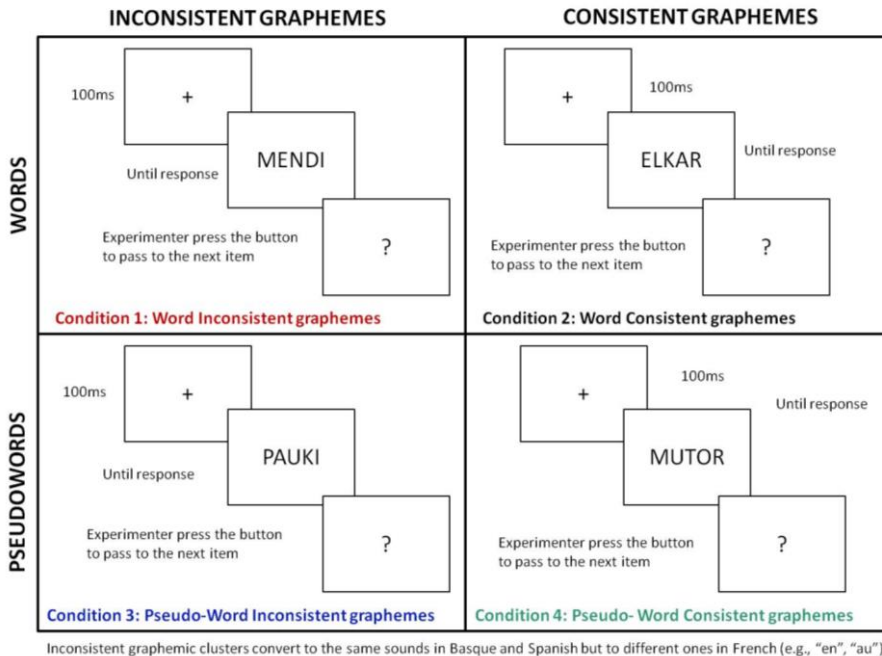


Figure 5: Lexical decision task.

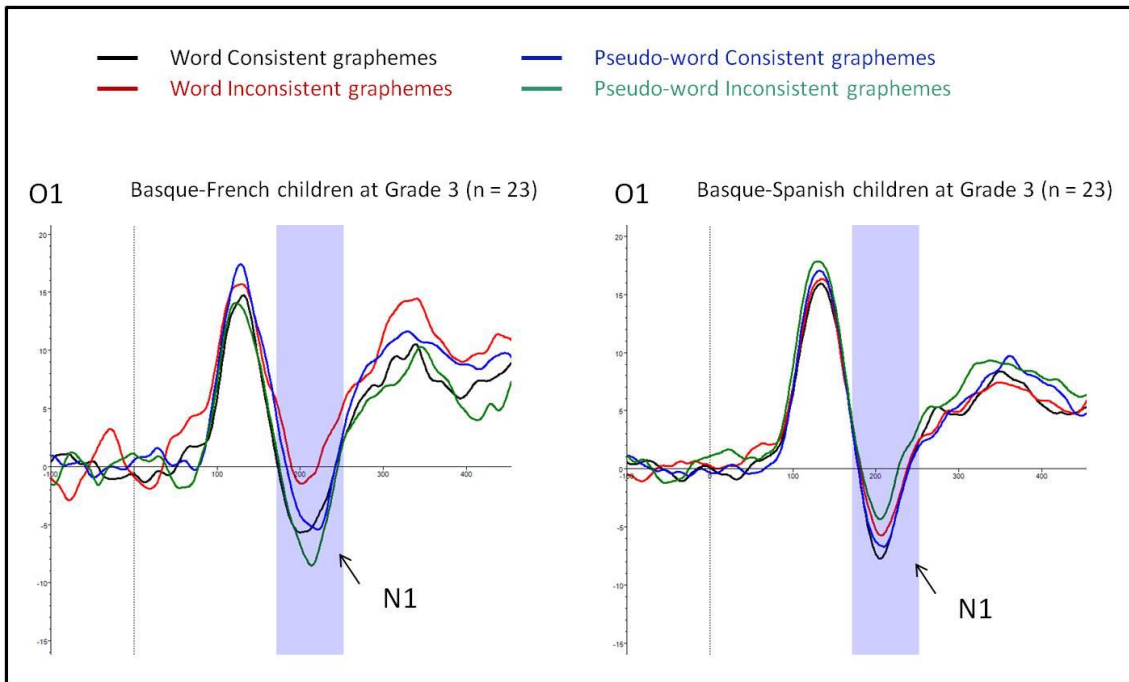


Figure 6: ERPs locked to Basque words and nonwords in the French-Basque and Spanish-Basque bilingual children.