
Playing with nonwords: morphological skills in dyslexia

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1 Background

While phonological and morphological abilities are both crucial for the acquisition of reading, morphology has been found to play a pivotal role especially at later stages of literacy acquisition, as established by several studies finding correlations between morphological skills and reading achievements in alphabetic orthographies (Brittain 1970; Tornéus 1987; Carlisle 1995). On the other side, research on reading impaired populations showed that their morphological abilities are severely compromised (Elbro & Arnbak 1996). In particular, deficits have been found across several tasks assessing the abilities to isolate and blend morphemes (Casalis et al. 2004), in gender and number agreement (Jiménez et al. 2004; Rispens 2004) and in other domains of inflectional morphology (Joanisse et al. 2000; Vender et al. 2017).

2 Research questions

In view of the above, the present study aimed to address the following research questions:

1. Is there (and what is the extent of) the dyslexic disadvantage across domains of Italian inflectional and derivational morphology?
2. Which are the most problematic domains for Italian dyslexic children?
3. Are morphological skills able to predict reading proficiency?

3 Method

A protocol comprising morphological tasks and preliminary measures was administered to 16 Italian dyslexic children (DC; 10;2 years old, $SD = 1.15$) and 18 typically developing children (CC; 10;6 y.o., $SD = 0.88$).

All children were tested along the following preliminary measures: non-verbal intelligence (*CPM Raven*, Raven, Court & Raven, 1998), receptive vocabulary (*Peabody Picture Vocabulary Test* by Dunn and Dunn 2000, Italian standardization by Stella, Pizzoli and Tressoldi 2000), word and nonword reading accuracy and speed (Tasks 2. and 3. of the *DDE-2* by Sartori, Job, & Tressoldi 2007). Eleven morphological tasks elicited the production of a derived or inflected form of a nonword (as in Berko's 1958 original Wug Test) or the retrieval of the base of a morphologically complex nonword.

The adoption of a test with nonwords is crucial for understanding whether children are able to capture and correctly apply the relevant word formation rules/patterns to possible, yet nonexistent, words. Besides pseudo-noun pluralization, the focus of most tasks was on verb or verb-based formation, as with past participles, deverbal adjectives and nominalizations (Table 1). Conditions in each task manipulated base allomorphy in compliance with the base verb conjugation class for the verb related tasks (all tasks except 1. and 7.), while they manipulated declension classes for noun pluralization in task 1. (as in Vender et al. 2017 and Melloni et al. in press) and type of evaluative affix in task 7.

Table 1. Summary of the morphological tasks and type of ability tested

Task 1.	singular N > plural N	INFLECTION
Task 2.	infinitive V > past participle V	
Task 3.	infinitive V > Agent N in <i>-tore</i>	DERIVATION
Task 4.	infinitive V > Action N in <i>-mento</i>	
Task 5.	infinitive V > Action N in <i>-ta</i>	
Task 6.	infinitive V > Adjective in <i>-bile</i>	
Task 7.	base N > evaluative N (<i>-ino, -one, -accio</i>)	
Task 8.	N in <i>-tore</i> > infinitive V	BASE RETRIEVAL
Task 9.	N in <i>-mento</i> > infinitive V	
Task 10.	N in <i>-ta</i> > infinitive V	
Task 11.	N in <i>-bile</i> > infinitive V	

To illustrate stimuli and elicitation procedure, we can consider an inflection task, Past Participle formation (task 2.). This task required the subject to derive the past participle of a nonce verb. The child was presented with a character, Goofy, who performed some invented actions. The elicitation formula was: “Qui si è messo a pindare. Cos’ha fatto?” (target: Ha *pindato*). (‘Here he started to *pindare*_{inf}. What has he done? (He has *pindato*_{PastPart}’). There were 9 items, three for each condition, corresponding to the three Italian conjugations:

1. Condition 1: Infinitive *a-re* > *-a-to*, e.g. *pind-are* > *pind-ato* (I conjugation)
2. Condition 2: Infinitive *e-re* > *-u-to*, e.g. *nov-ere* > *nov-uto* (II conjugation)
3. Condition 3: Infinitive *i-re* > *-i-to*, e.g. *call-ire* > *call-ito* (III conjugation)

A typical derivation task, *-bile* adjective formation, requires the subject the subject to derive an adjective from the infinitive form of a nonce verb by adding the suffix *-bile*. The elicitation formula was: “Questa strada si può madare, quindi possiamo dire che è...(target: *madabile*)” (“This street can be *madare*_{inf}, then we can say that it is...*madabile*_{Adj}’). There were nine items, three for each condition, built in compliance with conjugation classes as in task 2.

A base retrieval task like 8. required the subject to retrieve the infinitive form of the base verb from a nonce noun suffixed with the (agentive) *-tore*. The elicitation formula was: “Al pifatore piace...(target: *pifare*)” (“The *pifatore* likes...*pifare*_{inf}’). In this case, we had six items, three for each of the two conditions formally corresponding to the I and III verb conjugations, since only derived forms in *-a-tore* and *-i-tore* are allowed in Italian (nominalizations from verb of the second conjugation are formally opaque, as the theme vowel *-e-* becomes *-i-* in the derived nominal, as in *miet-i-tore* ‘reaper’ < *miet-e-re* ‘to reap’).

As for the scoring system, one point was attributed for each correct item and no points for incorrect ones; no penalizations were given to mispronunciation errors if the target morphological operation was correctly performed (e.g. *pindare* > *pintato*).

4 Results

The results of the study revealed that DC performed significantly more poorly than CC in the morphological tasks ($p < .001$).

To compare their performances in each task, independent sample t-tests were run considering the general accuracy in each task; then, a multivariate analysis of variance

(MANOVA) was conducted, with performance in each condition of every task as dependent variable and Group (DC; CC) as fixed factor. The analysis run on performance in each task revealed that DC underperformed CC in nine out of eleven tasks, especially in all of the inflection tasks and base retrieval tasks and in three out of five derivation tasks. No differences between CC and DC were found in task 4. and task 7., assessing the ability to form deverbal nouns in *-mento* and to add evaluative suffixes to base nouns.

Finally, correlation and simple linear regression analyses were run between the general mean accuracy in all morphological tasks and the preliminary measures. Morphological skills turned out to be a relevant predictor for all reading measures, especially for accuracy (Table 2).

Table 2. Summary of linear regression analyses predicting reading outcomes based on morphological skills

	<i>B</i>	<i>SE B</i>	β	<i>t</i>	<i>p</i>
Word reading speed	14.054	4.086	.520	3.439	<.01
Nonword reading speed	6.754	2.916	.379	2.316	<.05
Word reading accuracy	8.597	2.530	.515	3.397	<.01
Nonword reading accuracy	8.394	1.763	.644	4.761	<.001

5 Discussion

The study provided clear answers to the research questions raised in section 2.

As for research question 1: Dyslexia emerges as a deficit severely affecting morphological skills, especially in (but not limited to) those tasks and conditions requiring fine morphological skills.

As for research question 2: Dyslexic children's performance was significantly poorer in inflection tasks, i.e. noun pluralization and past participle formation, and in tasks tapping the ability to retrieve the infinitival form of (invented) deverbal nouns.

As for research question 3: Morphological skills turn out to be a relevant predictor for all reading measures, especially for reading accuracy.

6 Implications

Morphological skills are impaired in dyslexic children and are relevant for predicting reading abilities, as measured by our Wug Test. Therefore, the results of this study could be taken as concrete indications for speech therapists and educators: morphology-based trainings should be further developed and deployed with the aim to improve dyslexics' reading skills (see Arnback & Elbro 2000; Bowers, Kirby & Deacon 2010). In the perspective of an inclusive education, instruction should insist on various aspects of metalinguistic skills, and especially on morphological skills, as a potential remediation strategy for reading deficits.

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