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Computer-based Training Programs to Stimulate Learning to Read in French for Newcomer Migrant Children: A Pilot Study*

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PROGRAMMI DI FORMAZIONE REALIZZATI CON SOFTWARE COMPUTERIZZATI PER STIMOLARE L'APPRENDIMENTO DELLA LETTURA IN FRANCESE PER I BAMBINI MIGRANTI NUOVI ARRIVATI: UNO STUDIO PILOTA

Abstract

The integration of newcomer migrant children is a vital challenge for host countries. For such children, learning to read in a new language is a prerequisite for the acquisition of knowledge in all academic domains at school. To investigate this issue, two experiments were conducted: one with children who were just at the beginning of learning to read in French and another with children who could already read a few words in French. Two specific software programs were used for each group. Each group was exposed to the same experimental design, which included three assessment sessions, namely two before training to obtain a baseline of scores in different literacy skills and a third after training to

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examine the impact of 10 hours of training. In Experiment 1, the alphabetic code was stimulated: a significant effect on phonemic awareness was observed. In Experiment 2, the grapho-syllabic processing required to read words was stimulated: a significant effect on word reading was observed. Our initial results show that teachers can improve learning to read in ways tailored to the needs of newcomer migrant children.

Keywords: Alphabetic code; Learning to read; Newcomer migrant children; Syllable; Word reading.

The schooling of newcomer migrant children is currently a challenge for the French education system. UNICEF (2017) estimates that approximately 350,000 individuals entered the European Union (EU) in 2016 and that of those individuals, 131,000 were children under 18 years old. In 2017, European countries recorded 209,756 asylum claims by children and France registered 20,970 child asylum seekers (UNICEF, 2018). Migrant children experience interrupted education and have to change language several times. This critically increases their vulnerability during learning.

The aim of inclusive education is to help all pupils to overcome their difficulties. In this paper, the question is how to help newcomer migrant children learn to read in a language that is new to them, namely French. We proposed two software programs designed to stimulate literacy skills and initially developed for French poor readers: How are they effective for to this specific population?

1. Introduction

1.1. *Newcomer migrant children: a specific population*

It is useful to distinguish between first generation migrant pupils who have been in the host country for less than a year (so-called newcomers) and those who have been there for several years. While a lot of research has been conducted on language acquisition and reading in second-generation migrants (for a review, see Leseaux & Geva, 2006; Larson *et al.*, 2020), studies of newcomer migrants are rare. The literature on newcomer migrants in both the United Kingdom and the United States has focused

more on the topic of identity than on the role of language (Evans & Liu, 2018). In addition to their immigrant status, newcomer migrant children are also confronted with a factor that is disruptive for academic achievement, the change of school. This is often the case for most newcomers; for example, most of the participants in the research reported below had changed schools two or three times before the beginning of the research. This geographic mobility exposes these children to a significant risk of school failure (Mehana & Reynolds, 2004). Moreover, young newcomers face many challenges in terms of academic success: poverty, language barriers, often inadequate programs, lack of understanding of the realities of their situation, and insufficient resources to help them overcome trauma (Suárez-Orozco, Pimentel, & Martin, 2009).

What is the impact of such difficulties on newcomers' literacy skills? For example, when they arrive in their host country, they not only have to learn new words and start by understanding some short sentences, but they have also to build phonemic representation of new words. Acquiring this phonemic awareness is a challenge for them, especially when learning to read in a new language. Very few researchers have examined the issue of learning to read in newcomers. For example, Shany, Geva and Melech-Feder (2010) studied the emergent literacy skills of kindergarten children whose families had immigrated to Israel from Ethiopia (a primarily oral society). The authors examined developmental patterns, individual differences, and the contribution of home literacy. The emergent literacy skills of migrant children (Ethiopian Israeli group) were compared to those of low SES children coming from a primarily literate culture. The results showed that (1) all the children acquired literacy skills in the same order, including phonological awareness, letter naming and consonant writing; (2) in both groups, phonological awareness explained individual differences in letter naming, but vocabulary and syntactic knowledge added to the explained variance only in the migrant group; (3) letter naming was associated with consonant writing in both groups. In summary, this study shows that the two groups differed on various aspects of cognitive, cultural and environmental literacy and oral language but did not differ on their performance in early reading and writing tasks.

Coming from different backgrounds, children may differ significantly in their views and experiences of school. The role of teachers is to provide them with a pedagogical environment that presents them with challenges that are adapted to their individual needs, age and developmental level. Research has highlighted the significant risk that children of newly arrived migrants will not learn the dominant language and the focus is consequently placed more on language development and reading (Suárez-

Orozco, Darbes, & Dias, 2011). To summarize, newly arrived migrants should be distinguished from second-generation migrants on the basis of their length of residence in the host country as well as their proficiency in the language of the host country.

In France, to respond to the urgent need to welcome newcomer migrant children in schools, the French Ministry of Education has created multi-ethnic classes (so-called UPE2A [1], Pedagogical Units for Allophone Children). These have been set up in every region of France. These special classes are managed by the Academic Center for the Schooling of Newly-Arrived Allophone Students and Children from Traveling Families and Travelers (so-called CASNAV [2]), which accompanies the educational teams in the task of adapting their pedagogical activities to this specific population of migrants. In this perspective of inclusive education, the question is how to help these children learn to read in a language that is new to them, namely French. We proposed two software programs designed to stimulate literacy skills and initially developed for French poor readers. Our two experiments try to answer the question: How effective are they when used with newcomer migrant children? But first, we have to present the scientific hypotheses that were the basis for the design of these two software programs.

1.2. *Phoneme and syllable: two important units when learning to read in French*

To learn to read in an alphabetic language it is necessary to master the principle of the alphabetic code, i.e. to acquire the phoneme-grapheme correspondences specific to a written language. To establish these relationships between these small phonological and visual units, children must be able to consciously access phonemes. Multimodal in nature (auditory through the perception of the acoustic signals of the word, visual through the labial and motor-based reading needed for its pronunciation), the phoneme is a highly abstract phonological unit (Morais, 2003). Paradoxically, while phonemic categorization occurs very early on in babies, the phonemic awareness comes later, stimulated by the effect of learning the alphabetic code (Castles & Coltheart, 2004). This difficulty in access is explained, in

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particular, by the phenomenon of co-articulation, with awareness of consonant phonemes continuing to pose a particular problem for a certain number of children. Indeed, it is impossible to isolate the /p/ phoneme in the pronunciation of /pə/ even if the /ə/ is very short. One way of inducing phonemic awareness is to use the syllable, that is to say a phonological unit that is available at a very early age in French-speaking children (Duncan *et al.*, 2006; Goslin & Flocchia, 2007). Indeed, children have access to the spoken syllable at a very early age. During the development of children's phonological skills, the syllable is acquired earlier than the phoneme (Ecalle & Magnan, 2007). One of the proposed hypotheses is as follows: phonemic awareness, the difficulty of which is recognized, can be facilitated through oral syllabic processing based on the letters making up the syllable.

According to the «syllabic bridge» hypothesis (Doignon-Camus & Zagar, 2014), children who have not yet learned to read have a stock of lexical representations associated with infra-lexical representations of a syllabic nature. Schooling then brings about the progressive learning of letters (their shapes and names). The first letter-syllable connections are established between groups of letters and the spoken syllables that are already available. Gradually, these connections become increasingly automatic.

The construction of letter-sound correspondences is the product of a segmentation of the spoken syllable, which occurs at the same time as the developments described above, into smaller units and the corresponding written units, i.e. graphemes: it is at this point that the phonemic representations are constructed as the grapheme-phoneme links become established. Indeed, the representation of the phoneme is constructed on the basis of the corresponding visual unit, i.e. the grapheme. Then, by means of a concatenation mechanism, which requires only a minimum amount of cognitive effort to retrieve the units when written words are identified, a sequence of letters becomes associated with a sequence of sounds. This constitutes the progressive construction of syllable-type ortho-phonological units stored in a «mental syllabary» on which readers and, at a very early stage, learner-readers rely in order to identify written words. It should be noted that we find evidence of the description of the grouping of letters associated with sounds in the consolidated alphabetical phase in Ehri's model of the development of the recognition of written words (Ehri, 2005).

In a pioneering study, Colé, Magnan and Grainger (1999) demonstrated that the syllable is a unit used by readers in the processing of the written word. They found a phenomenon of syllabic congruence in both adults and children in Grade 1. Good readers in Grade 1 detect SO

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more quickly in SOLEIL than in SOLDAT and SOL more quickly in SOLDAT than in SOLEIL. Children seem to progressively construct a mental syllabary which expands as a function of the frequency of the syllables (Maïonchi-Pino, Magnan, & Ecalle, 2010). Children at the end of Grade 1 recognize written words starting with the most frequent syllables and those in Grade 5 use syllables irrespective of their frequency. The use of other paradigms, like detecting the letter in an illusory conjunction situation (Doignon & Zagar, 2006; Maïonchi-Pino *et al.*, 2012) or a lexical decision task in which the syllable is colored within the words (Chetail & Mathey, 2009), has confirmed that, in French, the syllable is a phonological unit that is pre-lexical and segmental and is available to learner readers at an early age.

To summarize, the phoneme in French is, as in all other alphabetic languages, the smallest unit that is essential for decoding new words and the syllable is the prominent and functional unit in word recognition.

1.3. *Two software programs resulting from fundamental research*

The first program [3], known as SyllaboCod, focuses on syllable processing. The aim is to discover the alphabetic code based on spoken syllables in order to master them and then use the corresponding written syllables to identify the written words. It targets children who are pre-readers or learners with difficulties attaining phonemic awareness. This software program is underpinned by three types of scientific arguments, as presented above: (1) the importance of phonemic awareness in learning to read and the difficulty of accessing this abstract unit, (2) the prominent nature of the spoken syllable in French and the importance of the written syllable as a functional unit for recognizing written words, and (3) the hypothesis of the «syllabic bridge». This software project should make it possible to address the issue of phonemic awareness in its entirety (time-consuming in the case of certain children) as revealed by a study of syllables presented in two different modalities, oral and visual. In this way, young children who will subsequently learn to read are exposed at an early age, in SyllaboCod, to orthographic syllables that will be stored for later reading.

The second software program, which is known as Chassymo, was developed to help children who experience difficulties in learning to read

[3] It was designed by one of the authors and developed by a software publisher www.adeprio.fr. There is also an app for tablets and this will be the object of a separate publication.

by helping them to automate the process of word reading. The aim of Chassymo is to stimulate word reading by focusing on the syllables, which are the ortho-phonological units used by readers, including young readers, once the grapheme-phoneme correspondences are mastered. The general principle of this software is to present a single written syllable together with its phonological value. Next, a spoken word is heard and the child has to say the position in the word at which the syllable is located. Whatever the child's response, feedback is given by coloring the syllable in the written word: in green if the response is correct, in red if the child's response is wrong.

Chassymo has been used with poor readers in first and second grade as well as with secondary school students. The effects of Chassymo on the development of word recognition and reading comprehension in French poor readers during Grade 1 and Grade 2 have been tested in several studies. The results have revealed an effect of graphosyllabic training on silent word recognition, word reading aloud and reading comprehension (Ecalle, Kleinsz, & Magnan, 2013; Kleinsz *et al.*, 2017). In another study, specific poor decoders were identified among a population of students with learning disabilities attending a special class in secondary school. These students were then trained with the Chassymo program, which is designed to encourage their word decoding skills. After 5 weeks of training, the results primarily showed an improvement in reading fluency (Potocki, Magnan, & Ecalle, 2015).

1.4. *Research question*

Might a software program used with French-speaking children with difficulties in learning to read also be effective with newcomer migrant children? However, before deciding on the best way to examine this question, we have to take into account the high level of heterogeneity among the population of newcomers and their previous real-life school experience. First, we have to assess their initial level in both oral and written French. Once this is known, it is possible to propose appropriate training. Computer-based training using frequently employed French software could be a good way to stimulate the learning of French in both the oral and written modality because migrant children will thus benefit from extensive exposure to their newly adopted language during the training sessions.

2. Method

Two experiments were conducted at school with newcomer migrant children as a function of their initial French literacy level as assessed by their teachers using their own pedagogical tools. We then assigned the children to one of the software programs depending on their teachers. The children with very little knowledge of the French alphabetic code worked with SyllaboCod and those who had begun to learn to read and had mastered some phoneme-grapheme correspondences worked with Chassymo.

Because of the high level of heterogeneity in this population, we adopted an experimental design that compared the children with themselves by first using a baseline indicating their progress without any specific intervention and then evaluating their progress after a period of training. To summarize, three assessment sessions were conducted at five-week intervals: between t0 and t1 no intervention (baseline), and between t1 and t2 training with the software [4].

2.1. *Experiment 1: to stimulate the French alphabetic code*

2.1.1. Participants

Eleven migrant children were involved at the start of this study. However, complete data could be collected for only six of them, schooled in two different classes. Only one child was in France for more than a year but he had already been attending school for a few months (see *Tab. 1*). Only two children had attended school in their country of origin. Their global academic level in their first language (L1) was assessed by a specialist teacher using academic tools (in mathematics and reading). With the exception of one child, it can be seen that they had a low level in L1. Their French literacy skills at pre-test at t0 were assessed by an experimenter. Their teachers were willing to take part in this study and to implement the training in the classroom as part of their pedagogical activities.

[4] There was holiday time between t0 and t1 but not between t1 and t2. This made it possible to propose five successive weeks of training. The school year in France usually consists of periods of six or seven successive weeks of school time separated by two weeks of holidays.

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Table 1. – Characteristics of the migrant children (N = 6).

Sex (boy/ girl)	Age (year; months)	NB of months in France	Country of origin	L1	Academic level in L1
b	14; 9	17	Romania	Romanian	A
b	13	7	Afghanistan	Pashto	A
b	15	9	Syria	Arabic	A
b	12; 7	5	Algeria	Arabic	B
g	7; 6	2	Italy*	Arabic/Italian	A
b	12	2	Kosovo	Serbian	A

Note: The academic level was assessed from A = «low» to C = «good»; * = the other country of origin (where she had learnt Arabic) was not known. She was assessed in Arabic as L1.

2.1.2. Assessments: material and procedure

The tasks described below were used in a large-scale study with French kindergarten children; all psychometric measures are available in the paper published by Ecalle and colleagues (2015). Letter-name knowledge in French was assessed because nearly all the children (except the girl) had been exposed to alphabets other than the Roman alphabet. The other domains evaluated were phonological skills, decoding and vocabulary. All the children understood enough French to be evaluated using the tasks described below. In each task, one practice trial was administered prior to the test items. The children were assessed in a small group in a quiet room at their school.

Letter-name knowledge. The experimenter successively named 15 letters and the children were asked to circle the named letter, which was presented in a set of seven letters in uppercase. Unexpectedly, the scores were very high (mean percentage: 93.3% at t0); and we therefore did not assess letter knowledge at t1 and t2.

Syllabic categorization. Four words were named by the experimenter and the children had to circle the two words with the same oral syllable. Only correct responses (the two words with the same syllable) were recorded (max = 6).

Phonemic segmentation. In this task, the children were asked to draw as many circles as they heard sounds (phonemes) in the named pseudowords with various syllabic structures consisting of two to four phonemes (max = 12).

Decoding. In this pseudoword reading task, the children were required to circle the pseudoword named by the experimenter from among five test items (e.g., pseudoword named: mida; test items: mida-nida-mipa-mdia-ufno) (max = 10).

Vocabulary. The children's receptive vocabulary was assessed using a classical procedure: Four pictures were presented and the children had to circle the one corresponding to the named word (max = 13).

2.1.3. Training: material and implementation

The aim of the SyllaboCod program is to stimulate the acquisition of letter-sound knowledge by using oral and written syllables. The material is composed of 34 sets (2*17 consonants), with each set consisting of 20 words chosen on the basis of their frequency. In the consonant graphemes studied, the complex vowel graphemes (only those consisting of two letters were retained, e.g. *an* → /ɑ̃/; *ou* → /u/) comprised the other 17 20-word series. Only the most frequent phonological units and associated grapheme-phoneme correspondences (GPC), and the most frequent syllables and words are included in this software. Furthermore, we distinguished the simple vowel graphemes (*a*, *i*, *u*, *o*, *e*) associated with the consonants, making 17 sets of 20 words with CV and CVC syllables. Each series of 20 words consisted of five lists of four words each – e.g. for *l* → /l/, the first list was: *lire* (read), *lunettes* (glasses), *lever* (raise), *lavabo* (washbasin) – for which the children completed the following tasks: (1) segment the oral words according to their spoken syllable, (2) find the letters needed to reconstruct the written syllable of the word (*Fig. 1*), (3) build the first syllable of the word they have heard.

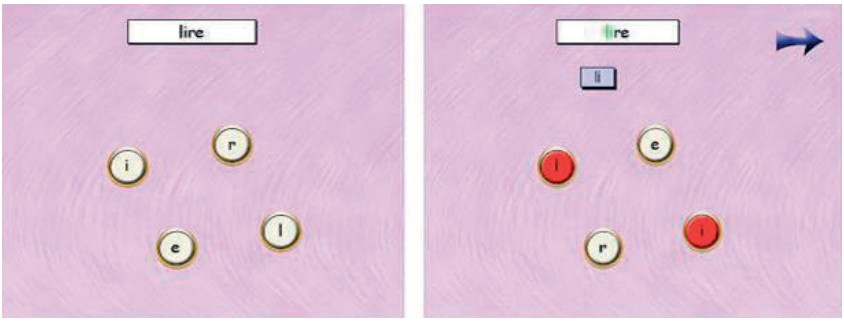

Figure 1. – Screenshots showing how the children had to click the letters to begin to write «lire» (left-hand screen) with feedback (right-hand screen).

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After the presentation of the 5 lists of 4 words, a fourth task was proposed in which the children had to find words from the series. Sitting alone with headphones in front of the screen, each child heard a word and then had to touch the corresponding written word from among four test words: the target word, another one from the series and two other words from other series.

The children performed the training between t1 and t2 over a period of five successive weeks with two 15-minute sessions being administered each day (or one 30-minute session per day), on 4 days per week, making a total of 10 hours. The implementation and duration of training were controlled by the teachers.

2.1.4. Results

To examine the effect of training, we compared the mean differences between the scores, with those observed between t0 and t1 (d1) corresponding to the baseline and those observed between t1 and t2 (d2) corresponding to the period of training. We expected d2 to be greater than d1. A non-parametric analysis (Wilcoxon test) was run to examine these differences in the four domains. We observed a significant effect of training ($Z = 2.2$, $p = .03$) on the scores in phonemic segmentation. No significant effect was found in the other three domains (*Fig. 2*).

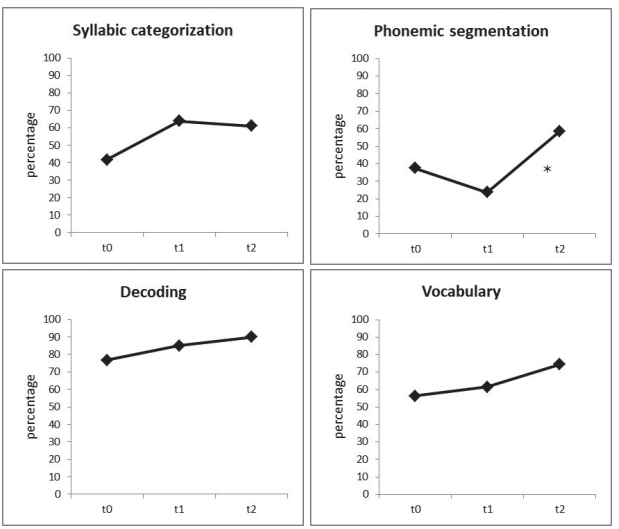
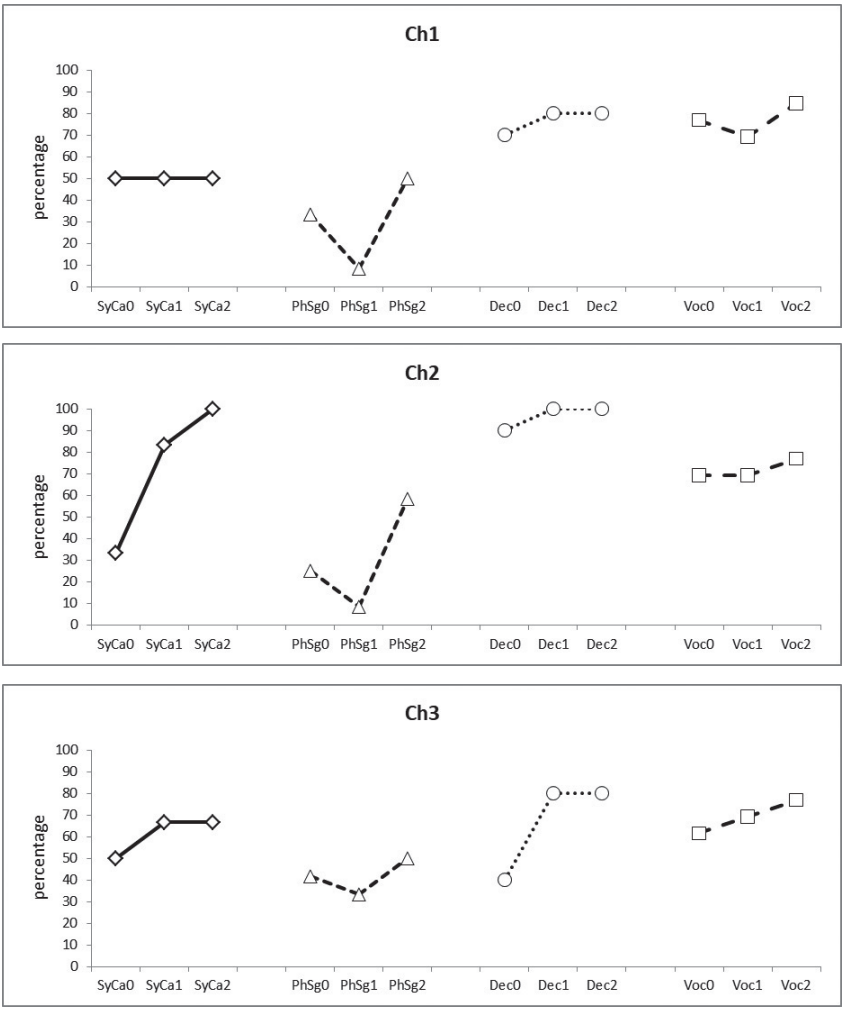


Figure 2. – Changes in the scores in the four domains as a function of the assessment sessions (= p < .05).*

To permit a visual inspection of the results for each child, their mean percentages in the four domains are presented in *Figure 3*. We observed a high level of heterogeneity not only between children but also between sessions for each child. In phonemic segmentation, four children out of six obtained lower scores at t1 than at t0, which was not expected, and five of them (Ch1, Ch2, Ch3, Ch4, Ch6) progressed during the training period between t1 and t2.



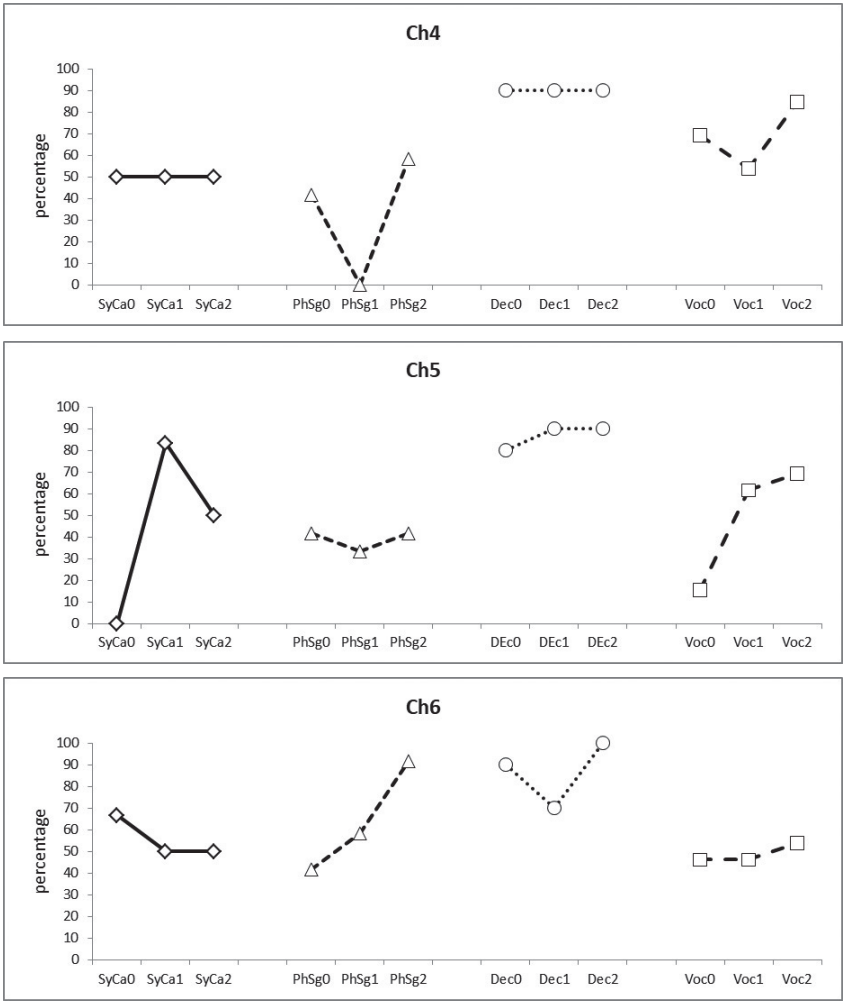


Figure 3. – Changes in the scores in syllabic categorization (SyCa), phonemic segmentation (PhSg), decoding (Dec) and vocabulary (Voc) as a function of the assessment sessions (t0, t1, t2) for each child.

2.2. *Experiment 2: to stimulate word reading*

2.2.1. Participants

Eleven children (6 boys; 5 girls) participated in this study. They were registered in four schools. With the exception of two young girls and one boy, they were all more than 12 years old (*Tab. 2*). Eight of them had attended school in their country of origin and three had not attended school before their arrival in France. The experiment was conducted in the same conditions as were used in Experiment 1 but with the Chassymo software, which is known to be efficient with French children.

Table 2. – Characteristics of the migrant children (N = 11).

Sex (boy/ girl)	Age (year; months)	NB of months in France	Country of origin	L1	Academic level in L1
b	12; 3	13	Algeria	Arabic	B
b	12; 2	6	Angola	Portuguese	C
b	15; 11	5	Mali	Soninke/ Bamabara	B
g	7; 11	16	Russia	Russian	B
g	7; 7	11	Algeria	Arabic	B
b	9; 7	11	Algeria	Arabic	B
b	14; 3	25	Romania	Romanian	A
g	12; 4	5	Gabon	French	B
b	12; 8	3	Italy*	Arabic/Italian	B
g	12; 6	3	Albania	Albanian/ German	B
g	13; 3	25	Italy*	Italian	A

Note: The academic level was assessed from A = «low» to C = «good»; * = the other country of origin was not known.

2.2.2. Assessments: material and procedure

Three domains were assessed, word reading, vocabulary and oral comprehension. The participants performed one practice trial before each task.

Word reading. We used a silent word recognition test (Ecalle, 2003; 2018) which comprised three forced-choice tasks. In the first task, the

target words were named by the experimenter; the second consisted of pictures which the children had to associate with the written word; and the third took the form of a semantic categorization task in which the children had to associate two words. In each of the tasks, the target word was presented in a list of five items consisting of the orthographically correct word (e.g., *bateau*, boat), and four pseudowords, namely a homophone (*bato*), a visually similar item (*baleau*), an item sharing the same initial letters (*batte*) and an item containing an illegal letter sequence (*btaeua*). Thirty-six target words were proposed (12 in each task). The children had to find the target in each list. The number of correct words was recorded (max = 36).

Vocabulary. The same test as in Experiment 1.

Oral comprehension. We used a shortened version of the ECOSSE test (Lecocq, 1996) in which the children heard a sentence and were asked to choose one picture out of four which represented the situation described in the given sentence (max = 28).

2.2.3. Training: material and implementation

The Chassymo program has been described in detail by Ecalle *et al.* (2013). The objective is to stimulate grapho-syllabic processing, which is known to be one of the core components of word reading in French. It should be remembered that with this program, children hear a spoken syllable and then have to say whether or not this syllable is present in the word and also indicate the position of the syllable (initial, median or final position). Feedback indicating the highlighted syllable in the written word is always given, irrespective of whether the answer is right or wrong. Once again, each child sat alone with headphones in front of the screen for one (30 min) or two sessions per day (2*15 mn) for 4 days per week during five weeks, giving a total of 10 hours. The conduct of the sessions was controlled by the teachers.

2.2.4. Results

The same analyses as in Experiment 1 were run to examine if the mean differences of performance during training (d2) were significantly greater than those obtained for the baseline (d1). We observed (*Fig. 4*) an effect of training at the limit of significance ($Z = 1.78$, $p = .07$) on oral comprehension and a significant effect ($Z = 2.4$, $p = .02$) on word reading.

The results of the eleven children are presented in *Figure 5*.

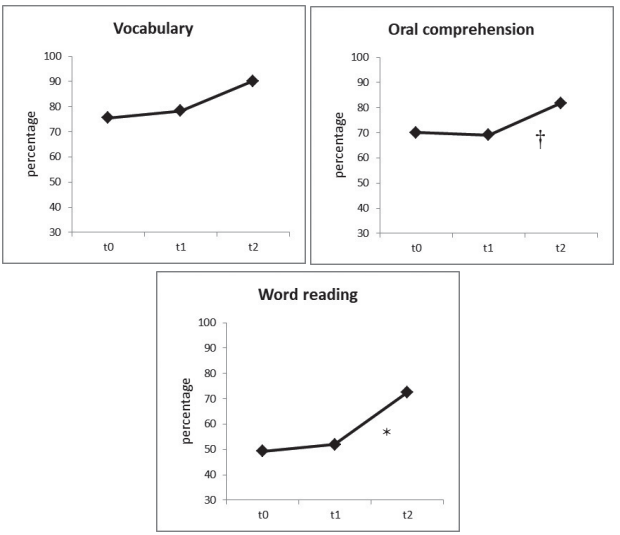
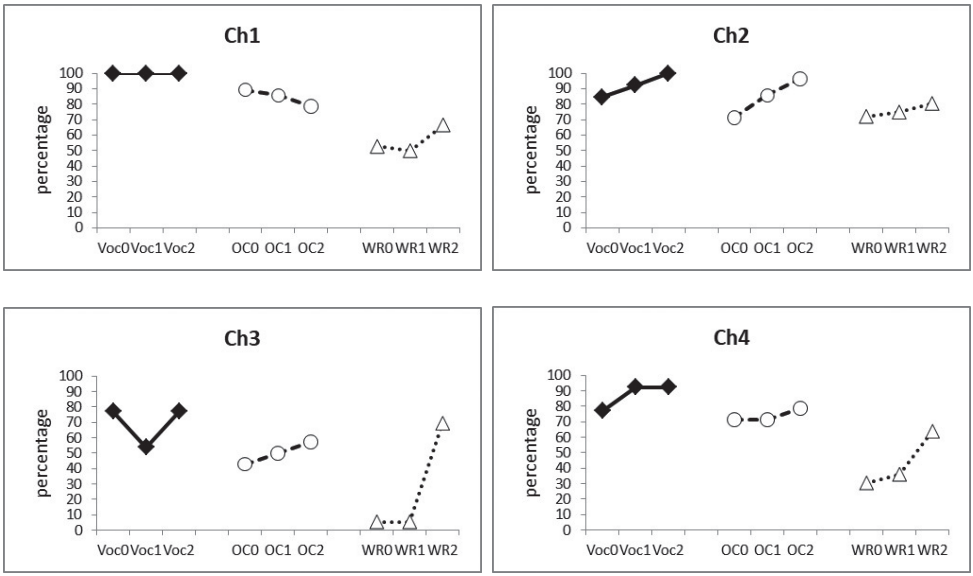


Figure 4. – Changes in the scores in the three domains as a function of the assessment sessions (= p < .05; † = p < .10).*



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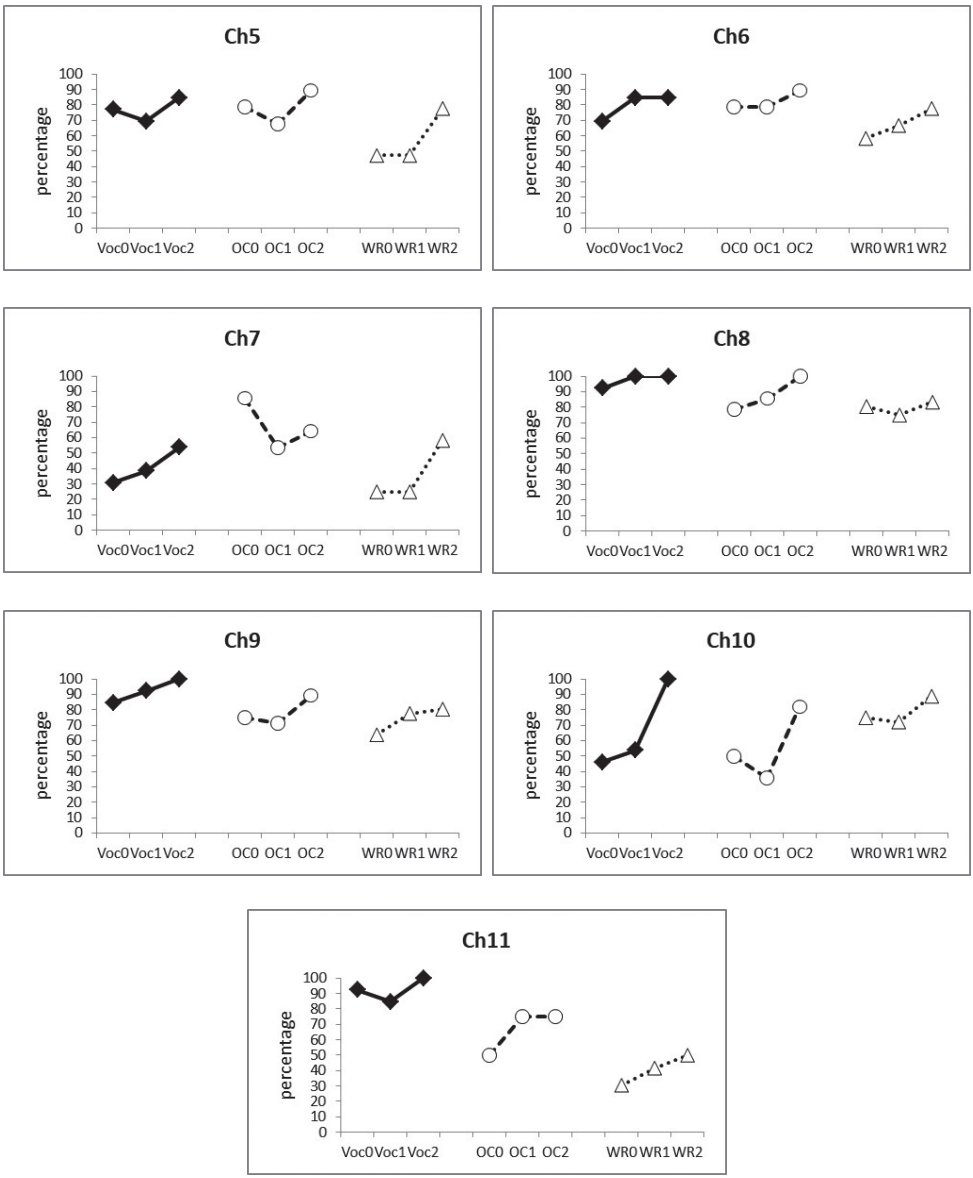

Figure 5. – Changes in the scores in vocabulary (Voc), oral comprehension (OC) and word reading (WR) as a function of the assessment sessions (t0, t1, t2) for each child.

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Beyond the high level of heterogeneity that we again observed, a visual inspection of the curves of the scores from t0 to t2 shows that, compared to the baseline, five children (Ch4, Ch5, Ch6, Ch9, Ch10) progressed in oral comprehension during the training period. In word reading, six children (Ch1, Ch3, Ch4, Ch5, Ch7, Ch10) progressed more after training (from t1 to t2) than during normal instruction (from t0 to t1). Finally, two of them (Ch5, Ch10) obtained higher scores after training in all three domains: vocabulary, oral comprehension and word reading.

3. Discussion

For migrant children who have suffered during their exile and who have often had no access to education in their own country and/or during their long exile, the most important thing when they arrive in France is to ensure that they benefit from the best school conditions so that they can learn in French, which is a new language for them. Learning to read is one of the important cognitive and cultural prerequisites for their integration.

We gave them computer-based training sessions with a software program adapted to their initial literacy skills in French. In Experiment 1, which involved newcomer migrant children with a low level of French literacy skills, we observed an effect of training in phonemic awareness, one of the domains which is considered to be a crucial skill for learning to read because it helps learners master the grapheme-phoneme correspondences and then to progressively automate decoding and word reading. However, although we expected to observe an effect on decoding skill, we found no impact of training in this domain. The pseudoword reading task which we used to assess decoding was not sensitive enough and unexpectedly high scores (close to 80%) were registered at t0.

In Experiment 2, which involved other newcomer migrant children who had begun to learn to read in French, two results are of interest. First, and as expected, a clear effect of training was observed on word reading. As in other studies conducted with French children experiencing difficulties during their first grades (Ecalle *et al.*, 2013; Kleinsz *et al.*, 2017), the impact of grapho-syllabic training is again positive with migrant children who are learning to read in French. Secondly, a small effect was also observed on oral comprehension. It seems to us that this could be due to these children's exposure to spoken French words and their syllabic structure, as this can help them encode and store the lexical representations that are one of the core component related to listening comprehension.

More generally, we might expect that newcomer migrant children who have been more extensively exposed (in terms of time) to this type of software, which presents both the oral and written facets of the French language, would benefit from a dual effect on French linguistic performance, namely in both oral comprehension and reading. Indeed, through the two software programs used in these two studies, the children had access to the phonological structure of the French language as well as to the links between the oral and written units. Consequently, in future research with newcomer migrant children, language assessment should be evaluated more completely. For example, the two aspects of language, receptive and expressive, should be taken into account: receptive language by means of specific tasks involving vocabulary, listening comprehension and reading (word and short text) and expressive language using another specific vocabulary task together with a sentence production task and a word spelling task.

This pilot study with two experiments, with all their limitations (more participants and more assessments are obviously needed) as well as their strengths (a design adapted to heterogeneity and differing initial levels of French literacy skills and two software programs that were the result of fundamental research), yielded encouraging results.

However, this study does not show that using the computer-based program is the best way to achieve rapid progress. At the same time, however, software designed on the basis of fundamental research and adapted to children's initial levels could be considered as a tool that allows children to be independent in their learning. Its use at school or in the family should help stimulate literacy skills in newcomer migrant children at their own pace in the language of their host country.

New studies that overcome the weaknesses of this pilot study will open up new avenues of research and bring about the development of educational tools that favor the academic and social integration of migrant children by helping them to read in the language of their adopted country.

4. Conclusion

The proportion of migrant students has increased in the last 10 years from 8 to 10% in most European countries (OECD, 2015). A recent study has shown that across OECD countries, 12.5% of students in 2015 had an immigrant background, compared to 9.4% in 2006 (OECD, 2016). The growing presence of children from immigrant families in European schools poses new challenges for the school system. The aim is for students

to be able to follow all the lessons in regular classes at the earliest possible stage. To this end, this study reports the implementation of intervention programs that use computer-based training to stimulate literacy skills and reading acquisition in migrant children.

Research has shown that school is the place where children of different ethnicities become integrated. Indeed, schools can, in some cases, act as an important factor in the development of the social fabric of European society (Gonzales, Suárez-Orozco, & Dedios-Sanguineti, 2013; Monteduro, 2015). Some studies have focused on the social inclusion of immigrant children at school (Pirchio *et al.*, 2017; Hubert *et al.*, 2018; Pirchio *et al.*, 2019). Teachers need more support in order to identify useful strategies so that they can operate effectively in heterogeneous classes (Fiorilli *et al.*, 2017). Furthermore, they need training to help them integrate computer-based tools in their pedagogical approach so that migrant children can benefit from more learning time. Although the introduction of new technologies is not a magic wand guaranteed to boost reading performance, their use in teacher-initiated pedagogic approaches could make a significant contribution. The «tertiary» meta-analysis by Archer, Savage, Sanghera-Sidhu, Wood, Gottardo and Chen (2014) reinforces this point of view and concludes that the classroom use of digital tools and after the individuals in question had received initial training and support in the chosen tool, effectiveness in terms of enhanced learner performance increased significantly. Newcomer migrant children, as a population with specific educational needs, deserve our full attention and it is necessary to mobilize researchers and teachers in order to introduce educational devices adapted to the learning of the language of the children's host country.

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Riassunto

L'integrazione dei bambini migranti nuovi arrivati è una sfida vitale per i paesi ospitanti. Per questi bambini, imparare a leggere in una nuova lingua è un prerequisito per l'acquisizione di conoscenze in tutti i domini accademici a scuola. Per indagare su questo problema, sono stati condotti due esperimenti: uno con bambini che stavano appena iniziando a imparare a leggere in francese e un altro con bambini che sapevano già leggere alcune parole in francese. Per ogni gruppo sono stati utilizzati due programmi software specifici. Ogni gruppo è stato esposto allo stesso disegno sperimentale, che comprendeva tre sessioni di valutazione, vale a dire due prima dell'intervento, ciò al fine di ottenere una base di punteggi in diverse abilità di alfabetizzazione, e un terzo dopo la formazione per esaminare l'impatto di 10 ore di formazione. Nell'esperimento 1, il codice alfabetico è stato stimolato: è stato osservato un effetto significativo sulla consapevolezza fonemica. Nell'esperimento 2, l'elaborazione grafo-sillabica richiesta per leggere le parole è stata stimolata: è stato osservato un effetto significativo sulla lettura delle parole. I nostri risultati iniziali mostrano che gli insegnanti possono migliorare l'apprendimento della lettura in diversi modi adattati alle esigenze dei bambini migranti nuovi arrivati.

Parole chiave: Bambini migranti nuovi arrivati; Codice alfabetico; Imparare a leggere; Lettura di parole; Sillaba.

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