

Class size effects on literacy skills and literacy interest in first grade: A large-scale investigation

Jean Ecalle^{a,*}, Annie Magnan^a, Fabienne Gibert^b

^a *CoDévA “Cognition, Développement, Apprentissages” Laboratoire Etudes des Mécanismes Cognitifs/Dynamique du Langage, UMR CNRS 5596-Université Lyon2, France*

^b *Direction de l’Evaluation et de la Prospective, Ministère de la Jeunesse, de l’Education nationale et de la Recherche, Paris, France*

Received 28 June 2005; received in revised form 8 March 2006; accepted 15 March 2006

Abstract

This article examines the impact of class size on literacy skills and on literacy interest in beginning readers from zones with specific educational needs in France. The data came from an experiment involving first graders in which teachers and pupils were randomly assigned to the different class types (small classes of 10–12 pupils vs. regular classes of 20–25 pupils).

Globally, the findings reveal that class size has a (small) impact on the two basic literacy skills, reading (word recognition task) and spelling (word production task). Children with high literacy interest made more progress than children with low literacy interest. The analysis also explores the effect of four factors – early schooling, age, first language and socio-economic status – on the same type of literacy skills as above. Smaller classes most specifically improved performances in two types of population: children whose first language is French and children from intermediate and average socio-economic brackets. This means, in contrast, that neither the children from the most disadvantaged backgrounds nor the children whose first language was not French benefited from the use of smaller first grade classes. Data in this experiment are examined in the light of studies on the connections between class size, classroom procedures and pupils’ engagement.

© 2006 Society for the Study of School Psychology. Published by Elsevier Ltd. All rights reserved.

Keywords: Class size; Literacy skills; Literacy interest; Reading; Spelling

* Corresponding author. Lab EMC/DDL (Psychologie) Université Lyon2, 5, av Mendès-France 69676 BRON Cedex, France. Tel./fax: +33 478772437.

E-mail address: Jean.Ecalle@univ-lyon2.fr (J. Ecalle).

Introduction

In France, as in many other countries, the causal effect of class size on pupils' school performance is an important issue in the ongoing educational debate. In 2002, the French government pledged to invest heavily in reducing the average class size in first grade in schools with a prevalently low socio-economic status intake. This educational policy was undertaken to prevent failure in reading and, consequently, to prevent illiteracy. The study presented here was conducted by French Ministry of Education and more precisely by the "Department for Evaluation and Forecasting" (DEP) with the collaboration of research centres from various French universities. Thus, 100 experimental classes were chosen from schools achieving very poor results in national third grade testing. First grade pupils were randomly selected from within these schools. The class size was reduced to children throughout the entire school year. 100 control classes (of normal size, i.e., about 20–25 pupils) were chosen on the same basis as the experimental classes.

Traditionally, the study of the effect of class size on school performance has been dominated by educational researchers and economists. Only recently have psychologists entered this field (Blatchford, Goldstein, & Mortimore, 1998; Rutter & Maugham, 2002). In the present study, we aim to examine the possible effects of class size on literacy interest and on two literacy skills, namely word reading and word spelling.

What impact does class size has on academic achievement?

Research into the effects of class size has been one of the most investigated areas in the educational field. However, meta-analyses have led researchers to different conclusions. One important negative finding has been that a variation in average class size is not associated with differences in pupils' progress. Thus, after reviewing a large number of studies, Hanushek (1986) concluded that there was no positive effect on pupils' school performance. On the contrary, Krueger (1999, 2003) argued that reducing class size brings significant and substantial returns in early grades and that resources should be targeted. Moreover, learning gains in literacy and mathematics are significant and lasting (Folger, 1989).

The research conducted during the 1980s investigated class size and students' achievement and/or classroom behaviour, teachers' satisfaction and/or stress, classroom organisation, cost effectiveness, and the unique features of small classes. During the 1990s, the research methods used to investigate class size became increasingly complex. Many recent studies on the impact of class size and of teacher–student ratios have concentrated on children's early years at school. The topic has been the subject of systematic examination in several large-scale studies using appropriate methodologies (Bennett, 1998; Ehrenberg, Brewer, Gamoran, & Willms, 2001; Goldstein, Yang, Omar, Turner, & Thompson, 2000; Podmore, 1998).

The major experimental studies in this field have been the Tennessee Student Teacher Achievement Ratio (STAR) experiment and the UK class size study at the Institute of Education, University of London. In the STAR project, 7000 pupils were randomly assigned to small (13–17 students), regular (22–25) and regular with teaching assistance

classes. Most of the results have shown that small classes did better from kindergarten to grade 3, that ethnic minority children did particularly well and had the highest self-concept scores, and that the effects were still present when the pupils moved to regular classes from grades 4 to 6 (Nye, Hedges, & Kostantopoulos, 2000). However, a reanalysis of the data using multi-level modelling reduces the sizes of the effects (Goldstein & Blatchford, 1998). Blatchford, Goldstein, Martin, and Browne (2002) report on the first year UK longitudinal study of 9330 reception year pupils from a group of randomly selected schools in England. They show a clear effect of class size differences on academic attainment in literacy and mathematics, and an effect for low baseline achievers and the socio-economically disadvantaged. Finally, in a recent study first graders in smaller classes performed better on literacy skills (NICHD, 2004).

The benefits seem to be greatest for children in the early grades, for children from lower socio-economic backgrounds, and for disadvantaged children (Finn & Achilles, 1999; Krueger & Whitmore, 2001; Molnar et al., 1999; Mosteller, 1995). However, the results of the studies are mixed. Thus, Rees and Johnson (2000) found no evidence that smaller classes alone led to greater student achievement; and Mishel and Rothstein (2002) found that, even using Krueger's methods, only 25.5% to 33.5% of studies revealed positive and significant impacts on student achievement.

It is clear that variations within the 25 to 35 pupil range are of little consequence, probably because they do not afford much opportunity for differences in either pedagogic style or classroom management techniques. However, very small classes (8 to 15 pupils) may be beneficial, especially for younger children and children with special needs (Nye et al., 2000).

Research and debate on class size differences have focused on their relation with academic achievement (Nye, Hedges, & Kostantopoulos, 1999; Nye, Hedges, & Kostantopoulos, 2002) and with teacher–pupil interactions (Blatchford, Bassett, Golstein, & Martin, 2003; Blatchford, Edmonds, & Martin, 2003; Blatchford, Moriarty, Edmonds, & Martin, 2002). In this paper, we investigate the relations between class size, literacy skills and literacy interest.

Methodological issues

The methods used to examine class size effects have either not been clearly described, the experimental designs have been inadequate (Blatchford et al., 2002), or the results have been biased upwards (Hanushek, 1999). Indeed, the key methodological problem involved in assessing the causal effect of class size on pupils' school performance is that the assignment of children to classes of different sizes needs be random because differences in performance between children from small and large classes can be caused by factors other than differences in class size. More precisely, two mechanisms are likely to play a role. Firstly, parents may choose the school to which they send their children partly on the basis of class size. It is likely that parents who care more about their children's achievement in school are more inclined to base their choices on class size. If that is the case, and if the degree to which parents care about their children's achievement has its own independent but unobserved effect on children's school performance, then the class size effect will be biased downwards.

Secondly, if there is more than one class of a particular grade level, the size and composition of each class depend on choices made by the school. The school might decide to form a larger and a smaller class at the same grade level and assign weaker pupils to the smaller class. If it is not possible to control for this assignment process, the class size effect will be biased upwards. In this study, the research design involved the random selection of schools and children within the participating local education authorities.

Basic literacy skills

It is now very well established that learning to read requires the child to construct a system of connections between the letter strings of printed words (orthography) and the phonemic sequences that comprise spoken words (phonology). The learning of grapheme–phoneme correspondences is the basis of reading in alphabetic systems. Thus, alphabetic orthographies depend on phonemic awareness for their acquisition (see recent reviews, [Castles & Coltheart, 2004](#); [Morais, 2003](#)).

Reading and writing are two complex cognitive activities which depend on two basic literacy skills, i.e., word recognition and word spelling. Children who learn to read and write in alphabetic systems need to develop phonological abilities because alphabetic written languages represent the phonological units of speech and phonological segments are abstract units ([Bradley & Bryant, 1983](#)). Numerous studies have shown that both adult illiterates ([Morais, Bertelson, Cary, & Alegria, 1986](#); [Morais, Cary, Alegria, & Bertelson, 1979](#)) and individual Chinese who are literate only in non-alphabetic scripts ([Read, Zhang, Nie, & Ding, 1986](#)) lack an awareness of phonemes. These results suggest that phonemic ability does not develop spontaneously in the normal course of linguistic development but only in the context of formal literacy instruction. At the earliest stage of reading acquisition, it may be necessary for children to acquire knowledge of the orthographic structure of their language and to develop strategies to map that structure onto existing knowledge about the language's phonological structure ([Harm & Seidenberg, 1999](#)). In line with this conception, researchers have found that the awareness and processing of phonological features are very important during the acquisition of early reading skills and need to be boosted to prevent reading failure ([Torgesen, 2002](#); [Wagner & Torgesen, 1987](#)).

In France, government instructions highlight the importance of phonic methods that emphasise phonological processing and encourage teachers to use them. Our hypothesis is that in smaller classes, teachers have the opportunity to spend more time developing phonological processing in children and this may, in turn, help encourage and develop higher literacy skills. The purpose of this study was to compare children's word recognition and word spelling in two types of first grade class (experimental e.g. small class size vs. control e.g. normal class size).

Motivation, literacy interest and reading

Several studies have pointed out the links between reading motivation and literacy skills such as phonological awareness, word recognition and text comprehension ([Baker](#)

& Wigfield, 1999; Lepola, Salonen, & Vauras, 2000; Salonen, Lepola, & Niemi, 1998; Wigfield & Guthrie, 1997). Reading motivation is described as a multidimensional domain with different constructs such as self-efficacy beliefs, coping tendencies, learning goals, attitudes about reading and interest in reading. This latter has been found to be an important variable which could impact reading performance. For example, Fritjers, Roderick, and Brunello (2000) assessed literacy interest in children from kindergarten through their affective responses to literacy and literacy-related activities. They found that literacy interest accounted for unique variance in written language performances. According to Tracey and Morrow (1998), exposure to literacy in a motivating context may influence reading and writing skills in beginning readers. We assume that small class size could give teachers the opportunity to create more motivational literacy activities and to monitor and manage small groups of children easily. Finally, small class size could impact both reading motivation and reading and spelling skills.

Some other factors influencing early literacy skills

Early schooling could be a condition that allows young children to further develop their social knowledge and their language and cognitive skills. After controlling for parents' socio-economic status, Florin (2000) found evidence that children who attended kindergarten at two years of age performed better in language and cognitive tasks than children who attended kindergarten later. Thus, early schooling could also help enhance literacy skills in first graders. Moreover, given that some French studies have demonstrated an impact of age on literacy skills in first grade (Florin, Cosnefroy, & Guimard, 2004), we expected that children born at the beginning of the school year would exhibit better literacy skills. However, this would only be the case in normal classes, not in small classes because of the numerous, targeted interventions by teachers who would even be able to help the younger children. Consequently, small classes could reduce individual differences and could cancel out the impact of the factors of early schooling and quarter of birth, and even of socio-economic status and first language.

In fact, when children learn to read and spell in a language with which they are not very familiar, we might assume that some learning difficulties arise because the relations between oral and written language are evident in the alphabetic code. We therefore expected to observe a difference in literacy skills between beginning readers with French first language and those whose first language was not French. Finally, socio-economic status (SES) is well known to be associated with literacy skills. In an early study, it was shown that low socio-economic status is linked to poor reading achievement (Davie, Butler, & Goldstein, 1972) even if this relation may be explained by causal factors such as the lower frequency of reading activities at home (Adams, 1990) or lower levels of phonological awareness (Bowey, 1995; Lonigan, Burgess, Anthony, & Barker, 1998). A more recent study has provided evidence of an effect of SES on letter knowledge, on familiar word reading and on non-word reading, mainly in first grade (Duncan & Seymour, 2000).

The general hypothesis is that small class size allows teachers to interact more with all their pupils and that they might also be able to target their interventions in literacy on specific needs observed in certain children. Several questions are addressed here. Is there any impact of class size on literacy skills and literacy interest during first grade? We expected class size to have an effect on literacy skills (reading and spelling) and on children's literacy interest given that teachers in small classes could help all the children to master the alphabetic code and to modify their motivation for reading and writing. In the French curriculum, some children repeat the first grade when they have major reading and spelling difficulties. How, in small classes, do literacy skills in the two populations (children with normal age and those repeating a year) evolve? Could small class size have any specific effect on the development of literacy skills in children with literacy disabilities? Another question relates to the possible impact of class size at the end of first grade on different factors such as early schooling, age, first language and socio-economic status.

Method

Participants

The class size reduction was not randomly distributed across the general population of French first graders. In fact, the French government would only conduct the experiment in areas exhibiting a variety of social difficulties, such as lower socio-economic status, unemployment, disrupted families, etc. ... i.e., so-called "Zones d'Education Prioritaire" (zones with specific educational needs). In the classes in these areas with very poor results in national third grade testing, at least half of the pupils' scores were in the bottom 20%. However, the random procedure for the experiment applied specifically to these areas in different regions. Teachers and classrooms were first assigned randomly to small and large sizes, then pupils assigned randomly to teachers. In fact, children in normal classes (with 20–25 pupils, control group) were randomly chosen to be compared to those in classes of small size (experimental group). These latter classes had no more than 12 pupils. One hundred classes in each condition distributed throughout different regions of France participated in this research. The education authorities were committed to this experiment and teachers participated in assessing children on literacy skills and literacy interest. Data were obtained from 570 children in the experimental group and 622 children in the control group, i.e., 1192 children subdivided into 1095 of normal age (mean age: 80.5 months; range 72–86) and 97 older pupils repeating a year (mean age: 91.5 months; range: 87–97).

Children were administered pre-tests at the beginning of school year (October) to assess phonological skills (PS), language comprehension (LC) and pre-reading skills (PrS; alphabet knowledge and high-frequency words recognition) which are good indicators for reading and spelling outcomes. A composite score (PS+LC+PrS) was calculated to assess initial literacy skills and then to compare experimental groups and control groups in different conditions examined further (see Part 2 of Results). [Table 1](#)

shows that experimental and control groups could be considered relatively “homogeneous” because they never differed significantly on initial literacy skills.

Before examining the possible impact of the four factors on reading and spelling performances during the second half of school year, we analysed their impact on initial literacy skills assessed in October. We observed no effect of age and early schooling ($p > 0.05$), an effect of quarter of birth, $F(3, 877) = 14.08$, $p < 0.0001$, $\eta^2 = 0.05$, scores decreased from QB1 to QB4 (26.6, 26.2, 24.4, 23.1), an effect of first language, $F(1, 879) = 52.02$, $p < 0.0001$, $\eta^2 = 0.06$, children with French as first language outperformed those without French as first language (26.2 vs. 23), an effect of socio-economic status, $F(3, 877) = 14.08$, $p < 0.0001$, $\eta^2 = 0.03$, scores decreased from SES1 to SES4 (29.9, 26.2, 25, 23.8).

Design and materials

Literacy skills

The children were assessed twice, in February–March and in June, on the basis of two literacy tasks. First, a spelling task was administered. The children had to write the word underneath a picture named by the teacher. In the first session, 12 words with a high frequency index (Novlex, Lambert & Chesnet, 2001) were presented, 4 with a CV structure in the spoken language (e.g.: *main*, hand), 4 with a CVCV structure (e.g.: *lapin*, rabbit) and 4 with a CCVC structure (e.g.: *fleur*, flower) (see Appendix A). For this task, we calculated a composite score – which we refer to as the “phonological recoding” score – which comprises both orthographically correct (e.g. *main*) and phonologically correct (e.g. *min*) responses (max: 12). We observed an internal consistency reliability alpha of 0.65. In the written word recognition task, the same words were proposed. The children had to find the target word in a list of 4 items consisting of the orthographically correct word (e.g., *lapin*), and 3 pseudowords, namely a homophone (*lapain*), a visually similar item (*lapiu*), and an item sharing the same initial letters (*lacet*). We consider only the orthographically correct responses ($\alpha = 0.79$).

In the second session, 12 additional target words with low frequency and the same syllabic structure as the first 12 items were proposed (see Appendix A) in the two literacy tasks. Again, the dependent variables were orthographically correct responses in the reading task ($\alpha = 0.81$) and phonological recoding scores in the spelling task ($\alpha = 0.91$) (max: 24).

Literacy interest

Five questions about literacy and five questions about game-like activities were proposed in session 2 (see Appendix B). The children had to indicate on a Likert scale whether or not they liked the described situation. The observed internal consistency reliability alphas were 0.61 for answers to the literacy items and 0.59 for answers to game-like items. The indicator of literacy interest was the difference between the total satisfaction score in literacy situations and the total satisfaction score in game-like situations. When this difference was positive ($\geq +3$), we considered literacy interest to be high (group LI+), with the children preferring literacy activities. When the difference was negative (≤ -3), we considered it to be low (group LI-). In this

Table 1

Mean performances (max=40), standard deviations, and sample size at session 0 (October) in initial literacy skills (composite score: phonological skills+language comprehension+pre-reading skills) for different groups, and with *p* after *t*-tests (at 0.05 level)

		Experimental group	Control group	<i>p</i>
Total	M	25.22	24.92	ns
	S.D.	(6.21)	(6.52)	
	<i>n</i>	570	622	
<i>Age</i>				
Normal age	M	25.11	24.94	ns
	S.D.	(6.27)	(6.53)	
	<i>n</i>	572	523	
Repeating a year	M	26.45	24.72	ns
	S.D.	(5.48)	(6.49)	
	<i>n</i>	50	47	
<i>Early schooling</i>				
ES 2 years old	M	25.87	25.29	ns
	S.D.	(6.14)	(6.6)	
	<i>n</i>	161	87	
ES 3 years old	M	24.94	24.92	ns
	S.D.	(6.13)	(6.86)	
	<i>n</i>	330	293	
<i>Quarter of birth</i>				
QB 1	M	26.75	26.44	ns
	S.D.	(5.78)	(7.23)	
	<i>n</i>	135	103	
QB 2	M	26.05	26.33	ns
	S.D.	(6.74)	(7.36)	
	<i>n</i>	113	88	
QB 3	M	24.69	24.07	ns
	S.D.	(6)	(6.22)	
	<i>n</i>	128	105	
QB 4	M	23.4	22.8	ns
	S.D.	(5.73)	(5.77)	
	<i>n</i>	120	89	
<i>First language</i>				
French speaking	M	26.59	25.82	ns
	S.D.	(5.63)	(6.72)	
	<i>n</i>	296	282	
No French speaking	M	23.26	22.49	ns
	S.D.	(6.41)	(6.54)	
	<i>n</i>	200	103	
<i>Socio-economic status</i>				
SES 1	M	30	29.75	ns
	S.D.	(7.4)	(9.02)	
	<i>n</i>	12	16	
SES 2	M	27.02	25.02	ns
	S.D.	(6.24)	(6.08)	
	<i>n</i>	81	70	

Table 1 (continued)

		Experimental group	Control group	<i>p</i>
<i>Socio-economic status</i>				
SES 3	M	25.1	24.82	ns
	S.D.	(5.94)	(6.88)	
	<i>n</i>	291	235	
SES 4	M	23.85	23.84	ns
	S.D.	(6.13)	(6.38)	
	<i>n</i>	112	64	

condition, children indicated their preference for other activities such games rather than literacy. From the sample of 1192 subjects, 482 normal-aged children¹ were selected using these criteria.

Results

Initially (Part 1), we examined the change in performances between the two sessions on the basis of the scores obtained on the same 12 words used in the reading and spelling tasks. Next (Part 2), the performances of normal-aged children who provided complete data were analysed on the 24 words proposed in the June session.

Part 1

First, analyses were conducted for the 1192 subjects. The data are presented in Table 2. Two separate multivariate analyses of covariance (MANCOVAs) were carried out on the scores in the reading task (orthographically correct responses) and the spelling task (phonological recoding scores) with two between-factors, Age (normal age vs. repeating a year), Class (experimental vs. control), one within-factor, Session (sessions 1 and 2) and initial literacy skills assessed in October as covariates.

In the reading task, we observed a significant² effect of Session, $F(1, 1187)=33.98$, $p<0.0001$, $\eta^2=0.03$, with higher performances in session 2 (7.87) than in session 1 (6.29) and a significant effect of Age, $F(1, 1187)=7.36$, $p<0.007$, $\eta^2=0.01$, with better performances for normal-aged children (7.11) than for children repeating a year (6.62). The interaction Session*Age, $F(1, 1187)=11.85$, $p<0.001$, showed that normal-aged children made more progress between session 1 and session 2 than children repeating a year (+1.64 vs. +0.79). In the spelling task, we observed an effect of Age, $F(1, 1187)=20.08$, $p<0.0001$, $\eta^2=0.02$, with normal-aged children outperforming children who were repeating a year (6.29 vs. 5.1), and an effect of session, $F(1, 1187)=38.26$,

¹ Because there were too few children repeating a year in the two conditions LI+ and LI- across the groups, their results were discarded.

² Only significant effects at 0.05 will be presented and effect size (with eta squared) will be given only for main effects.

Table 2

Mean performances (max=12), standard deviations, and sample size in the reading and spelling tasks as a function of Session (March vs. June, s1/s2), Age (normal-aged vs. repeating-a-year, NA/Ry), and Class (Experimental vs. Control)

		Experimental				Control			
		Reading		Spelling		Reading		Spelling	
		s1	s2	s1	s2	s1	s2	s1	s2
NA	M	6.32	8.1	5.29	8	6.25	7.76	4.67	7.2
	S.D.	(2.77)	(2.77)	(3.79)	(3.83)	(3.02)	(3.05)	(3.84)	(4.09)
	<i>n</i>	572				523			
RY	M	6.46	7.36	4.42	6.06	6	6.68	4.19	5.72
	S.D.	(3.01)	(2.99)	(3.22)	(3.52)	(2.9)	(3.18)	(3.57)	(4.22)
	<i>n</i>	50				47			

$p < 0.0001$, $\eta^2 = 0.03$, with higher performances in session 2 (6.75) than in session 1 (4.64). The interaction Session*Age, $F(1, 1187) = 12.22$, $p < 0.0001$, showed that normal-aged children made more progress between session 1 and session 2 than children repeating a year (+2.62 vs. +1.58).

To examine the effect of Literacy Interest in the 482 normal-aged children, two MANCOVAs were conducted on the scores in the reading and spelling tasks with two between-factors, Literacy Interest (low vs. high), Class (experimental vs. control), one within-factor, Session (sessions 1 and 2) and initial literacy skills assessed as covariates. The main effect of literacy interest and the interactions with this factor are only reported. The data are presented in Table 3.

No effect of literacy interest was found. In the reading task, the analysis revealed a Literacy Interest*Session interaction, $F(1, 477) = 4.15$, $p < 0.04$. It was due to the greater difference in session 2 between children with LI+ and those with LI- (+0.68) rather than to the difference between these two groups in session 1 (+0.23). In the spelling task, the analysis revealed again a Literacy Interest*Session interaction, $F(1, 477) = 4.01$, $p < 0.05$. It was due to the greater difference in session 2 between children with LI+ and those with LI- (+0.88) rather than to the difference between these two groups in session 1 (+0.35).

Table 3

Mean performances (max=12), standard deviations, and sample size of normal-aged children in the reading and spelling tasks as a function of Session (March vs. June, s1/s2), Literacy Interest (high vs. low, LI+/LI-), Class (Experimental vs. Control), with number of children in each group (*N*)

		Experimental				Control			
		Reading		Spelling		Reading		Spelling	
		s1	s2	s1	s2	s1	s2	s1	s2
LI+	M	5.69	7.81	4.39	7.55	6.69	8.36	5.4	8.21
	S.D.	(2.88)	(2.83)	(3.48)	(4.01)	(2.74)	(2.7)	(3.78)	(3.71)
	<i>n</i>	85				97			
LI-	M	6.23	7.71	5.2	7.79	5.69	7.13	3.87	6.21
	S.D.	(2.77)	(2.81)	(3.95)	(3.72)	(3)	(2.99)	(3.78)	(4.19)
	<i>n</i>	164				136			

Table 4

Mean performances (max=24, and standard deviations) in the reading and spelling tasks as a function of early schooling (children aged 2 and 3 years in preschool), quarter of birth (first, second, third and fourth), first language (French vs. no French as first language) and socio-economic status (from high to low, 1 to 4)

		Experimental		Control	
		Reading	Spelling	Reading	Spelling
<i>Early schooling^a</i>					
ES 2 years old	M	15.78	16.08	15.15	14.1
	S.D.	(4.63)	(6.81)	(5.52)	(6.88)
	<i>n</i>	161		87	
ES 3 years old	M	15.4	15.06	14.58	13.6
	S.D.	(4.93)	(7.34)	(5.56)	(7.79)
	<i>n</i>	330		293	
<i>Quarter of birth</i>					
QB 1	M	16.41	16.21	15.47	15.35
	S.D.	(4.44)	(6.72)	(5.75)	(7.35)
	<i>n</i>	135		103	
QB 2	M	15.81	15.7	15.98	15.26
	S.D.	(5.08)	(7.5)	(4.99)	(6.98)
	<i>n</i>	113		88	
QB 3	M	15.02	14.78	14.13	12.35
	S.D.	(4.74)	(7.09)	(5.49)	(8.04)
	<i>n</i>	128		105	
QB 4	M	14.83	14.92	13.12	17.7
	S.D.	(5.04)	(7.48)	(5.59)	(7.28)
	<i>n</i>	120		89	
<i>First language</i>					
French	M	15.99	16.5	14.85	13.72
	S.D.	(4.42)	(6.81)	(5.39)	(7.59)
	<i>n</i>	296		282	
No French	M	14.86	13.8	14.2	13.51
	S.D.	(5.35)	(7.44)	(6.01)	(7.68)
	<i>n</i>	200		103	
<i>Socio-economic status^b</i>					
SES 1	M	18.33	20.25	17.62	18.56
	S.D.	(2.42)	(4.75)	(5.04)	(6.67)
	<i>n</i>	12		16	
SES 2	M	16.64	17.65	14.64	13.09
	S.D.	(5)	(6.94)	(6)	(7.53)
	<i>n</i>	81		70	
SES 3	M	15.67	15.47	14.75	13.46
	S.D.	(4.65)	(6.99)	(5.38)	(7.51)
	<i>n</i>	291		235	
SES 4	M	14.07	13.12	13.71	13.82
	S.D.	(5.06)	(7.37)	(5.72)	(7.99)
	<i>n</i>	112		64	

^a Ten children who had never attended preschool were omitted from the sample of 881 subjects providing complete data in June.

^b Socio-economic status was assessed on the basis of the parent with the higher professional level. SES1 consists of medical professions, lawyers, senior managers, and university teachers, SES2 of shopkeepers, schoolteachers, SES3 of industrial laborers, and SES4 of unemployed, cleaners.

Part 2

In June, we examined the effect of class size in the two tasks using two-way analyses of covariance (ANCOVAs) with initial literacy skills as covariates. We then performed these analyses to examine the main effects of the factors (early schooling, quarter of birth, first language, socio-economic status) and their possible interaction with the Class factor. The data are presented in Table 4.

As far as the Class factor (experimental vs. control) is concerned, we observed a significant effect on the performances in the reading task, $F(1, 878)=5.89$, $p<0.015$, $\eta^2=0.01$, and in the spelling task, $F(1, 878)=13.37$, $p<0.0001$, $\eta^2=0.01$. The experimental group outperformed the control group in reading (15.53 vs. 14.68) and in spelling (15.41 vs. 13.67). The covariates explained 29% of variance of reading scores and 28% of variance of spelling scores.

No significant effects of early schooling and of quarter of birth were found in reading or in spelling ($p>0.10$).

The population was divided into two groups consisting of children who had French as their first language, on the one hand, and children for whom French was not the first language on the other. With spelling scores, ANCOVA with first language (L) and class as between-factors (C), and initial literacy skills as covariates showed a significant interaction $L*C$, $F(1, 876)=7.39$, $p<0.007$. Post hoc comparisons (Tukey) showed that this interaction was due to the significant difference between the two groups in the experimental classes as a function of first language (16.5 for French vs. 13.81 for not French, $p<0.0001$). For children in the control group, the difference between the two groups “French first language” and “not French” was not significant (13.72 vs. 13.51).

Finally, an ANCOVA was conducted on each dependent variable for literacy skills with the SES (from highest level 1 to lowest level 4) and Class (experimental vs. control) as between-factors and initial literacy skills as covariates. In spelling, a significant Class * SES interaction, $F(3, 872)=3.09$, $p<0.026$, was observed. Post hoc comparisons (Tukey) showed that this was due to the greater difference between the experimental group and the control group in SES2 (17.65 vs. 13.09, $p<0.0002$) and SES3 (15.47 vs. 13.46, $p<0.006$), with the experimental group achieving the better performances. The differences for SES1 and SES4 were not significant. In the experimental group, the differences between the four SES values were more marked than in the control group (no significant differences between SES2, SES3, SES4).

Conclusion

The analyses conducted in Part 1 examined the development of literacy skills during the second half of first grade using the same 12 words in a forced-choice reading task and in a spelling task. As expected, performances in reading and in spelling increased considerably. However, this development was less marked in children who were repeating a year. More importantly, these initial results did not indicate any effect of class size. An effect of “age” was observed, with the older children who were repeating a year, i.e., who were suffering from major literacy difficulties, still obtaining significantly lower reading and spelling

scores than the normally aged children. Moreover, when literacy interest factor was introduced in the analyses, an interaction Literacy interest*Session was observed indicating that normal-aged children made more progress than children repeating a year in reading and spelling during the second half of school year.

The second set of analyses was carried out to examine the possible impact of different factors on literacy skills at the end of the school year using the same 24 words in the two tasks. These revealed an effect of class in the reading and spelling tasks in favour of the experimental group, i.e., of the small classes. However, the size of this effect was small (1% variance explained).

No effect of early schooling and quarter of birth was observed neither in reading nor in spelling. In the reading task, no effect of first language and socio-economic status was found. In the spelling task only, we observed a Class*First Language interaction showing that only experimental group children with French as first language outperformed their peers without French as first language. Again in spelling, the Class*SES interaction revealed a differential effect of SES. In fact, for the SES2 and SES3 children, the differences between the two experimental and control groups were greater than for the children from SES1 and SES4.

Discussion

The purpose of this study was to investigate the possible effect of small classes as of first grade when children are confronted with the formal teaching of reading and writing. It should be remembered here that the sample was taken only from areas with specific educational needs. Children were randomly assigned to experimental and control classes (without the intervention of the parents or education authorities), thus preventing the type of major methodological bias that has been identified in other studies.

The recurrent question motivating this study is: can a substantial reduction in the size of first grade classes facilitate written language learning? In other words, can this type of educational procedure improve performances in the two fundamental components of reading and writing, i.e., the identification and production of written words? Given the results presented above, the answer is clear: YES. We found a significant effect of class to the benefit of the experimental group, that is to say that the performances observed in the small classes were better than those found in the control group (normal-sized classes). However, this confirmation has to be stated with caution on two counts: on the one hand because, as mentioned, the size of the effect was small, and on the other, because the effect of class factor did not appear in the initial analyses using 12 words for the two variables – reading and spelling – that express the level of the basic literacy skills.

What is the specific impact of the small classes? We have provided a number of answers to this second question. We have seen that the level of interest had no effect on written word identification and production performances. Another result shows that when interest in reading is high, children's performances improve more quickly than when it is low.

Children who are repeating a year advance less than normally aged children during the first half of first grade. We may therefore wonder what effect repeating a year has on children with learning difficulties.

Of the four factors that we used in order to examine the possible specific impact of small classes, two of them, early schooling and quarter of birth, did not affect reading and writing performances. In effect, whatever the age at which the children entered preschool and whatever their quarter of birth, there was no significant difference in their performances at the end of first grade. This absence of any effect runs counter to results obtained in other studies which show that children who enter kindergarten at a young age do better in first grade (Florin, 2000; Jones, Gullo, Burton-Maxwell, & Stoiber, 1998). However, the effect of quarter of birth was present at the beginning of school year on initial literacy skills. We observed also the impact of initial literacy skills which explained around 30% of variance of reading and spelling scores at the end of school year.

The other two variables, first language and socio-economic status, that we examined revealed only an interaction with the factor of “class” on spelling performances. For the factor of “first language”, we observed an effect in the experimental classes, with children who had French as their first language achieving better spelling performances. For the other children, class size had no significant effect. This means that small classes only benefit some children, i.e., those who are learning to read in their first language.

The same phenomenon is observed in connection with socio-economic status. The interaction Class * Socio-economic status shows the children coming from the middle socio-economic brackets (SES2, 3) benefited most from attending small classes. In other words, and contrary to the results of other studies (Finn & Achilles, 1999; Molnar et al., 1999; Mosteller, 1995), the small classes in our study did not help the children from the lowest socio-economic level or the disadvantaged pupils (without French as first language, repeating a year).

To summarize, the object of our study (smaller classes) most specifically improved performances in two types of population: children whose first language is French and children from intermediate (tradespeople, shopkeepers) and average (employees, labourers) socio-economic brackets. This means, in contrast, that neither the children from the most disadvantaged backgrounds nor the children whose first language was not French benefited from the use of smaller first grade classes. This represents a significant limitation to this mechanism.

Despite this limitation, how can we explain the observed increase in literacy skills in small classes? It has been noted that pupils in large classes are less attentive, more off-task (Blatchford, Bassett et al., 2003; Blatchford, Edmonds, & Martin, 2003). In smaller classes, the quantity and quality of pupil–teacher interactions are different. Teachers can spend more time with children in need of special help, give them more immediate feedback and offer individualized supports for learning (Blatchford, Moriarty et al., 2002; Haughey, Snart, & da Costa, 2003). The teacher–pupil interactions are more pleasant and less conflictual, thus creating a more effective working environment. This greater quantity of interactions and greater focus by the teachers vis-à-vis their pupils might thus help encourage the pupils in their schoolwork and motivate them more in learning to read and write. In our study, we have not reported any observations concerning classroom processes, teaching styles, or teacher–pupil interactions. This

constitutes an important limitation in explaining the beneficial, but certainly small, effect of smaller classes.

Moreover, the pupils' engagement may be the key to why small classes work better (Finn & Achilles, 1999; Finn, Panno, & Achilles, 2003). Finn et al. (2003) have written an excellent review of the research on the effects of class size on pupils' engagement in learning. They suggest that the positive effect of small classes on academic performance is due to an increase in pupil engagement (time on task, attentiveness, active participation, effort and initiative-taking). Furthermore, the authors think that in small classes there is less anti-social behaviour (opting out, distracting others) and more pro-social behaviour (following rules, positive interactions with teacher and supporting contributions of peers). Finally, these authors introduced four mechanisms to explain why small classes affect pupils' academic and social engagement (p. 351), (1) the "diffusion of responsibility" (individuals in a larger group tend to feel less of a responsibility to participate), (2) "group cohesiveness" (in smaller groups, contributions are more highly valued and are thus more rewarding), (3) the "social loafing" (individuals who are part of a larger group put in less effort than individuals in smaller groups) and (4) the "sense of belonging" (the psychological sense of community increases in small classes). However, we think that these social mechanisms should be the subject of experimental investigations in this kind of educational research.

If, as would appear evident, to read is to understand and to write is to communicate, the underlying cognitive processes involved in these two activities are those mobilized during the identification and production of written words. Equally, illiteracy in these respects is simply the behavioural reflection of major cognitive deficiencies in the processing of written language. We can therefore claim that our study has provided a number of answers in the field of the prevention of illiteracy via the processes involved as of the very beginning of the learning of the alphabetic code. Finally, the very great reduction in class size (classes with a maximum of 12 pupils) brings only a limited benefit, on the one hand in terms of performance and, on the other, only in certain populations since the very disadvantaged children in our study benefited not at all or only slightly from this arrangement.

In our opinion, the prevention of academic problems and illiteracy requires the implementation of a regular diagnostic process at an early age in order to indicate the need for remedial intervention adapted to the child's level of difficulties, age and experience. A number of potential avenues have already been outlined. For example, interventions targeting phonological skills (Torgesen, 2002), teaching procedures that create a motivational context (Tracey & Morrow, 1998), and educational software that focuses on reading (Chera & Wood, 2003; Magnan & Ecalle, 2006; Magnan, Ecalle, Veuillet, & Collet, 2004) all help, to some extent, combat the difficulties involved in learning to read and write. The establishment of smaller classes represents an additional method for the prevention of reading failure that could be used to target certain populations of children in that it permits focused interventions on the part of the teachers. However, if smaller classes are to be effective, teachers must also be trained in the appropriate management of this type of class (Blatchford, Moriarty et al., 2002).

Finally, we still need to examine the medium-term effect of smaller classes on the acquisition of reading and writing within the framework of a longitudinal study. Such a study is currently being undertaken.

Acknowledgements

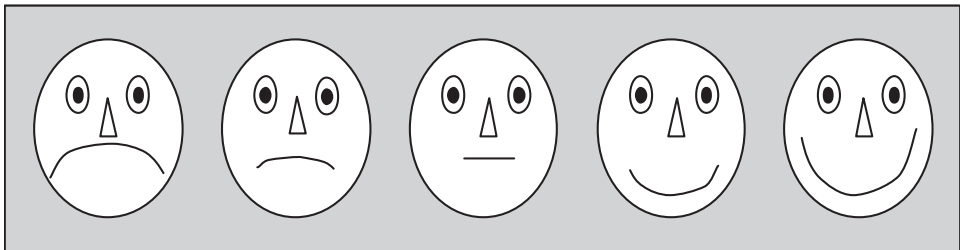
This research was supported by a research grant (2003–2005) from the French Ministry of Education (Ministère de la Jeunesse, de l’Éducation nationale et de la Recherche). We thank J. Levasseur and the staff of the “Direction de l’Évaluation et de la Prospective” (DEP-MJENR) for their valuable cooperation.

Appendix A. Items used in the spelling and reading tasks

	High frequency	Low frequency
CV (3–4 letters)	main feu jeu cou	pain chou seau vin
CVCV (5–6 letters)	maison chemin lapin cadeau	raisin landau bidon requin
CCVC (5–6 letters)	fleur plume cloche brosse	treize frite globe glace

Appendix B. Faces proposed as responses to the literacy interest questionnaire

1 2 3 4 5



Notes: The children had to circle the face corresponding to their choice: not at all happy (1), not happy (2), no affect (3), happy (4), very happy (5).

Questions about literacy.

You are at the public library: how do you feel about it?

You receive a book as a gift: how do you feel about it?

You learn to read: how do you feel about it?

You look at books with your friends: how do you feel about it?

You look at books: how do you feel about it?

Questions about game-like activities.

You play with a ball: how do you feel about it?

You go to the swimming pool: how do you feel about it?

You receive a racket as a gift: how do you feel about it?

You go cycling: how do you feel about it?

You play ball with your friends: how do you feel about it?

References

- Adams, M. J. (1990). *Beginning to read. Thinking and learning about print*. Cambridge, MA: MIT Press.
- Baker, L., & Wigfield, A. (1999). Dimensions of children's motivation for reading and their relations to reading activity and reading achievement. *Reading Research Quarterly*, 34(4), 452–477.
- Bennett, N. (1998). Annotation: Class size and the quality of educational outcomes. *Journal of Child Psychology and Psychiatry*, 39, 797–804.
- Blatchford, P., Bassett, P., Goldstein, H., & Martin, C. (2003). Are class size differences related to pupils' educational progress and classroom processes? Findings from the Institute of Education Class Size Study of children aged 5–7 years. *British Educational Research Journal*, 29(5), 709–730.
- Blatchford, P., Edmonds, S., & Martin, C. (2003). Class size, pupil attentiveness and peer relations. *British Journal of Educational Psychology*, 73, 15–36.
- Blatchford, P., Goldstein, H., Martin, C., & Browne, W. (2002). A study of class size effects in English school reception year classes. *British Educational Research Journal*, 28(2), 169–185.
- Blatchford, P., Goldstein, H., & Mortimore, P. (1998). Research on class size effects: A critique of methods and a way forward. *International Journal of Educational Research*, 29, 691–710.
- Blatchford, P., Moriarty, V., Edmonds, S., & Martin, C. (2002). Relationships between class size and teaching: A multi-method analysis of English infant schools. *American Educational Research Journal*, 39(1), 101–132.
- Bowey, J. A. (1995). Socio-economic status differences in preschool phonological sensitivity and first-grade reading achievement. *Journal of Educational Psychology*, 87, 476–487.
- Bradley, L., & Bryant, P. E. (1983). Categorizing sounds and learning to read: A causal connection. *Nature*, 301, 419–421.
- Castles, A., & Coltheart, M. (2004). Is there a causal link from phonological awareness to success in learning to read? *Cognition*, 91, 77–111.
- Chera, P., & Wood, C. (2003). Animated multimedia “talking books” can promote phonological awareness in children beginning to read. *Learning and Instruction*, 13, 33–52.
- Davie, R., Butler, N., & Goldstein, H. (1972). *From birth to seven: A report of the national child development study*. London: Longman.
- Duncan, L. G., & Seymour, P. H. K. (2000). Socio-economic differences in foundation-level literacy. *British Journal of Psychology*, 91, 145–166.
- Ehrenberg, R. G., Brewer, D. J., Gamoran, A., & Willms, J. D. (2001). Class size and student achievement. *Psychological Science in the Public Interest*, 2, 1–30.
- Finn, J. D., & Achilles, C. M. (1999). Tennessee's class size study: Findings, implications, misconceptions. *Educational Evaluation and Policy Analysis*, 21(2), 97–109.
- Finn, J. D., Pannozzo, G. M., & Achilles, C. M. (2003). The “whys” of class size: Student behavior in small classes. *Review of Educational Research*, 73(3), 321–368.
- Florin, A. (2000). *La scolarisation à deux ans et autres modes d'accueil [Schooling of 2 y-o children in kindergarten and others types of children reception]*. Paris: Editions INRP.
- Florin, A., Cosnefroy, O., & Guimard, P. (2004). Trimestre de naissance et parcours scolaire [Quarter of birth and scholastic trajectory]. *Revue Européenne de Psychologie Appliquée/European Review of applied Psychology*, 54(4), 237–246.

- Folger, J. (1989). Lessons for class size policy and research. *Peabody Journal of Education*, 67(1), 123–132.
- Fritjers, J. C., Barron, R. W., & Brunello, M. (2000). Direct and mediated influences of home literacy and literacy interest on prereaders' oral vocabulary and early written language skill. *Journal of Educational Psychology*, 92(3), 466–477.
- Goldstein, H., & Blatchford, P. (1998). Class size and educational achievement: A review of methodology with particular reference to study design. *British Educational Research Journal*, 24(3), 255–268.
- Goldstein, H., Yang, M., Omar, R., Turner, R., & Thompson, S. (2000). Meta-analysis using multilevel models with an application to the study of class size effects. *Journal of the Royal Statistical Society, Series C*, 49, 399–412.
- Hanushek, E. A. (1986). The economics of schooling: Production and efficiency in public schools. *Journal of Economic Literature*, 24, 1141–1177.
- Hanushek, E. A. (1999). Some findings from an independent investigation of the Tennessee STAR experiment and from other investigations of class size effects. *Educational Evaluation and Policy Analysis*, 21(2), 143–164.
- Harm, M. W., & Seidenberg, M. S. (1999). Phonology, reading acquisition, and dyslexia: Insights from connectionist models. *Psychological Review*, 106(3), 491–528.
- Haughey, M., Snart, F., & da Costa, J. (2003). Teachers' instructional practices in small classes. *Alberta Journal of Educational Research*, 49(2), 182–197.
- Jones, I., Gullo, D. F., Burton-Maxwell, C., & Stoiber, K. (1998). Social and academic effects of varying types of early schooling experiences. *Early Child Development and Care*, 146, 1–11.
- Krueger, A. B. (1999). Experimental estimates of education production functions. *Quarterly Journal of Economics*, 114, 497–532.
- Krueger, A. B. (2003). Economic considerations and class size. *The Economic Journal*, 113(483), 34–63.
- Krueger, A. B., & Whitmore, D. M. (2001). The effect of attending a small class in the early grades on college-taking and middle school results: Evidence from the Project STAR. *The Economic Journal*, 112, 1–28.
- Lambert, E., & Chesnet, D. (2001). Novlex: une base de données lexicales pour les élèves de primaire [NovLex: a lexical database for French elementary-school readers]. *L'Année Psychologique*, 101, 277–288.
- Lepola, J., Salonen, P., & Vauras, M. (2000). The development orientations as a function of divergent reading careers from pre-school to the second grade. *Learning and Instruction*, 10, 153–177.
- Lonigan, C. J., Burgess, S. R., Anthony, J. L., & Barker, T. A. (1998). Development of phonological sensitivity in 2- to 5-year old children. *Journal of Educational Psychology*, 90, 294–311.
- Magnan, A., & Ecalte, J. (2006). Audio-visual training in children with reading disabilities. *Computers and Education*, 46(4), 407–425.
- Magnan, A., Ecalte, J., Veuillet, E., & Collet, L. (2004). The effects of an audio-visual training program in dyslexic children. *Dyslexia*, 10(2), 131–140.
- Mishel, L., & Rothstein, R. (2002). *The class size debate*. Washington, DC: Economy Policy Institute (Available at <http://www.epinet.org>).
- Molnar, A., Smith, P., Zahorik, J., Palmer, A., Halbach, A., & Ehrle, K. (1999). Evaluating the SAGE program: A pilot program in targeted pupil–teacher reduction in Wisconsin. *Educational Evaluation and Policy Analysis*, 21(2), 165–177.
- Morais, J. (2003). Levels of phonological representation in skilled reading and in learning to read. *Reading and Writing*, 16, 123–151.
- Morais, J., Bertelson, P., Cary, L., & Alegria, J. (1986). Literacy training of speech segmentation. *Cognition*, 24, 45–64.
- Morais, J., Cary, L., Alegria, J., & Bertelson, P. (1979). Does awareness of speech as a sequence of phones arise spontaneously? *Cognition*, 7, 323–331.
- Mosteller, F. (1995). The Tennessee study of class size in the early school grades. *Critical Issues for Children and Youths*, 5(2), 113–127.
- NICHD. (2004). Does class size in first grade relate to children's academic and social performance or observed classroom processes? *Developmental Psychology*, 40(5), 651–664.
- Nye, B., Hedges, L. V., & Konstantopoulos, S. (1999). The long-term effects of small classes: A five-year follow-up of the Tennessee class size experiment. *Educational Evaluation and Policy Analysis*, 21(2), 127–142.

- Nye, B., Hedges, L. V., & Konstantopoulos, S. (2000). The effects of small classes on academic achievement: The results of the Tennessee class size experiment. *American Educational Research Journal*, 37, 123–151.
- Nye, B., Hedges, L. V., & Konstantopoulos, S. (2002). Do low-achieving students benefit more small class: Evidence from the Tennessee class size experiment. *Educational Evaluation and Policy Analysis*, 24(3), 201–221.
- Podmore, V. N. (1998). Class size in the first years at school: A New Zealand perspective on the international literature. *Journal of Educational Research*, 29, 711–721.
- Read, C., Zhang, Y., Nie, H., & Ding, B. (1986). The ability to manipulate speech sounds on knowing alphabetic spelling. *Cognition*, 24, 31–44.
- Rees, N. S., & Johnson, K. (2000). A lesson in smaller class sizes. *Heritage Views* [www.heritage.org/views/2000].
- Rutter, M., & Maugham, B. (2002). School effectiveness findings 1979–2002. *Journal of School Psychology*, 40, 451–475.
- Salonen, P., Lepola, J., & Niemi, P. (1998). The development of first graders' reading skill as a function of pre-school motivational orientation and phonemic awareness. *European Journal of Psychology of Education*, 13(2), 155–174.
- Torgesen, J. K. (2002). The prevention of reading difficulties. *Journal of School Psychology*, 40(1), 7–26.
- Tracey, D. H., & Morrow, L. M. (1998). Motivating contexts for young children's literacy development: Implications for word recognition. In J. L. Metsala, & L. C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 341–356). London: Erlbaum Ass.
- Wagner, R. K., & Torgesen, J. K. (1987). The nature of phonological processing and its causal role in the acquisition of reading skill. *Psychological Bulletin*, 101, 192–212.
- Wigfield, A., & Guthrie, J. T. (1997). Relations of children's motivation for reading to the amount and breath of their reading. *Journal of Educational Psychology*, 89(3), 420–432.