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Evaluating the predictive impact of an emergent literacy model on dyslexia in Italian children: a four-year prospective cohort study

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Abstract

The strong differences in manifestation, prevalence and incidence in dyslexia across languages invite studies in specific writing systems. In particular, the question of the role played by emergent literacy in opaque and transparent writing systems remains a fraught one. This research project tested, through a four-year prospective cohort study, an emergent literacy model for the analysis of the characteristics of future dyslexic children and normally-reading peers in Italian, a transparent writing system. A cohort of four-hundred and fifty children were followed from the last year of kindergarten to the third grade in their reading acquisition process. Dyslexic children were individuated (grade three) and their performances in kindergarten in textual competence, phonological awareness, and conceptual knowledge of the writing system were compared with a matched group of normally-reading peers. Results showed the predictive relevance of the conceptual knowledge of the writing system. The study's implications are discussed.

Keywords: dyslexia, predictors, prospective cohort study, emergent literacy, transparent writing system

Developmental dyslexia is a learning disorder affecting 3-17% of students (Barbiero, Lonciari, Montico, Monasta, Penge *et al.*, 2012; Zakopoulou, Anagnostopoulou, Christodoulides, Stavrou, Sarri *et al.* 2011). This striking variability in rates is still debated, and it emerges because the different orthographies characterizing languages determine differences in reading performances among dyslexics of different countries (Paulesu, Démonet, Fazio, McCrory, Chanoine, *et al.*, 2001). Dyslexia dramatically affects children's learning processes, because of the central role that reading plays in the acquisition of knowledge. It is, therefore, important to identify, as soon as possible, the predictors and risk factors of this disorder in order to intervene at the preschool stage (Snow, Burns & Griffin, 1998). This study investigates the characteristics of future dyslexic children and their normally-reading peers in the transition from emergent literacy to the formal learning of reading and writing in a transparent writing system.

Differences of dyslexia across writing systems

Developmental dyslexia is defined as a specific learning difficulty in reading (accuracy and fluency), that is unexpected in relation to an individual's cognitive abilities (British Dyslexia Association, 2007). Dyslexia has been found in all transparent writing systems (letters correspond almost 1:1 with sounds) and opaque writing systems (the correspondence between letters and sounds is not 1:1). Examples of the former are: Greek (Zakopoulou *et al.* 2011), Finnish (Lyytinen, Ahonen, Eklund, Guttorm, Kulju, *et al.* 2004), and Italian (Zoccolotti, De Luca, Di Pace, Judica, Orlandi, *et al.*, 1999). English, meanwhile, is the most important example of an opaque writing system (Scarborough, 1990).

Dyslexia is considered a neurological disorder with relevant variations. Indeed, both neurological studies (Helmuth, 2011; Paulesu, *et al.*, 2001), and studies on familial factors (Lyytinen *et al.* 2004; Muter & Snowling, 2009) show the universality of dyslexia. Whereas

the differences in prevalence and manifestation confirm dyslexia's language-bound nature (Helmuth, 2011; Paulesu *et al.*, 2001). For instance, Lindgren, De Renzi and Richman (1985) reported a stronger prevalence of dyslexia in US children (12%) than among Italian children (8%). Neither, is there agreement on the prevalence of this disorder in a specific language (Barbiero *et al.*, 2012).

While it is widely accepted that the development of dyslexia is, in great part, language-related, there is no consensus as to what kind of linguistic deficit leads to a reading disorder (Lyytinen *et al.*, 2004). Many scholars agree in placing phonological awareness in different languages at the core of developmental dyslexia (Caravolas, Volìn & Hulme, 2005; Goswami, Wang, Cruz, Fosker, Mead & Huss, 2011; Ziegler, Bertrand, Tòth, Csépe, Reis *et al*., 2010; Ziegler & Goswami, 2005). However, languages change drastically in terms of whether phonology is encoded or decoded, and this has an influence on the manifestation of dyslexia. Landerl, Ramus, Moll, Lyytinen, Leppanen *et al.* (2012) assessed the same group of predictors in dyslexic children speaking different languages, in terms of orthography depth. They found that the characteristics of the specific writing systems exacerbate some symptoms of dyslexia. The problem is, as Share (2008) noted, that most research on dyslexia is English-based. Results, therefore, are difficult to apply to transparent writing systems.

Phonological awareness is defined as the ability to identify and manipulate units of sound. From this general definition, phonological awareness can have different forms, corresponding to the different ways in which a word can be sub-divided into sound units (phonemes, syllables, rhymes, alliterations, and the like). Also, when children are phonologically processing a word, they implement several different abilities (synthesis, analysis, comprehension, production, *inter alia*). Several studies have analyzed this construct with the following tasks:

- elisions of sounds, in which children have to individuate a sound pronounced by the experimenter and eliminate it from the word (see Bruce, 1964)
- one-to-one correspondence, in which children are asked to tap for every phoneme or syllable they can identify in a word (see Liberman, Shankweiler, Fisher & Carter, 1974)
- recognition of rhyme and alliteration, in which the child has to individuate the same unit of sound at the beginning or at the end of different words (see Lenel & Cantor, 1981).

A few studies have also explored implicit forms of phonological awareness, that do not require deliberate control during the performance:

- sensitivity to the phonological properties of a word, in which children have to substitute a phoneme with another one (see Carlson & Anisfeld, 1969) or where they are asked to write as best they could (see Tolchinsky-Landsmann & Levin, 1987);
- segmentation of sounds, in which children are asked to repeat only a part of the words or sentences pronounced by the experimenter (see Fox & Routh, 1975);
- judgment of relative length, in which children have to recognize and produce examples of long and short words (see Sinclair & Berthoud-Papandropoulou, 1978);
- production of rhymes and alliterations, in which children listen to rhymes and alliterations and are then asked to produce something similar (see Dowker, 1989).

Opaque orthographies, such as English, make use of grapheme phoneme translation to recognize less reliable words. Transparent languages, meanwhile, provide isomorphism between code and phonemic spelling: i.e. there is a direct and unambiguous phoneme-grapheme and grapheme-phoneme correspondence. By contrast, a deep orthography, provides an ‘opaque’ relationship between the pronunciation of the sound and its spelling: the same

letter can represent different phonemes, depending on the context in which it is located or different letters may represent the same phoneme. The conquest of grapheme-to-phoneme and phoneme-to-grapheme automation naturally occurs more slowly (Seymour, Aro & Erskine, 2003).

The contribution of phonological ability to reading acquisition (Landerl & Wimmer, 2000; Share, 2008; Ziegler *et al.*, 2010) in both opaque and transparent writing systems, and on dyslexia in opaque writing systems (Boets, de Smedt, Cleuren, Vandewalle, Wouters *et al.*, 2010), in particular English (Scarborough, 1990) is acknowledged. However, there is less agreement on the role that this component plays in the development of dyslexia in transparent writing systems.

Given this, a predictive study of dyslexia that analyzes the role that children's early skills play in the development of a reading disability would be extremely useful (Goswami, 2008). With such a study it should be possible to understand whether phonological awareness is a predictor or a consequence of dyslexia.

Previous research on reading has indicated the best predictors: letter knowledge, phonological awareness and rapid automatized naming (Boets *et al.*, 2010; Landerl *et al.*, 2012); verbal learning, verbal memory (Torppa, Lyytinen, Erskine, Eklund & Lyytinen, 2010); and short-term memory, pseudo-word or non-word repetition, and expressive vocabulary (Puolakanaho, Ahonen, Aro, Eklund, Leppanen *et al.*, 2008). Predictive studies can be conducted at any stage of development. However, to untangle phonological awareness from other influences from the formal acquisition of reading, it is important to analyze the skills, knowledge, and attitudes of pre-readers.

Among predictors of reading there are many varied components, which an emergent literacy construct helps to systematize (Lonigan, Burgess & Anthony, 2000; Pinto, Bigozzi,

Accorti Gamannossi & Vezzani, 2009; Whitehurst & Lonigan, 1998).According to Lonigan *et al.* (2000):

> Emergent literacy consists of the skills, knowledge, and attitudes that are presumed to be developmental precursors to conventional forms of reading and writing [...], and thus it suggests that significant sources of individual differences in children's later reading skills are present prior to school (p. 1).

Emergent literacy varies in its components depending on the writing system. For Italian, Pinto *et al.* (2009) have validated the following three-factor model: textual competence (the ability to get to grips with the individual units of meaning conveyed by the word and to form a network of relations between words that are in the text), and conceptual knowledge on writing systems (the knowledge and availability of the visual attributes of the letters in words) influence the acquisition of reading as much as phonological awareness. Interestingly, this model excluded general cognitive-linguistic abilities as predictors of formal literacy. The construct of emergent literacy is extremely useful for the early prediction of dyslexia as it creates a filtered system of linguistic components. These are all inter-related and underline the short-sightedness of explaining reading disabilities with a single predictor. Furthermore, there is strong evidence that emergent literacy skills can be improved, and evidence suggesting, indeed, that dyslexia can be prevented (Lonigan, Purpura, Wilson, Walker & Clancy-Menchetti, 2013). Surprisingly, there is though a scarcity of predictive studies on dyslexia conducted before emergent literacy begins to interact with formal literacy (Boets *et al*., 2010), especially among participants who are not at-risk of dyslexia. The lack of research is associated to the controversy over the role of phonological awareness in dyslexia. According to the results of a meta-analysis conducted by Swanson, Trainin, Necoechea and Hammill (2003), the importance of phonological awareness (and rapid naming) in predicting reading performance has been overstated because of the meta-analysis of correlational studies (Swanson, Trainin,

Necoechea & Hammill, 2003). Research on dyslexia is typically centred on the development of dyslexia in English, which might have led scholars to overestimate the importance of phonological awareness, (Landerl & Wimmer, 2000; Share, 2008; Ziegler *et al.*, 2010), in predicting dyslexia: English, after all, has an opaque writing system.

To analyze this particular aspect, we need to turn to predictive studies conducted in transparent writing systems, where phonological awareness might play a lesser role in the acquisition of reading.

Dyslexia in transparent languages: predictors

In this regard, three recently published studies are relevant for the present study. All three explored, in longitudinal terms, the relationship between emergent literacy and developmental dyslexia in transparent writing systems, with a focus on phonological awareness.

Wimmer and Schurz (2010) summarized, in an article, 20 years of research on dyslexia causation in German, with its regular orthography. In particular, the authors conducted two longitudinal studies on the influence of phonological awareness on reading, assessed three years later. The sample included 530 children in the first study and 300 children in the second. Phonological awareness was assessed through the detection of onsets and rhymes (study 1), and by asking children to repeat a word and its phonemic segments (study 2). Surprisingly, children with a phonological awareness deficit did not necessarily show a later reading deficit, nor did the reading deficit subgroup show a phonological awareness deficit at this stage. The authors concluded that dyslexia resulted from reduced orthographic-phonological connectivity. According to them, competent readers not only master phonological awareness, they also have tight orthographic-phonological binding.

Zakopoulou *et al*. (2011) conducted a study aimed at developing a tool identifying dyslexia predictors at preschool age for Greek, another transparent language. Five hundred and eighty two children participated in this longitudinal study. They were examined at the end of the second kindergarten year, and at the end of grade two in primary school. Among their results, the 'sound discrimination' task was one of the most reliable factor for dyslexia, confirming the predictive impact of phonological awareness on dyslexia.

The Jyväskylä Longitudinal Study of Dyslexia is a prospective longitudinal study, which aims at identifying early dyslexia predictors in Finnish, yet another transparent language. A hundred children at risk of dyslexia – family histories were examined – were matched to a control group and followed for several years. Phonological awareness was assessed through word-level and syllable-level segment identification, synthesis and continuation of phonological units, initial phoneme identification, and the production of the first phoneme. Phonological awareness emerged as a predictive factor of dyslexia, both through a logistic regression analysis (Puolakanaho, Ahonen, Aro, Eklund, Leppanen *et al.*, 2007), and through a longitudinal path model with standardized estimates (Torppa *et al.*, 2010). Interestingly, both studies confirmed the connection between early phonological skills and dyslexia, but the authors also reported limitations affecting the influence of phonological awareness on dyslexia. Puolakanaho *et al.* (2007) reported that this component resulted in a significant predictor only at 4.5 years of age, whereas no statistically significant effect was found at 3.5 years of age. Torrpa *et al*. (2010) stressed that the role played by phonological awareness was rather small (only 1.2% variance in reading accuracy and fluency was predicted). The authors explained this data stating that this component also shared variance with other predictors of reading accuracy and fluency and that, therefore, there were not strong unique contributions.

Dyslexia in Italy

In 2010 the Ministry of Health of Italy promoted a consensus conference to define guidelines for the diagnosis and for the treatment of learning disabilities. In this document, dyslexia was defined as a "reading disorder, intended as the ability to decode the text" (Consensus Conference, 2011, p. 9). The National Law 170, published 8 October, 2010, recognizes dyslexia as a learning disorder, and specifies that it emerges through difficulty in reading accuracy and speed. Law 170 also states that dyslexia is diagnosed by the National Health System. 1.3% to 8.5% of students have difficulties in reading (Barbiero *et al.*, 2012). Italian scholars have worked extensively on diagnostic instruments (for instance, Cornoldi, Colpo, & MT group, 1998; Sartori, Job, & Tressoldi, 1995), and treatment (for instance, Tressoldi & Vio, 2007). Predictive studies have been conducted in primary school (for instance, Borella, Chicherio, Re, Sensini & Cornoldi, 2011; Brizzolara, Chilosi, Cipriani, Di Filippo, Gasperini *et al.*, 2006; Facoetti, Trussardi, Ruffino, Lorusso, Cattaneo *et al.* 2010; Tressoldi, Stella & Faggella, 2001; Scalisi, Pelagaggi, Romano, De Conno, & Carrieri, 2005), As yet, no longitudinal study has been conducted to identify the early predictors in kindergarten (emergent literacy) of dyslexia. The present study responds to the main recommendation for dyslexia in Italy: inserted in the Consensus Conference (2011), this was the request for prospective cohort studies that could shed light on the predictors of dyslexia among emergent literacy skills.

Rationale for this study

A few critical facts emerge from an overview of the literature described above.

- The strong variance in manifestation, prevalence, and the incidence of dyslexia across languages suggests that research should focus on the cultural elements of this learning disability.
- As most studies are either cross-sectional, or longitudinal on children identified as being at high genetic risk of dyslexia, it is impossible to disentangle cause from effect, and to make comparisons with the normal population.
- Phonological awareness is considered a strong predictor of reading and dyslexia in opaque writing systems, but there is still confusion as regards its influence on dyslexia in transparent writing systems.

This study aimed at contributing to these points by analyzing the differences in emergent literacy skills between future normally-reading children and future dyslexic children, through a four-year prospective cohort study. In the Italian educational system formal literacy begins in primary school, as stated by the National Curriculum. Consequently, we began the study in the last year of kindergarten, as it represents a period of rapid changes, both developmental and cultural. We decided to focus on the last year of kindergarten so as to capture the highest level of emergent literacy skills, right before the transition to formal literacy starts. Also, we decided to assess children's emergent literacy skills at the beginning and at the end of the school year in order to detect any variation in the predictive weight of each component. The emergent abilities, and relative measures, to be assessed in kindergarten have been selected following the indications of the emergent literacy model for Italian validated by Pinto *et al.* (2009). In this way, it was possible to have measures that have been proven to be predictive of the development of formal writing in Italian (Pinto, Bigozzi, Accorti Gamannossi & Vezzani, 2011).

The reading acquisition process was assessed until the third grade, when dyslexia is diagnosed in Italy (Consensus Conference, 2011). This research design allows us to compare the characteristics of dyslexic students and normally-reading peer in the emergent literacy stage, and discuss them in the context of their general reading acquisition process.

Research aims and hypotheses

This study explored the predictive impact of emergent literacy on dyslexia in a transparent writing system by comparing performances in phonological awareness, conceptual knowledge of writing systems, and textual competence. These were assessed at the beginning and at the end of the last year of kindergarten, between dyslexic students, as diagnosed in the third grade, and matched normally-reading peers.

This study offered the following hypotheses:

H1) dyslexic students had a lower phonological awareness than their normally-reading peers in kindergarten;

H2) dyslexic students had a lower conceptual knowledge of a writing system than their normally-reading peers in kindergarten;

H3) dyslexic students and their normally-reading peers did not show any difference in textual competence in kindergarten;

H4) dyslexic students' performances in phonological awareness and conceptual knowledge of the writing system are significantly lower than their normally-reading peers' performances in both assessments in kindergarten, but the effect is stronger when assessed at the end of last year of kindergarten;

H5) phonological awareness and conceptual knowledge of writing systems are predictive of reading performances in the first grade, in the early acquisition of formal reading;

H6) phonological awareness and conceptual knowledge of writing systems are not predictive of reading performances in the third grade as the exposure to formal instruction in the written language have become less important.

Method

Participants

We followed a cohort of 450 children (mean age 5.1 years, range 4.7-5.8; 228 girls and 222 boys) for four years, from the last year of kindergarten to the third grade. From this sample we had previously excluded children (*n*=28) showing a formal mastery of reading and writing during the study. The parents of the participants gave informed consent for the participation of their children in the study.

In the Italian educational system, children typically start kindergarten at age three, and finish it when they are five. Children, then, enroll in primary school when they are six years old. Primary school lasts five grades, and children move to secondary school when they are 11. The school year begins in mid-September and ends in mid-June. All classes participating in the study (kindergarten and primary school) were part of the same school district, sharing, therefore, characteristics: similar educational and teaching practices, and middle socio-economical level. Most importantly, in Italy the formal teaching of literacy begins in primary school, and follows a specific curriculum, as set down in national law. Even though there might be cases in which kindergarten educators teach reading and writing to children, in our sample none of the kindergarten classes were exposed to formal literacy. This is particular relevant in understanding the construct of emergent literacy that derives from the exposure to several print sources which fosters children's knowledge about the writing system.

All participating kindergartens were following the national guidelines released by the Ministry of Education, guidelines which were valid at the time of the study. No schools were

following a specific program. We have also controlled for the potential confounding effect of specific trainings implemented in the classroom. None of the participants' kindergarten teachers implemented special training in their classroom to empower relevant variables for this study: conventional reading, phonological awareness, textual competence, or conceptual knowledge of writing systems. All schools were also comparable in terms of presence, visibility and accessibility of meaningful material for the written language.

Research design

The research design was broken down into four steps (Table 1).

INSERT TABLE 1

In the first step, at the beginning of the last year of kindergarten, the cohort was formed of 450 children. The sample of the second step, at the end of the last year of kindergarten, was the same, without any drop-outs. The samples of the third and fourth steps, respectively beginning of the first and third grade, were 427, because 'drop-outs' went to different primary schools than the ones included in the study.

An important characteristic of the Italian school system must be noted. The Italian population is characterized by very low mobility: families tend to live in the same neighborhood over several generations. Children generally attend school in the same area. As a consequence, in this study, subject attrition through the three stages was extremely low.

In the first two steps, kindergarten students' emergent literacy was assessed, first at the beginning, and then at the end of the last year. In the third step, first grade students' reading performance was assessed. In the fourth step, at the beginning of the third grade, the diagnostic procedure for dyslexic students began. Teachers of all 427 students were asked to report all cases of children with reading difficulties, excluding those students who been certified following the indications of the National Law 104/1992 (law for handicap people's assistance,

social integration, and rights). According to these criteria 35 poor readers were found. These students were sent to centers specialized in the diagnosis and treatment of learning disabilities, with the consent of their parents. These centers have formulated a diagnosis of dyslexia following the International Classification of Mental Disorders, ICD-10, the official clinical reference for the Italian National Health System (World Health Organization, 1992): normal level of intelligence, reading performance at a clinical level, and no neurological, sensory, or educational deficits (see also Tressoldi *et al.*, 2001).

Exclusion of mental retardation. Students' IQs were calculated through the Wechsler Intelligence Scale for Children-III (2006) and none of the subjects were, on these grounds, affected by mental retardation: participants' IQ scores ranged from 92 to 108.

Exclusion of environmental factors (such as inadequate schooling) and sensory problems. Subjects were clinically analyzed by reconstructing their case history, in order to exclude children whose reading impairment could have been explained by environmental factors. Referring to the aforementioned exclusion criteria (World Health Organization, 1992), nine subjects were excluded from the experimental sample for the following reasons: they had been born in Italy to foreign parents (3); they had registered an excessive number of absence days in first grade (3); one had an ocular pathology (1); one student had severe headaches that hindered learning (1); and one student suffered from severe educational deprivation at home (1).

Assessment of reading competence. Students were then assessed with two standardized tests for dyslexia (MT Battery, Cornoldi *et al.*, 1998; Battery for the Assessment of Developmental Reading and Spelling Disorders, Sartori *et al.*, 1995; see Measures section for details). Both tests allowed for the control of students' reading performances in terms of accuracy and speed, in a set of different tasks. A total of 14 children were ruled out by the two

standard tests, as their performances were statistically normal: less than two standard deviations distant from average for speed and/or higher than the fifth percentile for accuracy.

At the end of this procedure, 12 students received an official diagnosis of dyslexia. The documentation regarding their certification was deposited at the local schools. For the purposes of this study, three children were excluded because their data in the first two steps (assessment of emergent literacy) were not available. The final sample of dyslexic children was nine students (mean age in kindergarten 5±.00; 7 boys and 2 girls). Out of the initial 450 students, then, considering a turn-over rate of 5%, 2.8% of the sample was diagnosed as dyslexic. This result is lower than some percentages reported in the literature (Consensus Conference, 2011), but in line with other data available for Italy (Barbiero *et al.*, 2012). Neither of the students diagnosed with dyslexia had another disorder in comorbidity. This last data might explain the relatively low percentage of dyslexic children found in this study. This study confirmed a higher prevalence of dyslexia among boys: indeed, seven of the nine were boys (Consensus Conference, 2011). It is important to note that, unlike other studies which extracted children from at-risk populations (for instance studies on familial risk such as Muter & Snowling, 2009; Lyytinen *et al.* 2004), dyslexic children were individuated from the normal population, this offering a specific contribution to research on dyslexia.

To compare the dyslexic students' performances to their normally-reading peers, we have selected a group within the overall sample matched for three set of important confounding variables: socio-economic status, teaching practices, and gender. First, students' socio-economic status was derived from their parents' occupation. Each student was assigned a score from 1 (low socio-economic level) to 5 (high socio-economic level). The dyslexic and the normally-reading groups did not have significantly different scores. Thus, we can assume that the two groups were equivalent in this variable. Second, from each dyslexic child's classroom,

we selected only the classmates with their same gender, and their same socio-economic status score. Consequently, children who did not share the same learning environment (that is, children from other classrooms), and children with a different (lower or higher) socio-economic status were excluded, and the gender ratio between dyslexic and normally-reading students was balanced. From this procedure, we derived a matched control group consisting of 65 children (mean age in kindergarten = 5±.00; 39 boys and 26 girls).

Procedure and measures

In the first two steps, the beginning and end of the last year of kindergarten, we assessed children's emergent literacy components, whereas in the fourth step, in third grade, dyslexic students were individuated (see table 1).

First and second step: emergent literacy (beginning and end of the last year of kindergarten). Emergent literacy skills were evaluated through tests measuring phonological awareness, textual competence and conceptual knowledge of the writing system. The choice of potential predictors was driven by the emergent literacy model for Italian-speaking children developed by Pinto *et al.* (2009), a model validated for Italian, a 'transparent' writing system. All children's productions were recorded, transcribed and coded by two independent judges. Agreement between the judges was between 88% and 99%; cases of disagreements were resolved through discussion. All measures reported acceptable and good reliability scores: the alpha coefficients of the instruments used ranged between .75 and .89.

Phonological awareness

Identification and production of sound patterns (Pinto et al., 2009). Children were exposed to two verbal stimuli, one containing rhymes, and the other a series of alliterating words. The instruction was: "Now I am going to tell you a poem, which is a bit like a story but

not quite. And I would like you to make up something like that." Children were not asked to repeat the experimenter's poem, but to produce one of their own, with the stimuli acting as examples. The order of the two stimuli was counterbalanced. Out of these two tasks, three scores were derived. Rhythm (children's ability to reproduce the prosody); rhyme (children's ability to detect the rhymes within the stimulus); and alliteration (children's ability to detect alliterations within the stimulus): 0 no rhythm/rhyme/alliteration produced, 1 one rhythm/rhyme/alliteration produced, 2 two or more rhythms/rhymes/alliterations produced.

Identification of phonemes (Pinto et al., 2009). Children were asked to identify similar words among triplets of words, two of which had a phoneme in common. Three scores were derived. Recognition of initial phonemes, recognition of intermediate phonemes, and recognition of final phonemes: 0 if no distracter was identified, 1 if 1 distracter was identified, and 2 if two or three distracters were identified.

In both tasks, students' scores ranged from 0 to 2.

Textual competence

Test of relational concepts (Edmonston & Thane, 1988). Children were presented with a series of tables with three pictures each, then they were asked to point to the picture which matched the sentence pronounced by the examiner. Students' scores ranged from 0 to 63.

Language comprehension (Rustioni Metz Lancaster, 1994). Children were assessed in their comprehension of particular syntactic structures: active, negative, passive, relative, temporal, and adversative sentences were tested. Students' scores ranged from 0 to 5.

Story production (Spinillo & Pinto, 1994). Children were asked to tell a story. The story was recorded, transcribed and analysed by two independent judges on three parameters.

- Structure (5 levels of complexity according to the presence, absence and/or combinations of eight fundamental elements: title, conventional story opening, characters, setting, problem,

central event, resolution and conventional story closing). Students' scores ranged from 0 to 5.

- Cohesion (presence/absence of causal and temporal cohesiveness). Students' scores ranged from 0 to 3.
- Consistency (number of inconsistencies balanced by the total number of sentences). Students' scores ranged from 0 to 3.

Conceptual knowledge of a writing system

Invented writing (Pinto et al., 2009). The test measured children's knowledge of words, words boundaries, word morphology, directionality of print and their functioning in written language (Pinto et al., 2009). This test allowed for the identification and exclusion of children with formal mastery of reading and writing. Children were asked to draw, write and read as best they could, from which three different scores were obtained.

- Conceptual knowledge on orthographic notation. Children were asked to write down their name, the words they knew, and the word 'apple'. This score defined how similar children's signs were to conventional letters. Scores were assigned as follows: 0 for drawings, 1 for scribbles, 2 for forms similar to letters, 3 for sequences of well-shaped letters. The mean score was then calculated. Students' scores ranged from 0 to 3.
- Conceptual knowledge on the orthographic variation of sound quantity. Children were asked to write down two long words (one given by the experimenter, one of their choice), and two short words (one given by the experimenter, one of their choice). This score defined whether children were aware of the numeric correspondence between sounds and signs (one sign *per* sound). Scores were assigned as follows: 0 for drawings; 1 for performances based on a non-correspondence between signs and sounds (words of the same length, or longer word written shorter than the short word); 2 for performances in which the difference in

length is present and correct, without a 1:1 correspondence between signs and sounds; 3 for performances in which the difference in length is present and correct, with a 1:1 correspondence between signs and sounds. The mean score was then calculated. Students' scores ranged from 0 to 3.

- Conceptual knowledge of the orthographic variation of phonemic units. Children were asked to write two pairs of words, each of which were formed by two words which were similar in the first part and different by only the last letter. This score defined whether children were aware that words that sound similar are also written in a similar way, with small variations. Scores were assigned as follows: 0 for drawings, 1 for performances in which the two words were written, either identically, or completely different; 2 for performances with a partial equivalence and a partial differentiation, where though the two parts do not correspond to sound variations; 3 for performances with a partial equivalence and a partial differentiation, in which the two parts correspond perfectly to variations in sounds. The mean score was then calculated. Students' scores ranged from 0 to 2. Invented spelling. Children were asked to read the written words. This measure was coded on four levels: 0 absence of performance; 1 performance without any correspondence between the written signs and the pronounced sounds; 2 performance with low correspondence between groups of signs and sounds; 3 performance with largely correct correspondence between groups of signs and groups of sounds; 4 performance with perfect correspondence between groups of signs and groups of sounds. Students' scores ranged from 0 to 4.

It is important to note, that this task does not measure formal reading and writing. The maximum score was assigned if the children showed an understanding that each phonological unit corresponds to a single grapheme, which did not necessarily have to be the conventional sign used in Italian. It did though have to share the same characteristics as the Italian writing system: i.e. one sign for each sound.

Third step: assessment of reading performance (grade one)

Participants' reading ability was assessed with a standardized reading test (Sartori, Job & Tressoldi, 1995). Students were asked to read two twenty-two-word lists aloud. Students were individually assessed by an experimenter. The score for this task was calculated by counting the number of words correctly read in five minutes.

Fourth step: identification of dyslexic children (grade three)

Besides the Wechsler Intelligence Scale for Children (Wechsler, 2006), and a clinical assessment, children were tested with two standard Italian reading achievement tests for the diagnosis of dyslexia.

- Clinical assessment (case history; World Health Organization, 1992)
- Wechsler Intelligence Scale for Children-III (Wechlser, 2006)

MT Battery (Cornoldi et al., 1998)

The test assesses accuracy and fluency in reading texts and it is used to identify children affected by a reading disability. Children were asked to read a short story aloud, while the experimenter was taking note of errors in reading (accuracy score) and the total time of reading (fluency score).

Battery for the Assessment of Developmental Reading and Spelling Disorders (Sartori et al., 1995)

This battery includes the following sub-tests:

- Conversion from graphemes to phonemes: children have to read aloud a list of 22 letters and a list of 22 numbers; then children are presented with 20 pairs of letters and have to determine whether the letters are the same (Hh) or different (Po).

- Vocabulary: children have to read a mixed list of 24 words and 24 non-words, and for each of them they have to determine whether it is a word (e.g. ‘apple’) or a non-word (e.g. ‘sapple’)
- Reading without a syntactic and semantic context: children have to read a list of 112 words as fast as possible, words which vary in length and frequency of use.
- Indirect reading: children have to read a list of 48 non-words.
- Reading of words with an irregular accent: children have to read a list of 60 words that have an irregular accent in Italian (*frìggere* instead of the expected *friggère*).

Data analysis

The participants of the assessment for emergent literacy (beginning and end of the last year of kindergarten) were divided into two groups: nine children who in grade three had been diagnosed with dyslexia, 65 children who in grade three were normally-reading students, matched for teaching practices, socio-economic status, and gender. The two samples were independent. In the emergent literacy assessment, data were not normally distributed, and monotonic transformations did not succeed in normalizing them. Consequently, we have compared the emergent literacy performances of dyslexic children with the performances of their normally-reading peers through a non-parametric test, the Mann-Whitney’s U test.

To control the predictive impact of the emergent literacy components on the measures of reading (number of words read in the first grade, speed and accuracy in the third grade), we have run six multiple regression analyses with stepwise method. This includes each of the two assessments conducted in the last year of kindergarten (beginning and end of the school-year). As noted before, the emergent literacy variable data were not normally distributed. Therefore, the results must be interpreted with caution for the violation of the assumption of normality.

Results

Descriptive statistics of all measures of the two emergent literacy stages in the matched control group and in the dyslexic group are reported in table 2.

INSERT TABLE 2 HERE

The comparison between the dyslexic and the matched normally-reading peers groups did not produce any statistically significant difference in the first assessment of emergent literacy factors (at the beginning of the school year): phonological competence, textual competence, and conceptual knowledge of orthographic systems.

In the second step (end of the last year of kindergarten), only the conceptual knowledge of writing system showed a statistically significant difference (U=27.50, p<.01, r=.52). The matched control group (Mean Rank= 41.58) outperformed the dyslexic group (Mean Rank= 8.06). In specific, all four subtests of the conceptual knowledge of writing system factor produced a statistically significant difference, with the matched control group reporting higher performances than the dyslexic group:

- Conceptual knowledge on orthographic notation (Control's Mean Rank= 41.31 vs. Dyslexic's Mean Rank= 10.00; U=45.50, p<.01, r=.63);
- Conceptual knowledge on the orthographic variation of sound quantity (Control's Mean Rank= 39.93 vs. Dyslexic's Mean Rank= 19.94; U=134.50, p<.01, r=.64);
- Conceptual knowledge of the orthographic variation of phonemic units (Control's Mean Rank= 41.79 vs. Dyslexic's Mean Rank= 6.00; U=13.50, p<.01, r=.59);
- Invented spelling (Control's Mean Rank= 39.54 vs Dyslexic's Mean Rank= 22.78; U=160.00, p<.01, r=.27).

All statistically significant differences have a large effect size (*r*>.50), except for invented spelling in the second step, which reported a small effect size.

The same battery of emergent literacy was used in the first and second stage. However, one instrument, the identification of phonemes, produced a floor effect for both subgroups in the first test, conducted at the beginning of the last year of Kindergarten. 95% of the participants were unable to answer any item in this task. This task is, clearly, still too difficult for children at this stage of development. Instead, in the second stage, children's performances improved.

To understand better the role played by the emergent literacy components in dyslexia, we tested the predictivity of phonological competence, textual competence, and conceptual knowledge of writing system on one measure of reading in the first grade (number of words correctly read in five minutes), and in the third grade (speed and accuracy) through six multiple linear regression analyses with stepwise method. In the first grade, the two regression models were statistically significant. The three emergent literacy components assessed at the beginning of last year of kindergarten explained 13% of the variance of first graders' reading performance (Adj. R^2=.13; $F_{1, 68}$=10.83, *p*=<.01). The only significant predictor was the conceptual knowledge of writing systems (Beta=1.92, t= 3.30, *p*<.01). The three emergent literacy components assessed at the end of last year of kindergarten explained 5% of the variance of first graders' reading performance (Adj. R^2=.05; $F_{1, 59}$=4.14, *p*=<.05). Again, the only significant predictor was the conceptual knowledge of writing systems (Beta=1.88; t= 2.04, p<.05).

In the third grade, multiple linear regression analyses were repeated to test the predictivity of emergent literacy (beginning and end of school year) on two measures of reading performances: speed and accuracy. None of these analyses were statistically significant.

Discussion

This study explored the differences in emergent literacy components between dyslexic and normally-reading children in a transparent writing system through a prospective cohort study.

According to the first hypothesis, dyslexic students would have a lower phonological awareness than their normally-reading peers in kindergarten. Our data contribute to the debate on the role played by phonological awareness in dyslexic children, by assessing this component within an emergent literacy model (kindegarten), that is before formal learning has began to retroactively influence students' phonological awareness. In our study phonological awareness was not different between the two groups in kindergarten, supporting the hypothesis that in transparent orthographies, such as Italian, phonological awareness is less important in determining reading deficits (Landerl & Wimmer, 2000; Share 2008; Wimmer & Schurz 2010; Ziegler *et al.*, 2010). On the other hand, this result questions a set of studies conducted, for the most part, in opaque writing systems (Ziegler & Goswami, 2006; Goswami *et al.*, 2011; Caravolas *et al.*, 2005; Ziegler *et al*., 2010). It must be noted that this result is supported by the decision to assess phonological awareness, both as factorial measure, and in terms of the contribution of its sub-components. Dyslexic and normally-reading children were not different in any of these measures. Indeed, students were tested on a whole continuum, from basic phonological processing, such as rhythm and rhyme detection, to complex phonological processing, such as phoneme detection. Moreover, all these measures were taken twice in a school year, to capture better the developmental shifts in these variables, particularly those expected in the last year of kindergarten. This consideration was supported by the phonemic detection task, which still resulted inaccessible at the beginning of the school year, while it is within reach at the end of the school year. To comprehend better this claim, it is useful to take into account the results for the reading acquisition process in the control group. As expected,

phonological awareness did not predict reading performances in the third grade. However, curiously, given our expectations, neither did it predict reading in the first grade. Overall, this result echoes Lepola, Niemi, Kuikka and Hannula's (2005) claim, that phonological awareness in transparent orthographies might be a formal literacy component or a marker of the beginning of reading, rather than a predictor among the emergent literacy components.

A further contribution to the role played by phonological awareness in dyslexia derives from the second hypothesis, according to which dyslexic students would have a lower conceptual knowledge of a writing system than their normally-reading peers in kindergarten. This factor produced the only statistically significant difference at the end of kindergarten. This result, supported by large effect sizes, is a promising contribution for dyslexia predictors. Indeed, the conceptual knowledge of writing systems is the integration of the awareness of sound patterns, executive functions and knowledge of conventional rules in a specific writing system. In other words, the factor assessed by invented writing and reading is the presence of a system of symbolic representations specific to a writing system, and the capacity to apply said system. As Oulette and Sénéchal stated (2008), invented writing, the task used to measure the conceptual knowledge of writing system, measures the developmental progression in which children attempt to merge phonological and orthographic characteristics over time. This other factor becomes the medium through which phonological awareness exerts its effect on reading skills. It is important to note that conceptual knowledge of the writing systems does not mean being able to write. It means knowing that sounds need to be matched with a specific set of signs, and not to signs in general. Independent phonological awareness does not predict formal literacy, whereas when it is absorbed into another factor and put in interaction with the graphic-motor skills and knowledge specific to a writing system, its effect becomes significant.

To understand better the relevance of the differences existing between dyslexic and normally-reading students in conceptual knowledge of writing system, we have also analyzed

the role that this factor plays in the reading acquisition process. In line with our fifth and sixth hypotheses, the conceptual knowledge of writing system does predict reading performances in the third grade, where it predicts reading performances in the first grade. These results are in agreement with Wimmer and Schurz's (2010) hypothesis of orthographic-phonological connectivity, according to which, competent readers not only master phonological awareness, they are also able to integrate orthography and phonology. It confirms Torrpa *et al.*'s impression (2010) that phonological awareness shares variance with other predictors, and it does not bring a strong unique contribution. Also, this result confirmed Landerl *et al.*'s (2012) finding that phonological awareness and linguistic competences, as assessed by phoneme deletion and rapid automized naming, are stronger in opaque writing systems than in transparent ones. Their effect on transparent writing systems may have been overstated (Share, 2008).

The third hypothesis was that dyslexic students and their normally-reading peers would not have shown any difference in textual competence in kindergarten, and this was confirmed by our data. This is a reminder of how the core characteristics of dyslexia are extremely specific, and how they do not derive from a lack of general cognitive-linguistic skills, such as vocabulary, referential and syntactic comprehension or cognitive-linguistic competences (Ramus, 2003).

These findings allowed us to explore which of the emergent literacy components discriminate future dyslexic children from their normally-reading peers. The fourth hypothesis allowed us to determine the developmental pattern behind these differences. We expected that the statistically significant differences in emergent literacy components would have a larger effect size when assessed at the end of last year of kindergarten, as compared to the beginning of the year. While the similarities in phonological awareness and textual competence between future dyslexic children and their normally-reading peers were stable in the two repeated

measures, the conceptual knowledge of a writing system becomes predictive at the end of the last year of kindergarten. While the future normally-reading peers improve in their performances from the first and the second assessment, future dyslexic students remain stable. The last year of kindergarten in Italy is an excellent opportunity to capture the emergence of the atypical pattern of reading acquisition.

These two last sets of results are helpful for understanding the main conclusion of this study, that future dyslexic children have significantly lower levels in the conceptual knowledge of writing system than their normally-reading peers. In the normal acquisition of formal reading, this factor seems to play a role only in the very early stages (grade one), whereas it loses its efficacy later on. Phonological awareness plays an important role for reading acquisition, but the durability of its effects over time is currently under question. Longitudinal studies showed that the predictive effect of emergent literacy components in general, and phonological awareness in particular, are evident in the first grade, but diminishes over the kindergarten to the third grade (e.g. de Jong & van der Leij, 1999; Kirby, Parrila & Pfeiffer, 2003; Wagner, Torgesen, Rashotte, Hecht, Barker *et al.*, 1997). This suggests the existence of a temporal sensitive window in which the conceptual knowledge of writing system supports children to integrate the phonological aspects of the language with the conventional rules of the writing system properly. This 'scaffold' appears to be weaker in dyslexic children. Future studies should explore whether this component can be enhanced during the 'temporal window' as a target for specific instructional practices.

In summary, this study confirms that emergent literacy predicts the early acquisition of formal reading, and it then loses its effect as reading instruction progresses (de Jong & van der Leij, 1999; Kirby *et al.*, 2003; Wagner *et al.*, 1997). Phonological awareness played a relevant role only when absorbed into another emergent literacy component, conceptual knowledge of writing system, in the interaction with analysis of signs. The presence of this other factor puts

the predictive weight of phonological awareness into perspective. Moreover, this study confirms the relevance of an emergent literacy model for the Italian writing system in predicting reading acquisition, and highlighting, at an early stage, differences between dyslexic and normally-reading children. The main conclusion of this study is that phonological awareness measured in kindergarten does not differentiate between Italian children, who later exhibit serious reading difficulties, and children with typical reading development, while the conceptual knowledge of writing system does. Interestingly, conceptual knowledge of writing system, and all its components were predictive by the end of kindergarten. We hypothesized that initially, at the beginning of the last year of kindergarten, the conceptual knowledge of the writing system is starting to emerge. The last year of kindergarten is a period of rapid changes in literacy, as children become progressively able to benefit from a literate environment. The main difference between the two groups is that, while future normally-reading children's conceptual knowledge of the writing system is evolving over the course of a school-year, the same does not happen in future dyslexic children. This type of data is important since emergent literacy is a continuously changing aspect of the child's development.

Lonigan *et al.* (2013) stated, there is the need for studies to analyze which intervention components do and do not work. In this regard, the conclusions of this study suggest that educational professionals should look for indications on how to intervene on reading difficulties, and dyslexia, from studies conducted in their specific writing system. However, the results provided in this study suggest control over whether the emergence of writing skills, as assessed by the invented writing task, influence the development of dyslexia, when children shift from emergent to formal literacy. This conclusion chimes with Berninger, Nielsen, Abbott, Wijsman and Raskind's (2008) call for more research on the relationship between writing problems and dyslexia, in their opinion under-recognized and under-treated. Also,

emergent writing could be a key to preventing future difficulties in reading, along with Edwards' (2003) considerations that intervention can take place at the kindergarten level.

This study, its results and the implications of those results, has from certain limitations. Data showed that phonological awareness is predictive of dyslexia when integrated with the conceptual knowledge of the writing system. However, the exclusion of phonological awareness as a single predictor is proven for the specific measures of phonological awareness taken in this study: the identification and production of rhyme and alliteration, and the detection of initial, intermediate, and final phonemes within triplets of letters. It would be relevant to replicate the study by assessing different measures for phonological awareness. It would also be interesting to replicate this study by including in the kindergarten assessment other aspects within the cognitive profile, potentially relevant for dyslexia, such as rapid automatized naming (Brizzolara *et al.*, 2066).

This data contribute to the knowledge of reading acquisition problems in typical and atypical students, but it would not be advisable to adopt the measures used in this study as a screening procedure, remembering Fletcher's (2005) concerns over the early detection of learning disabilities. Future research should focus on exploring the sensitivity of the measures, false positives and negatives, to differentiate between structural deficits and developmental delays.

In this study, our sample of dyslexic children did not include any student with disorders in comorbidity. Future studies should replicate the research design on the population of students with reading difficulties, by adopting more lenient criteria in creating the sample of struggling readers (including, for instance, children with a specific language disorder, or with other learning disorders). This would deepen our understanding of the degree to which emergent literacy predictors of dyslexia overlap with predictors of reading difficulties when associated with other learning disorders.

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Tables

Table 1

Research design and measures

Emergent literacy **Last year of Kindergarten**		**Reading performances** **Primary School - 1st Grade**	**Diagnosis of dyslexia and reading performances** **Primary School - 3rd Grade**
First step (beginning of the school year) n=450	Second step (end of the school year) n=450	Third step n=427	Fourth step n=427
Phonological awareness (Pinto *et al.*, 2009). • Identification and production of sound patterns • Identification of phonemic patterns *Textual competence* • Test of relational concepts, TCR (Edmonston & Thane, 1988). • Test of language comprehension (Rustioni Metz Lancaster, 1994). • Story production (Spinillo & Pinto, 2003). *Conceptual knowledge on*		*Reading performances (*MT Battery (Cornoldi *et al.*, 1998)	*Reading performances (*MT Battery (Cornoldi *et al.*, 1998) • speed • accuracy *Diagnosis of Dyslexia* • Clinical assessment (case history; World Health Organization, 1992) • Wechsler Intelligence Scale for Children-III (Wechlser, 2006) • MT Battery (Cornoldi *et al.*, 1998) • Battery for the assessment of developmental reading and spelling disorders (Sartori *et al.*, 1995)

writing system • Conceptual knowledge on orthography (Pinto *et al.*, 2009).	

Table 2

Descriptive analysis of emergent literacy measures in the two stages: dyslexic (n=9) and matched normally reading children (n=65)

			Emergent literacy			
			Stage 1		**Stage 2**	
Dimension	**Component**	**Measure**	**M ± SD**		**M ± SD**	
			Dyslexic	Normally -reading	Dyslexic	Normally -reading
Phonological awareness	Identification and production of sound patterns	Rhythm	.78±.22	.89±.59	1.33±.17	1.05±.57
		Rhyme	.89±.26	1.06±.77	1.67±.17	1.29±.63
		Alliteration	.78±.22	.65±.57	1±0	.75±.66
	Identification of phonemes	Initial phonemes	N/A, floor effect		1.27±.36	.60±.63
		Intermediate phonemes			1.33±.31	1.20±.62
		Final			.75±.22	1.00±.56

		phonemes				
Textual competence	Test of Relational Concepts		47.67±2.83	50.85±8.73	55.11±1.71	54.83±6.35
	Test of language comprehension		4.33±.24	4.58±.75	5±0	4.80±.47
	Story production	Structure	1.56±.24	2.16±1.06	2.33±.37	2.95±1.14
		Cohesion	1.44±.24	1.55±.94	1.55±.34	1.92±.87
		Consistency	1.22±.28	1.45±.76	1.56±.24	2.03±.79
Conceptual knowledge on writing system	Conceptual knowledge of orthographic notation		1.81±.14	2.47±.55	2.4±.09	2.85±.36
	Conceptual knowledge of orthographic variation of sound quantity		1.39±.16	1.45±.59	1.5±.24	2.55±.59
	Conceptual knowledge of orthographic variation of phonemic units		1.28±.15	1.59±.83	1.67±.08	1.99±.12
	Invented spelling		1.54±.15	2.14±1.01	3±.17	3.08±1.00