The Role of Naming Speed, Phonological Processing and Morphological/Syntactic Skill in the Reading and Spelling Performance of Second-Grade Children

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Introduction

1 Prospective and retrospective studies have consistently established that phonological processing abilities are closely related to reading and spelling acquisition. The phonological limitation hypothesis, which proposes a unitary theory of reading difficulty, claims that reading difficulties are caused by a phonological impairment alone (Bryant, Nunes & Bindman, 1998; Morris, Stuebing, Fletcher et al., 1998; Share 1995, 1999). One alternative theoretical view implicates linguistic capacity, which is hypothesized to involve phonological, morphological/syntactic and pragmatic awareness. Tunmer and Hoover (1992), examining predictive correlations between grade 1 to grade 2, reported evidence indicating that syntactic awareness may account for variance in decoding ability even after phonological awareness has been controlled for. Joanisse, Manis, Keating and Seidenberg (2000) investigated the relationships between dyslexia, speech perception, phonology and morphology, and concluded that the dyslexic group had a delay in language skills, particularly in morphology, rather than a phonological impairment alone. The psycholinguistic hypothesis suggests that dyslexic children experience difficulties in acquiring and efficiently using the rules which, in the syntactic and phonological systems, govern the order-dependent combination of abstract formal elements such as phonemes and grammatical morphemes (Scarborough, 1990). A second alternative view implicates the cognitive processes underlying naming speed, suggesting that phonological deficits and the processes underlying naming speed are separable sources of reading dysfunction. The naming-speed deficit hypothesis is based on the fact that reading is a bimodal cognitive activity, which involves brain areas implicated in both

visual and verbal processing (Wolf & Obregon, 1992, 1997; Wolf & Greig Bowers, 1999; Greig Bowers & Newby-Clark, 2002; Wolf, Goldberg O'Rourke, Gidney et al., 2002). According to the phonological limitation hypothesis, which subsumes morphological/ syntactic skill and naming speed under phonological processes, difficulties in processing morphological/syntactic tasks and deficits in naming speed are consequences of deficient phonological processing, which is the most potent factor (Wagner, Torgesen & Rashotte, 1994; Gottardo, Stanovich & Siegel, 1996; Shankweiler, Crain, Katz & al, 1995).

2 The aim of this paper is to challenge the unitary phonological theory of written language by testing an integrative hypothesis according to which phonological, formal psycholinguistic skills and cross-modal (visual-verbal) skills may both contribute to written language development/dysfunction. In an initial study, interactions between phonological awareness, morphological/syntactic skill, working memory and reading were explored in a group of 37 children from kindergarten to grade 1. The results indicated that, although phonology is a potent factor for reading, the role of morphological/syntactic skill as a predictive linguistic skill cannot be ruled out entirely (Plaza, 2001). In a second study involving a larger group of children (n = 267) at the end of grade 1, and assessing phonological awareness, morphological/syntactic skill and naming speed, hierarchical analyses indicated that phonological processing, morphological/ syntactic skills and naming speed were still predictors of reading and spelling performance after variance in the others had been controlled for (Plaza & Cohen, in press). In the study reported here, the spelling performance of 199 of the 267 children assessed at the end of grade 1 was assessed at the end of grade 2 using three spelling measures including word, pseudo-word and text spelling. In order to explore the covariance relationships between phonological processing, morphological/syntactic skill and naming-speed processing, we conducted a series of hierarchical regression analyses on the spelling performance of the group of 199 second-grade children at the end of grade 2.

MethodSubjects

3 A group of 199 French-speaking children, individually assessed at the end of grade 1 in June 2001, were administered collective spelling tasks in June 2002 at the end of grade 2.

Procedure at the end of grade 1

4 The tasks administered at the end of grade 1 included individual assessment of reading, spelling, phonological processing, morphological/syntactic skill and naming speed. *Reading* was assessed using (a) a "one-minute test" (Khomsi, 1999), which requires the child to read aloud as many words as possible in one minute, (b) the *BATELEM-A* test (Savigny, 1984), which requires the child to read graphemes, words and sentences aloud, (c) a pseudo-word reading test, and (d) the *LMC-R* (Khomsi, 1999) reading comprehension test, which requires children to select, from four pictures, the one that corresponds to a particular written sentence. The reading test included 12 sentences, which the child read silently. *Spelling* was assessed using (a) a pseudo-word spelling test (12 items), and (b) a text dictation, taken from a reading battery (Inizan, 2000). *Phonological processing assessment* was assessed by means of an initial phoneme deletion task (12 items) (Chevrie-Muller & Plaza, 2001). *Morphological/syntactic skill* was assessed by means of a judgment/ correction task used in previous studies (Plaza, 2001; Plaza & Cohen, in press). The child is asked to listen to 12 sentences and required (a) to decide whether or not each sentence is grammatical and (b) to correct any mistakes. Errors in these sentences concerned determiners, subject-verb agreement, gender, adverbs, prepositions, conjunctions and

word order. *Naming speed* was assessed using three tasks involving 48 stimuli (pictures, digits and letters), derived from the RAN Test (Denckla & Rudel, 1974).

Procedure at the end of grade 2

5　The spelling tasks collectively administered at the end of grade 2 consisted of (a) a pseudo-word task (20 items) (b) a word task (20 items) and (c) a text dictation. The pseudo-words involved simple graphemes, contextual graphemes as /s/, /g/, /c/ which vary according to the vocalic context, and complex graphemes as /gn/, /an/, /eu/, /in/ / ouil/, /on/ , /ou/, /eil/, /ille/. The real words were regular, except for one irregular ("femme", woman). They involved simple graphemes, contextual graphemes as /s/, /g/, / an/ and /on/ which vary according to the vocalic context, and complex graphemes as / au/, /ou/, /gn/, /eu/, /ai/, /eil/.

Results

6　Correlation between reading and spelling at grade 1, spelling at Grade 2, and the three other variables

7　The correlations between the variables are displayed in Table 1. "Phonology" involves the phoneme elision task; "naming speed" involves the picture, digit and letter-naming tasks, and "morpho-syntactic skill" involves the morphological/syntactic task. The spelling tasks at grade 2 involved: pseudo-word, real word, phonetic and lexical components of the text dictation.

Table 1 : Correlation between performance on the tasks in grade 1 (Gr1) and spelling performance in grade 2 (Gr2)

Variable	Phonetics Gr2	Usage Gr2	Morpho-syntax Gr1	Phonology Gr1	Naming speed Gr1
Phonetics Gr2	1	.83	.43	.61	.42
Usage Gr2		1	.35	.56	.39
Morpho-syntax Gr1			1	.45	.14 ns
Phonology Gr1				1	.29
Naming speed Gr1					1

8　Note: Correlation greater than .19 are significant at the .05 level, correlation greater than .25 are significant at the .01 level, and correlation greater than .32 are significant at the .001 level.

9　Table 1 shows that the reading and spelling measures at grade 2 were correlated with the three variables explored. Phonological awareness correlated with pseudo-word spelling (.59), real word spelling (.55), phonetic and lexical features of dictation (.52). Morphological/syntactic skill correlated with pseudo-word spelling (.41), real word spelling (.39), phonetic components of dictation (.41) and lexical components of dictation (.33). Naming-speed skills similarly correlated with pseudo-word spelling, real word spelling, phonetic and lexical features of dictation (.39).

10　The correlation between spelling at grade 1 and the three variables were explored in a series of hierarchical regression analyses. To determine whether one variable

significantly predicted spelling performance after the two other variables had been statistically controlled for, each variable was entered at step 1, step 2 and step 3 respectively for pseudo-word spelling and real word spelling.

Table 2 : Hierarchical multiple regression analysis for grade 1 variables predicting phonetics spelling (PHSP) and usage spelling (USP) at grade

Step	Variable	R2 PHSP	R2 change PHSP	P value	R2 USP	R2 change USP	P value
1	Phoneme elision	.37		<.0001	31		<.0001
2	Morpho-syntax	.40	.3	<.002	33	3	<.05
3	Naming speed	.46	.6	<.0001	38	7	<.0001
2	Naming speed	.43	6	<.0001	37	6	<.0001
3	Morpho-syntax	.47	.4	<.001	38	1	<.04
1	Morpho-syntax	.18		<.0001	12		<.0001
2	Phoneme elision	.40	.22	<.0001	33	21	<.0001
3	Naming speed	.47	.7	<.0001	38	5	<.0001
2	Naming speed	.32	.14	<.0001	24	12	<.0001
3	Phoneme elision	.47	.15	<.0001	38	14	<.0001
1	Naming speed	.18		<.0001	15		<.0001
2	Phoneme elision	.44	.16	<.0001	37	22	<.0001
3	Morpho-syntax	.47	.3	<001	38	1	<.04
2	Morpho-syntax	.32	.14	<.0001	24	9	<.0001
3	Phoneme elision	.47	.15	<.0001	37	13	<.0001

11 Table 2 indicates that, when this was done, naming speed and morphological/syntactic skill accounted for a significant proportion of the variance in grade 2 spelling when entered at steps 2 and 3.

Discussion

12 The data are consistent with our previous studies, indicating that while phonological awareness was the more potent factor, naming speed and morphological/syntactic skill in grade 1 accounted for a significant proportion of variance in grade 2 spelling above and beyond phonological awareness. Each of the three variables predicted spelling independently of the contribution made by the other two. Phonological awareness accounted for 15% of variance in pseudo-word spelling and 12% in word spelling, naming speed accounted for 5% in pseudo-word spelling and 6% in word spelling, morphological/ syntactic skill accounted for 3% in pseudo-word spelling and in word spelling. These results confirm that reading disorder is a puzzle. We know that phonology is an important piece of this puzzle, but some of the others have yet to be identified (Breznitz and Share, 2002).

13 The three "pieces" explored in this study tapped into similar and heterogeneous underlying processes. The initial phoneme elision task required the child to encode verbal information (pseudo-words) in the auditory working memory, separate and manipulate phonemic units, and articulate a new pseudo-word. The morphological/ syntactic task required the child to encode verbal information (sentences) in the auditory working memory, focus on one word which was not appropriate, retrieve the correct item from the verbal long-term memory, and articulate it. The naming-speed tasks required the child to encode visual information, retrieve lexical labels from the verbal long-term memory, hold them in the auditory working memory, and articulate them. All three tasks shared the same emphasis on phonological processing (working memory and articulation), but the initial phoneme elision task required assembly and, unlike the other two tasks, did not require addressed phonology. The naming-speed tasks, on the other

hand, specifically involved visual and verbal processing. The phonological task and the morphological/syntactic task both required meta-linguistic ability in order to focus on the formal features of linguistic items (phonemic units of non-significant pseudo-words in the latter, morphemic units in the former). This was not the case of the naming-speed tasks, which required retrieval speed and more automatized processes.

14   The involvement of morphological/syntactic skill and phonemic awareness in spelling performance is consistent with the general psycholinguistic hypothesis which suggests that dyslexic children experience difficulties in mastering the order-dependent combination of phonemes and grammatical morphemes, which are the basic formal elements of phonological and syntactic processing (Scarborough, 1990). The involvement of naming-speed tasks is in accordance with neuropsychological findings indicating that a lower naming speed may be an index of lower-level problems disrupting the development of fluency in word identification (Wolf & Greig Bowers, 1999). Reading needs efficient and high-speed connections to be made between visual stimuli (printed words) and their phonological counterparts.

15   Taken as a whole, the results reported here provide support for an integrative hypothesis about the interactions between phonological processing, morphological syntactic skill and naming speed processes as predictors of reading and spelling (dis)ability. While phonological awareness, morphological/syntactic skill and naming speed represent independent sources of difficulties, there are clinical implications for diagnosis and intervention. These data highlight the necessity of including naming-speed measures and morphological/syntactic skill in diagnostic reading batteries, in addition to phonological measures.

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ABSTRACTS

The performance of 199 children was examined at the end of grade 1 on tasks assessing phonological processing, morphological/syntactic skill, naming speed, reading and spelling. At the end of grade 2, the children were assigned three measures of spelling. A series of hierarchical analyses indicated that the three variables (phonological awareness, morphological/syntactic skill and naming speed) at the end of grade 1 were still predictors of spelling performance at the end of grade 2, after variance in the others had been controlled for. The results, which confirm that morphological/syntactic skill and naming-speed skill can predict written language after phonological ability has been controlled for, challenge the unitary phonological theory of written language difficulties.

INDEX

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