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Is Morphological Awareness a Relevant Predictor of Reading Fluency and Comprehension? New Evidence From Italian Monolingual and Arabic-Italian Bilingual Children

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In this study, we examined the contribution of morphological awareness to reading competence in a group of Italian L1 and Arabic-Italian early L2 children, i.e., exposed to Italian before 3 years of age. Children from first to fifth grade (age range: 6–11 years old) were tested on a range of morphological awareness and lexical tasks. Reading ability was tested through standardized tests of reading fluency and comprehension. Results showed that L1 children outperformed L2 on every measure of morphological awareness, as well as on reading tests. Regression analyses revealed that morphological awareness contributed to a different extent to reading ability across groups. Accuracy in the morphological awareness tasks was a significant predictor of word (and non-word) reading fluency in L1 and L2 first and second graders, while only in L1 third to fifth graders, response times and accuracy to a morphological awareness task explained a unique amount of variance in reading comprehension. Our results highlight the critical role of morphological processing in reading efficiency and suggest that a training inspired by morphological awareness may improve reading skills also in bilingual students.

Keywords: reading achievement, morphological awareness, derivational morphology, reading comprehension, L2 children, reading in L2 children

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INTRODUCTION

In recent years, research has often investigated the linguistic underpinnings of reading development, highlighting the role of phonological skills and vocabulary as significant predictors of literacy achievement (Gathercole and Baddeley, 1989, 1993; Baddeley et al., 1998). From this standpoint, adequate phonological skills are a prerequisite for the development of optimal phonological representations of words in the mental lexicon (Fowler, 1991), and, as a consequence, of reading development (e.g., Baddeley et al., 1998). This study goes further by exploring another possible linguistic predictor of reading: morphological awareness, i.e., the consciousness of how complex words are made up of smaller units and the ability to manipulate those units to generate a new word (Carlisle, 2000; Kuo and Anderson, 2006). Since evidence based on young or impaired readers suggest that they benefit from a morphological parsing strategy in reading (Casalis et al., 2004; in Italian, Burani et al., 2008; Angelelli et al., 2014), it appears important to explore the role that morphological awareness plays in reading development both in monolingual and bilingual populations. In this study, we tested the performance of monolingual and bilingual reading learners on a range of morphological awareness tasks and reading tests. By doing so, we aimed at gaining a clearer understanding of the relationship between morphological awareness and reading achievement.

It is known that reading development is a complex cognitive and linguistic process that involves several underlying cognitive abilities, such as phonological awareness, vocabulary, and grammatical skills (cf. Nagy and Townsend, 2012). According to the literature, however, beyond phonological awareness and orthographic competence, also morphological awareness might be considered an additional predictor not only of word reading fluency (Fowler and Liberman, 1995; Carlisle and Katz, 2006; Roman et al., 2009) but, most importantly, of reading comprehension (Deacon and Kirby, 2004; Nagy et al., 2006; Tong et al., 2011). Therefore, morphological awareness seems to be a potential, interesting, underlying ability that might significantly contribute to the study of reading development (Carlisle, 1995; Deacon and Kirby, 2004; Roman et al., 2009).

Let us now briefly summarize what is generally intended by morphological awareness. Morphological awareness refers to the metalinguistic consciousness that words are constituted of individual units (i.e., morphemes) which can be analyzed and manipulated in various ways (Carlisle, 1995; Derwing et al., 1995; Kuo and Anderson, 2006). Roughly, there are three types of morphological operations that allow the creation of new word forms: inflection, derivation, or compounding. Inflectional processes allow the modification of grammatical aspects of the word such as number, gender, and tense (e.g., boy-s; open-ed), while derivational operations generate new words by changing, in some cases, the meaning of the root (e.g., easy; un-easy) and usually (but not necessarily) its grammatical category (e.g., "strong-ly" is the adverbial form of the adjective "strong"; however "farmer" is a noun that derives from the noun "farm" and it is used to refer to the person who runs a farm). Compounding mechanisms, on the other hand, generate new words, combining two autonomous lexical units (dish and washer) into a new word (e.g., dishwasher).

This study will focus on derivational morphology. From a developmental perspective, derivational formation might require a deeper knowledge of the complex association between morphemes and their meanings. That is, morphological awareness of derived words' composition involves knowledge of the semantic underpinnings of prefixes (e.g., the un- in unpleasant, with the prefix involving a meaning of negation) and suffixes (e.g., the -er in sing-er, with the suffix -er denoting agentivity). For this reason, while inflectional morphology tends to develop relatively early, derivational morphology knowledge continues to develop throughout school years (Casalis and Louis-Alexandre, 2000).

It should be noted that a difficulty in processing derivationally complex words, whose meaning is often unfamiliar to students, might hinder reading and comprehension of a new text. Therefore, investigating to what extent morphological awareness might scaffold children's ability to read and comprehend complex unfamiliar words might have important practical implications. This study aims to answer this question by focusing on the contribution of derivational morphological knowledge on reading achievement.

Let us now focus on the specific role that morphological awareness might play in reading development in the course of literacy acquisition (Tong et al., 2011), by distinguishing the specific contribution it exerts on beginning vs. competent readers. In young readers (i.e., according to the Italian school system, first and second graders, that are still learning to read and that have not automatized the reading process yet), morphological decomposition ability might allow parsing the word by analyzing it in smaller units (Rispens et al., 2008). There is a bulk of evidence indicating that young Italian readers tend to implicitly parse a word in smaller units (morphemes; Burani et al., 2008) to facilitate the reading process. According to these studies, words with a morphological structure (e.g., cass-iere, "cashier") were read faster than simple words (e.g., cammello, "camel") matched for length and frequency. Interestingly, morphological parsing speeded up reading times only in second graders and in children with dyslexia, but not in older skilled children (Burani, 2010; Marcolini et al., 2011; Angelelli, 2010; Angelelli, 2017). The authors concluded that children acquiring a transparent orthography such as Italian exploit morpheme-based reading and spelling to face difficulties in reading long unfamiliar words. Even though the previous studies do not refer to an explicit measure of morphological awareness, they showed that (implicit) morphological processing enhances reading performance in Italian young readers by facilitating the parsing of a complex word through decomposition.

Note that such findings are in line with the claim that in lexical access, readers are sensitive to the internal morphological representation of orthographically transparent (Baayen et al., 1997; Marslen-Wilson and Tyler, 1997) as well as opaque words (i.e., where morpheme meanings are inconsistent with word meaning; Rastle et al., 2004). For instance, a series of masked priming studies indicated that "corner," which can be inappropriately segmented as corn + er (though a corner is not someone who "corns") facilitated word recognition of CORN as pairs like dealer-DEAL, where primes and targets entertain a genuine morphological relationship (Crepaldi et al., 2010). That is, according to these studies, lexical elaboration may be sensitive to the internal morphological representation but not to the semantics of the morphemes (Rastle et al., 2004).

Additional evidence (Amenta et al., 2015) indicates that early morphological analysis in lexical access is sensitive to the semantic representations of the individual morphemes even in opaque words. That is, reading the Italian word *bottone* (button), at a very early processing stage, would automatically activate the representation "bott-one" (loud thud), significantly slowing down first fixations of this morphologically opaque word (Amenta et al., 2015). Consequently, one might claim that when we access a word such as *secchione* (nerd) we also process its underlying surface morphological structure (secchione; big bucket).

Overall, such findings suggest that, once the decoding process in reading is automatized, morphological analysis and decomposition might support the ability to make lexical inferences about the internal structure of complex words. According to the literature, such competence might facilitate the comprehension of unfamiliar words (Carlisle, 2007), and, as a consequence, the comprehension of the whole text. That is, decomposition processes (of derived words) would facilitate the extraction of semantic and syntactic information that supports reading comprehension of connected text (Kieffer et al., 2013). Thus, morphological awareness appears as a critical prerequisite of lexical analysis not only at word-level but also at text-level promoting lexical inference along the course of literacy acquisition.

Note that the previous studies were conducted on monolingual children. But what do we know about the development of a metalinguistic ability such as morphological awareness in bilingual children? Recent studies on this topic provided compelling evidence, suggesting a strong bilingual advantage in the development of metalinguistic awareness (e.g., Bialystok et al., 2014). For instance, Bialystock observed that English speaking children who entered a French immersion program at school, outperformed their peers (enrolled in a monolingual program) when undertaking a series of metalinguistic tasks, among which was the well-known Berko's Wug Test (Berko, 1958), which is based on inflectional morphology and proposed in the L1 of the children, namely English. The authors conclude that after only 2 years in an immersion education program, children showed some of the metalinguistic advantages generally associated with fully bilingual children (Bialystok et al., 2008). Another recent study (Kuo et al., 2017) demonstrated that L1 Spanish and L1 English children enrolled in a dual (English–Spanish) program showed better morphological derivational awareness both in English and Spanish in comparison with their peers in general education. The development of metalinguistic skills, with a specific focus in derivational morphology, in bilingual children appeared to have been enhanced by cross-language transfer of cognate words, i.e., words that show an overlap in form and meaning across languages as well as by an increased sensitivity to structural language features. As the authors note, indeed, many low-frequency academic words in English derive from the same stem of high-frequency words in Spanish (e.g., English *tranquil* and Spanish *tranquilo*; Proctor and Mo, 2009).

Previous studies have tried to address a further issue, namely, the relationship between morphological awareness and reading fluency and comprehension in L2 children (Goodwin et al., 2011; Ramirez et al., 2011; Kieffer et al., 2013). A study conducted on Arabic-English children demonstrated that morphological awareness exerts a cross-linguistic influence on reading fluency: for instance, Arabic morphological awareness predicts English word reading (Saiegh-Haddad and Geva, 2008). However, additional studies confirm that the correlation between morphological awareness and reading fluency in L1 and L2 appears to be strongly mediated by a child's phonological awareness and lexical abilities in both languages spoken (Goodwin et al., 2011; Ramirez et al., 2011). Accordingly, Kieffer et al. (2013) showed that morphological awareness predicted reading comprehension but only when controlling for lexical competence. Overall, taking together the above-mentioned findings, one might conclude that morphological awareness might appear enhanced in bilingual speakers, but its role in reading development is strictly linked to the child's lexical knowledge.

This study was designed to test the contribution of morphological awareness to reading fluency and comprehension in monolingual and bilingual children. The first aim of this study was to disentangle the predictive ability of morphological awareness in the development of reading competence on 41 L1 Italian children whose age ranged from 6 to 11. The second aim was to compare the morphological awareness of 12 Arabic-Italian speakers (age range 6–11 years of age) with 12 age-matched L1 Italian speakers. By doing so, we meant to investigate to what extent this competence contributed to reading achievement in L1 and L2 learners. Given the fact that Italian L2 readers demonstrate slow and often inaccurate reading performance (e.g., Murineddu et al., 2006), investigating the effects of morphological awareness on reading ability in this population might provide theoretical and practical implications to improve their academic performance.

To sum up, we propose the following predictions, which might apply to both L1 and L2 children. First, if a child still relies on word decoding to read fluently, then morphological awareness should influence reading fluency at word-level (e.g., Burani et al., 2008). Second, if a child has fully automatized decoding, she or he must be able to access a lexical unit fully defined from an orthographic, lexical, and semantic perspective; then morphological knowledge should support higher-order skills such as reading comprehension, enabling readers to make inferences about the meaning of morphologically complex words. In such a case, morphological awareness, together with other factors such as lexical knowledge, should affect reading comprehension at text-level.

Note that such predictions might apply to L1 and L2 children depending on their inherent reading competence (Bellocchi and Genesee, 2012). It is important to remember that according to previous studies based on Italian L2 speakers (Murineddu et al., 2006), L2 children might show a delay in automatizing reading skills resulting in a profile of learning difficulty. We expect therefore that morphological awareness could play a different role in L1 vs. L2 groups, according to their stage of reading development.

MATERIALS AND METHODS

Participants

A total of 53 children who attended a local public primary school in the Milan area, Italy, participated in this study. Participants ranged in age from 6;1 (years;months) to 10;11 (mean age = 8;2, SD = 1;3) and were enrolled in first through fifth grade, according to the Italian school system (first grade: 6–7 years old; second grade: 7–8; third: 8–9; fourth: 9–10; fifth: 10–11 years old). Children were divided into two groups: Arabic-Italian speaking bilingual children (L2, $n = 12$; 5M; age range: 6;1–10;11; mean age = 7;7, SD = 1;4) and monolingual Italian (L1, $n = 41$; 16M; age range: 6;2–10;11; mean age = 8;5, SD = 1;3). L1 children were subsequently divided into two groups according to the class they belonged to: beginning readers *L1* (21 children; 8M; age range: 6;2–8;0; mean age = 7;6, SD = 0;3), involving only first and second graders, and competent readers *L1* (20 children; 8M; age range: 7;11–10;11; mean age = 9;7, SD = 1;3), involving third to fifth graders. Beginning and competent L1 readers significantly differed in chronological age ($t = 6.89$, $p < 0.001$).

The choice to select groups with respect to grades was grounded on the fact that, in Italian, a child's ability to read is known to become automatized and effortless from the third grade onward (Zoccolotti et al., 2009). That is, accuracy levels for word reading reach ceiling by third grade, with reading speed improving more slowly since then (Tressoldi et al., 2001). Further evidence relies on the fact that reading fluency of (low-frequency) words after third grade show a significant increase with respect to non-words reading (Orsolini et al., 2006). Additional data indicate that in Italian first and second graders, reading skills appear to be predicted to a great extent only by phonological awareness and RAN, while from third grade on reading competence is no longer influenced by phonological skills, but by vocabulary, RAN, verbal memory (digit span), and visuospatial attention (Tobia and Marzocchi, 2014). The authors propose that according to the level of reading automation, readers might selectively activate different cognitive mechanisms.

Regarding the L2 group, all children could be regarded as early bilingual (eight of them were born in Italy, four of them arrived before 2 years of age; cf. Kovelman et al., 2008). By early bilingual, we refer to children who were exposed to a (minority) language (i.e., Arabic) from birth as a first language (L1) and began to learn the L2 (Italian) after they had been enrolled in Italian-only kindergarten at age 3. For each of them, we collected information about their exposure in months to Italian by means of a simple questionnaire that was completed by the parents. By doing so, we were able to test whether (traditional) length of exposure could affect children's performance to morphological tasks and/or reading tests. In general, children had an average of 5;6 years of exposure (SD = 1;1) to L2 Italian as a curricular language in pre-school and school.

To compare their performance with monolingual peers, 12 L1 children (out of the total of 41 children) were matched as close as possible to the bilingual participants (L2 group) with respect to age (±2 months) and gender. The two groups did not differ with respect to age (months) ($t = -0.066$, $p = 0.948$).

All the children came from a middle-low SES background, as emerged from a questionnaire that all the parents had to fill in, indicating their job and educational level. In the L1 group, most of the parents had a high school or a university degree; in the L2 group, at least one parent in each couple attained a high school degree in the home country.

To be included in both (L1 and L2) groups, children had to meet a number of criteria. First, none of them had to report a cognitive, neurological, sensorial disability. Second, none of them had to be identified as needing special educational support (according to teachers' reports). Written informed consent was obtained from the parents of all participating children in compliance with the guidelines of our Ethical Committee. The protocol was approved by the Ethical Committee of the University of Milano-Bicocca (IBR: no. 20974/13).

Materials

To address our research question, participants in both groups took part in three experimental tasks of morphological awareness and one of lexical ability. In addition, they were administered a battery of standardized tests of reading fluency (word- and text-level) and comprehension.

Morphological Awareness and Lexical Tasks

To study morphological awareness and lexical competence, we created three computerized tasks that investigated morphological awareness both in comprehension and in production. The tasks were presented on a laptop computer using E-Prime software 1.2 (Schneider, 2002), and were designed to be individually executed by the child under the supervision of the experimenter. Participants received oral and written instructions. For Tasks 2 and 3, which involved an oral response of the child, answers were recorded and scored off line.

Task 1 tackles the comprehension of nominal derivational morphology. Children were simultaneously orally and visually presented with pairs of words and were asked to distinguish those that were morphologically (as well as lexically and semantically) related (as in "anello-anellino" *ring-little ring*) or not (as in "burro-burrone" *butter-ravine*), by pressing the YES or the NO button on the keyboard. Note that in this task (as well as and in the production Task 3, see below) we opted for a simultaneous visual and oral presentation. We did so because a visual-only presentation would have been deeply affected by the reading skills of participants. An oral-only presentation could be possibly affected by lack of listening comprehension of the verbal string (possible in L2 children, but also plausible in L1 ones). Therefore, longer RTs could be caused on the one hand by struggle with reading, on the other by a problem in listening comprehension. By simultaneously presenting both orally and visually our stimuli, we were able to control these possible sources of bias.

Both accuracy scores and RT measures were obtained for each trial. Participants were provided with 4 practice items, which were followed by the 32 experimental items (for a list of the experimental items, see Appendix A).

Task 2 was a production task: participants had to recognize a morphological (lexical–semantic) relationship between the object visually and orally presented in the first picture ("campana" *bell*) and the target picture that the child had to name (i.e., "campanile" *bell tower*). The test comprised 16 experimental trials in addition to 6 practice items. Each trial involved a picture and its verbal description and a morphologically related target picture that had to be named out loud. The accuracy of the verbal responses was assessed as dependent variable. In this task, in contrast to Task 1, children were exposed to a concurrent presentation of oral and pictured version of items. Also in this case, we opted for a simultaneous presentation to facilitate comprehension of the experimental items.

Task 3 was a production task: children were orally and visually presented with a sentence that could involve or not a lexical mistake (i.e., "*Gianni ha mangiato un arrosto di tacco" **Gianni ate roasted heel* or "Silvia coltiva la salvietta" **Silvia cultivates the towel*). They had to detect the anomaly (if present), and to correct it by generating an appropriate (non-morphologically and non-semantically, but phonologically related) word (i.e., "tacchino," *turkey*, instead of "tacco" heel or "salvia," *sage*, instead of "salvietta" *towel*). Note that, as shown in our example, the incorrect lexical item (tacco) and the target (tacchino) were semantically independent, but involved a surface morphological relationship, i.e., words were both made up of a pseudo-stem, which was shared with the targets, and of a pseudo-suffix. Therefore, to correct the sentence, participants had to generate a new word by adding (as "–ino" in "tacchino") or deleting (as –etta in "salvietta") a pseudo-suffix. Note that to accomplish the task (i.e., correct the sentence), children could select other semantic plausible but phonologically unrelated words, i.e., selecting an appropriate but non-target word (i.e., "pianta" vegetable). Therefore, if participants were able to identify the target word, it would suggest that they relied on the decomposition of the morphological structure of the opaque word ("salvi-etta") to access the target ("salvia") (cf. Amenta et al., 2015).

In each experimental list, we manipulated within items and within participants whether the sentence was correct or not. Therefore, among the total 12 sentences, only 6 sentences required a change of the word by adding a pseudo-suffix as –ino to generate *tacchino*, or by deleting it as –etta to produce *salvia*. In this task, we considered as dependent variables accuracy and RT.

Finally, Task 4, assessing lexical comprehension, was collectively administered. We asked children to choose a picture matching a target word (i.e., "tavolozza" *palette* or "pinna" *fin*) that was orally named by the experimenter, among a set of pictures representing: (i) the target item (a palette for "tavolozza"); (ii) in half of the experimental sets, an item that could be morphologically related (e.g., "tavolo" table with respect to "tavolozza" palette; Grossmann and Rainer, 2004); in the remaining half, an item phonologically related to the target (e.g., "penna" pen with respect to "pinna" fin); (iii) an item that could be semantically related (e.g., "pennello" *brush* with respect to palette); (iv) an item that could be semantically unrelated (e.g., "occhiali" *glasses;*). Each participant was provided with a booklet reporting four pictures for each experimental item and was told to mark the correct one. The 26 testing items (of which the first two served as practice trials and were thus excluded from the analysis) are reported in Appendix A.

Importantly, all words employed in the experimental tasks were drawn from classical studies of morphological masked priming conducted in Italian (e.g., Marelli et al., 2013; Amenta et al., 2015) or reading experiments run on Italian fourth and fifth graders with and without reading difficulties (Traficante et al., 2014).

Standardized Tests

Reading speed, accuracy, and comprehension scores were obtained from the administration of the following Italian standardized tests: MT-2 reading tests (Prove MT-2 di lettura per la scuola elementare, Cornoldi and Colpo, 2011), which provide accuracy and speed measures for passage reading and accuracy scores for passage comprehension; test of word and non-word reading (Prova di lettura di parole e non parole, Zoccolotti et al., 2005), in which speed and accuracy scores were computed for 30 multisyllabic (i.e., made up of three or more syllables) words balanced for frequency of use and 30 (multisyllabic) non-words.

Procedure and Design

The morphological awareness tasks (except for Task 4), as well as the reading tests (except for text reading comprehension), were administered in individual sessions. The procedure was as follows. As for Task 1, in four practice trials children were first trained to recognize whether the two words presented were related to each other. In the practice trials, after the simultaneous oral and visual presentation of the two words (e.g., "torta" *cake*, "tortina" *little cake*; or "colla" *glue*, "collina" *hill*), the female voice on the computer explained why two words were related to each other (i.e., "a little cake is a cake") or not ("a hill is not a little glue"). In the experimental phase, the recorded voice asked after each pair of words whether the child thought they were related or not. Children were told to press as soon as possible a button on the keyboard marked with "Sì" *yes* or "No" *no*, to provide their answer.

Regarding Task 2, children received both oral and written instructions. They were told that they would see a picture and hear a voice naming it, then a picture representing an item semantically and morphologically related to the previous picture would appear on the screen. Their task was to name it. Again, there were six practice trials to make sure that children understood the task. For instance, after seeing the picture of a pizza and hearing a voice pronouncing it, children saw the image of a pizza restaurant. If they said "ristorante" *restaurant*, they were corrected and invited to describe it using a word "related to pizza," namely "Pizzeria."

As for Task 3, children were simply told to listen to a series of sentences describing the pictures appearing on the screen. At the end of each sentence they had to press a button if they detected an anomaly ("a mistake") in the sentence, and if so, they had to correct it out loud. The experimenter recorded their answers and coded them off-line.

For production Tasks 2 and 3, non-target responses were coded as morphologically relevant or irrelevant depending on whether they involved a totally unrelated word from a morphological perspective (e.g., as in the case of "ristorante" instead of "pizzeria"), or whether the error referred to the choice of an incorrect suffix to derive the new word. For example, after hearing "sacco" *bag*, a child produced "*sacchino" instead of "sacchetto" (*little bag*). Literally, "*sacchino" is a morphologically well-formed word, but it does not exist in Italian.

To assess reading ability, participants had to read the lists of words and non-words and the passage according to their grade level. In the reading comprehension test, the participant had to silently read a text and answer multiple-choice questions, with the possibility of accessing the text. Speed (number of syllables read divided by time in seconds to read them) and accuracy (number of errors) were calculated. Raw accuracy scores were converted to standardized scores (z-scores).

In each testing session, administration of reading tests was interspersed with that of morphological awareness tasks. Therefore, participants were individually tested in two sessions, lasting approximately 20 min each. Only Task 4 (lexical comprehension task) and the standardized test of text comprehension were collectively administered to the whole group.

RESULTS

Data Treatment and Statistical Analysis

First RT data of morphological awareness tasks were trimmed to remove outliers. We excluded two types of outlier trials: outliers defined as any RTs shorter than 100 ms and outliers defined as

RTs that were 2.5 SDs slower than the relevant mean RT (Baayen and Milin, 2010). After excluding outliers, we calculated mean RTs across subjects. We could not add as an additional dependent variable "Non target responses" to Tasks 2 and 3, as we did not have enough data points to run the analysis. All statistical analyses were performed using the log-transformed data.

Both RT and accuracy data were fitted to a series of general linear models and mixed-effects models using the statistical environment R (R Core Team, 2014), and in particular the packages Rcmdr (Fox, 2017), lme4, and lmerTest (Kuznetsova et al., 2017). In each analysis, we tested whether a reading variable was significantly predicted by the performance (accuracy and speed) to morphological awareness tasks and to the lexical task. In this section, we report the results of the *t*-tests and a summary of the fixed effects of the final (linear and mixed effects) models. In each model, we used a stepwise model selection procedure to estimate whether the inclusion of the morphological variables considered (Task 1 accuracy and speed; Task 2 accuracy; Task 3 accuracy and speed; Task 4 accuracy) added information to the models' fit and had to be included. For each dependent variable, we started with a base model, and then added each individual factor. If adding each factor did not result in a significant gain of the model fit, we removed it from the final model (Baayen et al., 2008). In mixed-effects models (that involve a specification of the random effects structure too), we started with a base model that included only a by-participants and a by-items random intercept. Then, we tested whether the inclusion of a by-participants or by-items random slope for each significant factor improved the fit of the model in comparison with the base model. All the best fitting models involved a basic random structure (i.e., a by-participants and by-items random intercept). For completeness sake, all the final models are available at this link (https://docs.google.com/document/d/1NMX0A1gSkoy_VzlSH1AFCliGdgipvXGqr7S4C-3T9W0/edit?usp=sharing).

Analysis: L1 Competent vs. L1 Beginning Readers

Descriptive statistics (mean and SDs) for all the variables included in the study are reported in **Table 1** (morphological awareness tasks and lexical task) and in **Table 2** for standardized reading tests. For the sake of simplicity, we provide a short but hopefully clear summary of the statistical results we have obtained in the analysis that compares competent vs. beginning readers on **Table 3** (first two rows).

First, we compared the performance of monolingual competent vs. beginning readers on the experimental tasks and standardized tests by means of a series of independent samples comparisons (*t*-tests). Regarding the morphological awareness tasks, there was a significant difference only in RTs of the production Task 3 [t (39) = −2.086, $p < 0.04$], with competent readers being significantly faster than beginning readers. Regarding reading tests, beginning readers' performance was, as expected, significantly slower, but not less accurate, when compared with competent readers: differences were significant with respect to reading times of non-words [t (39) = 2.164, $p < 0.037$], words [t (39) = 3.576, $p < 0.001$], and passage reading [t (39) = 2.667, $p < 0.011$].

TABLE 1 | Descriptive statistics (mean and SDs) of all variables for the morphological awareness tasks and for the lexical comprehension task in the L1 competent and beginning readers groups.

Variable	Comprehension Task 1				Production Task 2		Production Task 3				Lexical comprehension Task 4			
	Accuracy (proportions of accurate responses)		RT		Accuracy (proportions)		Accuracy (proportions)		RT		*z*-Scores		Raw scores	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Competent readers (L1)	0.80	0.15	4,290.89	1,124.40	0.75	0.12	0.82	0.13	7,542.94	2,158.00	0.35	0.58	23.15	1.72
Beginning readers (L1)	0.75	0.14	4,255.97	507.83	0.69	0.17	0.78	0.10	9,214.06	2,495.42	0.27	0.69	22.91	2.04

TABLE 2 | Reading and spelling performances of L1 competent and beginning readers on the standardized reading tests.

Variables	Word				Non-word				Passage reading				Text comprehension	
	Speed syll/s		Accuracy (*z*-Scores)		Speed syll/s		Accuracy (*z*-Scores)		Speed syll/s		Accuracy (*z*-Scores)		Accuracy (*z*-Scores)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Competent readers (L1)	3.33	1.37	−0.07	1.40	1.59	0.59	0.37	0.81	2.90	1.18	−0.51	0.78	−0.29	0.88
Beginning readers (L1)	2.08	0.82	−0.22	1.23	1.25	0.42	0.15	0.62	2.12	0.62	−0.07	0.90	−0.15	0.55

TABLE 3 | Summary of the results of the GLMs that were conducted to test the predictive role of morphological awareness variables on reading skills.

	Morphological awareness predictors					
	Comprehension Task 1		Production Task 2	Production Task 3		Lexical comprehension Task 4
	Accuracy	RT	Accuracy	Accuracy	RT	*z*-Scores
L1 competent readers	–	–	–	Text comprehension	Text comprehension	Text comprehension word (speed)
L1 beginning readers	NW (speed) NW (accuracy) Word (speed) Word (accuracy)	–	NW (speed) Word (speed)	Word (accuracy)		Passage reading (accuracy) Text comprehension
L2	Passage reading (speed)	–	NW (accuracy)	NW (accuracy)	–	Text comprehension

TABLE 4 | Descriptive statistics (mean and SDs) of all variables for the morphological awareness tasks and for the lexical comprehension task in L2 children and in L1 peers matched for chronological age.

Variable	Comprehension Task 1				Production Task 2		Production Task 3				Lexical comprehension Task 4			
	Accuracy (proportions of accurate responses)		RT		Accuracy (proportions)		Accuracy (proportions)		RT		*z*-Scores		Raw scores	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
L1	0.73	0.15	4,263.07	598.13	0.64	0.14	0.76	0.13	9,324.59	2,807.03	0.41	0.46	23.17	1.34
L2	0.63	0.14	4,697.88	1,232.86	0.48	0.26	0.63	0.13	8,092.66	1,355.49	–1.05	1.30	19.00	3.86

Second, a series of linear models were conducted to determine the specific contribution of morphological awareness measures on reading ability. In the models reported in this section of the paper and in all the subsequent ones, the sign of the coefficient assumes a positive value, denoting that the odds for an accurate/fast reading performance become larger when responses to the morphological tasks are more accurate/faster.

In the beginning readers group, the two reading fluency components (accuracy and speed) were differentially affected by morphological awareness. Regarding non-words, speed was significantly predicted by accuracy to the comprehension Task 1, e.g., establishing whether a pair of words was morphologically related or not (estimate = 0.892, SE = 0.698, $t = 3.725$, $p < 0.001$) and the production Task 2 (estimate = 1.668, SE = 0.604, $t = 2.760$, $p < 0.013$). The only significant predictor of non-words reading accuracy was again accuracy to the comprehension Task 1 (estimate = 0.635, SE = 0.766, $t = 3.579$, $p < 0.002$).

Word reading speed was significantly predicted by accuracy to the comprehension Task 1 (estimate = 0.890, SE = 1.347, $t = 3.749$, $p < 0.001$) and to the production Task 2, e.g., transforming a base word into a derived one (estimate = 0.678, SE = 1.166, $t = 2.858$, $p < 0.010$). Word reading accuracy was predicted by accuracy to the comprehension Task 1 (estimate = 4.462, SE = 1.346, $t = 3.316$, $p < 0.004$) and to the production Task 3 (e.g., correcting a short sentence by generating a new word that involved the same pseudo-stem but a different pseudo-suffix) (estimate = 4.921, SE = 1.871, $t = 2.630$, $p < 0.017$). Finally, accuracy to the lexical comprehension Task 4 appeared to be the unique significant predictor of the accuracy to passage reading (estimate = 0.713, SE = 0.190, $t = 3.729$, $p < 0.001$) and comprehension (estimate = 0.127, SE = 0.054, $t = 2.359$, $p < 0.0292$).

In the competent readers group, a general result indicated that reading fluency variables were not significantly predicted by performance to morphological awareness tasks, while reading comprehension was strongly influenced by accuracy and RT measures of the production Task 3 and by accuracy to the lexical Task 4. Regarding reading skills, only accuracy to the lexical Task 4 predicted word reading speed (estimate = 0.401, SE = 0.161, $t = 2.495$, $p < 0.022$).

Remarkably, reading comprehension scores were significantly predicted by both accuracy (estimate = 8.686, SE = 2.51, $t = 3.457$, $p < 0.003$) and RT data (estimate = 0.00029, SE = 0.001, $t = 2.68$, $p < 0.0164$) in the production Task 3, as well as by accuracy to the lexical comprehension Task 4 (estimate = 0.39, SE = 0.183, $t = 2.123$, $p < 0.049$). No other effect was found in this group.

To sum up, while reading speed and accuracy were positively related in first and second grade to morphological awareness tasks, in competent readers reading comprehension was predicted only by accuracy and speed measures in the production Task 3. In competent readers, the stronger predictor of both word reading and text comprehension appeared to be lexical competence (i.e., accuracy to the lexical Task 4). Overall current results suggest that in beginning readers reading fluency at word-level was significantly affected by morphological awareness (accuracy), while in competent ones accuracy and speed in a morphological task, together with accuracy to the lexical task, showed a predictive role for reading comprehension.

Analysis: L1 vs. L2

The second research question concerned the relationship between morphological awareness and reading measures of L2 children in comparison with their monolingual peers. **Tables 4** and **5** report the mean and the SDs of the L2 and L1 groups on the

TABLE 5 | Reading and spelling performances in L2 children and in L1 peers matched for chronological age on the standardized reading tests.

Variables	Word				Non-word				Passage reading				Text comprehension	
	Speed syll/s		Accuracy (z-Scores)		Speed syll/s		Accuracy (z-Scores)		Speed syll/s		Accuracy (z-Scores)		Accuracy (z-Scores)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
L1	2.75	1.20	–0.35	1.13	1.42	0.44	–0.44	0.70	2.66	0.86	–0.76	0.86	–0.35	0.90
L2	2.58	1.49	–1.61	1.82	1.59	0.61	0.43	1.12	2.05	0.90	–3.95	4.53	–0.46	0.33

morphological awareness measures and standardized tests of reading ability. **Table 3** (third and fourth rows) report a synthetic summary of the statistical results we have obtained when comparing L1 vs. L2 groups. Note that, due to the reduced number of L2 children (12), we did not conduct a separate analysis comparing beginning and competent readers in this sample. In addition, based on the evidence that L2 children might possibly show delayed achievements in reading when compared with L1 (cf. Murineddu et al., 2006), one might not safely assume that L2 children, in comparison with L1 ones, master decoding skills by third grade.

First, we tested whether the two groups differed on morphological awareness skills (accuracy and RT) as well as on reading ability by means of a series of independent mean comparisons (*t*-tests). As for morphological tasks, when we considered accuracy as dependent variable, L1 children performed better than L2 in basically all tasks [production Task 2: $t\ (22) = 2.024$, $p < 0.054$; production Task 3: $t\ (22) = 2.384$, $p < 0.026$; lexical comprehension Task 4: $t\ (22) = 3.532$, $p < 0.002$], except for the comprehension Task 1 (e.g., establishing whether a pair of words was morphologically related or not), where the difference did not reach significance [$t\ (22) = 1.666$, $p = 0.11$]. Interestingly, group difference was no longer significant when we considered the RT data of the morphological awareness tasks as a dependent variable. Regarding reading tests, L2 were significantly less accurate when compared with their L1 peers in word reading accuracy [$t\ (22) = 2.037$, $p < 0.054$]. However, interestingly, in non-word reading accuracy, L2 significantly outperformed L1 children [$t\ (22) = -2.272$, $p < 0.033$].

As the L2 group was not balanced for age, we further conducted a series of linear models and linear mixed-effects models to test whether the contribution of age (in months) and/or length of exposure to Italian (in months) could possibly interact and eventually overcome the effect of group. Therefore, by means of a models comparison procedure, we evaluated the contribution of all these factors (group, age, length of exposure to Italian) on morphological tasks as well as on reading ability. Regarding the morphological tasks, accuracy appeared to be significantly affected by length of exposure in Tasks 1–3; however, the first level effect of group remained significant (marginally in Task 1) and had to be kept in the models [Task 1: reference level: L2; estimate = −0.46, SE = 0.25, $t = -1.83$, $p < 0.06$; Task 2: reference level: L2; estimate = −1.121, SE = 0.322, $t = -3.47$, $p < 0.001$; Task 3: estimate = −1.011, SE = 0.23, $t = -4.39$, $p < 0.001$] as demonstrated by a series of mixed-effects models.

In the lexical comprehension Task 4, there was a significant effect of group [reference level: L2; estimate = −4.166, SE = 1.18, $t = -3.532$, $p < 0.001$], with chronological age and language exposure not contributing information to the model (all p's > 0.45). Similarly, the group differences found in the reading tests were confirmed even when we included length of exposure to the models [non-word reading accuracy: reference level: L2; estimate = 0.834, SE = 0.34, $t = 2.46$, $p < 0.022$; word reading accuracy: estimate = −1.229, SE = 0.0595, $t = -2.064$, $p < 0.0516$].

Analysis: L2

Again, we conducted a series of general linear models to test whether measures of morphological awareness predicted reading skills in bilingual development too. Importantly, in all the models we controlled whether the length of exposure to Italian contributed or not to the models' fit or not. For simplicity sake, we will report only significant results related to the morphological awareness measures and reading tests. Regarding non-words, accuracy was significantly predicted by accuracy in the production Task 2 (estimate = 5.036, SE = 1.470, $t = 3.427$, $p < 0.007$) and partially by accuracy in Task 3 (estimate = 6.195, SE = 2.978, $t = 2.080$, $p < 0.067$). When we considered passage reading speed as a dependent variable, accuracy to the comprehension Task 1 significantly contributed to the model (estimate = 4.174, SE = 1.584, $t = 2.634$, $p < 0.025$). In addition, accuracy to the lexical comprehension Task 4 appeared to be the only significant predictor of the accuracy in the passage comprehension test (estimate = 0.573, SE = 0.019, $t = 2.923$, $p < 0.015$). No other significant effect was found.

Overall, in the L2 group, we observed a pattern of results that resembled to a certain extent that of L1 beginning readers: morphological awareness predicted non-word reading accuracy, as well as passage reading speed, indicating that it contributed to reading ability at word level. However, none of the morphological variables, except for lexical ability, predicted reading comprehension, thus suggesting that at least in this sample, morphological awareness might contribute to text-level decoding, but not to comprehension.

DISCUSSION

In this study, we explored the extent to which morphological awareness affects reading fluency and comprehension in monolingual (L1 Italian) and bilingual (Arabic-Italian) children coming from low SES background. We experimentally tested this research question by designing three tasks of morphological awareness: one of comprehension and two of production. In addition, we evaluated students on a lexical task and on a range of standardized reading fluency and comprehension tests. Our results provided evidence supporting the existence of a general correlation between an *explicit* measure of morphological awareness to word derivation and reading ability (Kirby et al., 2012). Remarkably, as far as we are aware this is the first demonstration in Italian since the bulk of the current studies was conducted so far in English or Dutch (languages with opaque orthography).

Our findings suggested that morphological awareness is strictly intertwined with reading ability, though this relationship appeared to evolve significantly along with age, with crucial variations across different developmental populations. Let us start by discussing the outcomes observed in the monolingual sample. The data about L1 children highlighted two main findings: morphological awareness seems to influence word recognition and decoding early on during reading development, while in the last grades of primary school it showed a higher predictive impact on comprehension processes.

The pattern of results in the L1 beginning readers approached previous studies suggesting that decomposition of complex words (or even multi-morphemic non-words) into morphemic units supports reading ability in younger readers (Burani et al., 2008; Marcolini et al., 2011; Traficante et al., 2011). According to the above-mentioned literature, morpheme-based reading might allow children to read units smaller than the whole word, but bigger than the grapheme or the syllable (see, for instance, Angelelli et al., 2014). Our study adds to the previous research, by providing compelling evidence about the fact that an *explicit* measure of morphological awareness could be accounted as a significant predictor of accuracy and speed in words, non-words, and passage reading. Therefore, this might be an evidence that poor morphological representations and decomposition skills in children who are learning to read might be causally related to problems in reading fluency.

Data of the competent readers revealed a remarkably different pattern of results: morphological awareness and mostly lexical ability (i.e., accuracy to the lexical Task 4) played a significant role in predicting reading comprehension skills. Conversely, there was no contribution of morphological awareness to reading fluency. That is, results based on skilled readers revealed that, once lexical access is automatized in reading, involving direct access to a lexical unit fully defined from an orthographic, morphological and semantic perspective, morphological knowledge as well as vocabulary support comprehension skills, presumably allowing readers to make inferences about complex words in the text.

Note that this pattern of findings might appear hard to reconcile with a well-accepted view under which the relation between morphological awareness and reading achievement increases with age and grade level (Nagy and Anderson, 1984; Anglin, 1993). By contrast, we observed that awareness of derivational morphology predicts reading fluency in first and second graders, while from third grade on, it appears to support only reading comprehension.

Even though we have observed that from third to fifth grade, morphological awareness no longer contributes to word decoding, it is important to note that, according to the literature, some changes in the (implicit) processing of morphologically complex words might still occur in this time window. For example, Hasenäcker et al. (2017) indicate that morphemes progressively emerge as units of word recognition in the course of reading development in German children from 7 years of age up to 9, with peculiar differences between types of affixes (compound, suffixes, etc.). Dawson et al. (2017) report qualitative differences in the way English-speaking 7- to 9-year-old process complex words when compared with young and older adolescents, suggesting that (implicit) morphological processing continue to develop up to early adolescence.

In general, it is presumable that morphological knowledge, as a metalinguistic skill, entails not only a lexical–semantic and syntactic component but also a phonological processing instance. All these sources of morphological information are differentially at stake in specific stages of reading development. In early reading achievement, for instance, awareness of words composition relies over and above the level of phoneme, contributing to decoding skills (e.g., Mann and Singson, 2003; Deacon and Kirby, 2004); later in the development of reading, awareness of the lexical–semantic decomposition of a complex word seems to support comprehension only indirectly through word reading (e.g., Deacon et al., 2014). Under this view, our data provide further evidence supporting the idea that morphological awareness increasingly supports reading achievement along the course of development, but that the nature of its role evolves over time.

The second question that this study addressed was whether morphological awareness in L2 children would be able to predict reading skills to the same extent as in L1. In general, L2 children showed a significantly poorer performance when compared with L1 children with respect to both morphological awareness ability and reading skills. At a more fine-grained level of analysis, considering the performance in single tasks, L2 children underperformed compared with monolingual children in tasks assessing morphological awareness and lexical ability. In particular, accuracy in the production Tasks 2 and 3 was significantly lower than in L1 children, while no difference was found for RTs. As for the accuracy in these tasks, there were a number of non-target responses that involved the choice of an incorrect suffix to derive the new word (i.e., producing "*sacchino" instead of "sacchetto" little bag). Even though this type of error occurred in both groups, it was more likely in L2 children (though the number of data points was too small to perform a reliable analysis), indicating that the performance to the production tasks depended to a great extent on children's lexical knowledge. Perhaps most interestingly, it also indicated that children relied on morphological rules to produce a new word. Future research should focus on disentangling the causes of difficulties that emerged in our L2 sample, possibly due to a lack in lexical knowledge, from their derivational morphological skills.

Overall, our findings are in line with a number of previous studies (cf. Goodwin et al., 2011; Ramirez et al., 2011). For instance, a research based on a population of Spanish-English bilinguals coming from low SES background (Park et al., 2014) revealed that L2 children underperformed monolinguals both on accuracy and RTs in two tasks of morphological awareness (morpheme blending and morpheme generation). To account for the differences found on morphological awareness in these groups, the authors propose a bilingual lexical interference explanation. Namely, bilinguals activate two competing lexical entries for the same word (Grosjean, 2001; Marian and Spivey, 2003), which might additionally involve multiple derived representations in each language. However, building on the fact that results were based on bilinguals whose L2 lexical knowledge, as well as linguistic stimulation, appeared to be impoverished, it is possible that it was not bilingualism *per se* to hamper morphological processing. Recall indeed that there is strong evidence for a bilingual advantage on metalinguistic tasks, among which morphological awareness (Bialystok et al., 2014). Therefore, even in our study, it is possible that poorer morphological representation in bilingual children could be due to a reduced L2 vocabulary size, in particular with respect to those words used in our tasks that were somewhat less common in the everyday life.

Regarding standardized tests, L2 children's accuracy on word reading was significantly lower when compared with their monolingual peers. Conversely, in non-word reading, the significant difference indicated a better performance of L2 children. This pattern of results confirms that reading in bilingual children might be characterized by an over-reliance on sub-lexical processing mechanisms; this tendency seems to significantly facilitate non-word reading, while critically hindering word reading efficacy. Note that such finding is in line with previous research based on early L2 Italian pre-school children, which showed a performance on non-word repetition comparable to their monolingual peers. By contrast, their ability in other tasks of morpho-syntactic knowledge appeared significantly lower with respect to monolinguals, though not directly comparable to that of SLI children (Vender et al., 2016).

Again, note that it was not the aim of this article to disentangle whether word decomposition in reading was based on grapheme–phoneme correspondence or on the morphological structure. Indeed, in contrast to previous studies that manipulated on purpose the morphological structure of lexical reading stimuli, we relied on already existing standardized reading tests to evaluate children's reading ability. Our results simply indicate that morphological awareness stands out as a strong linguistic underpinning of lexical decoding in learning to read during the early years, or in older readers such as bilinguals coming from low SES, who still struggle to read.

With regard to the effects of morphological processing efficiency on bilingual reading, we observed that accuracy in morphological awareness tasks predicted non-word reading fluency, while efficiency in morphological awareness tasks was a significant predictor of passage reading accuracy. In addition, lexical ability (assessed by means of accuracy to the lexical Task 4) did not predict reading fluency, but only text comprehension skills. That is, lexical competence exerted its predictive effect only on text comprehension, suggesting that learners, whether bilingual or monolingual, nearly exclusively relied on vocabulary to comprehend a text. Such pattern of results suggests that, as in L1 beginning readers, in L2 children morphological processing supports word (text) and non-word decoding, while vocabulary skills seem to be involved in text comprehension. Therefore, one might claim that reading at word-level appears to rely on decomposition processes that are supported by morphological skills, while comprehending a text is almost exclusively predicted by the lexical competence of the reader at least in L1 beginning readers and in L2 children.

Regarding lexical ability, in contrast to previous research revealing a strong correlation between L2 vocabulary size and the probability of a correct reading aloud performance (Primativo et al., 2013), we did not replicate such finding, as lexical ability appeared to be involved only in text comprehension also in L2 children. However, such difference could possibly be due to the fact that, in comparison with previous studies that contrasted both a receptive and expressive component of vocabulary, in the current one we tested only lexical comprehension.

In general, given the different role that morphological awareness appears to play along the course of reading development, it should be important to consider such skill to improve the ability to read not only in children who are learning but also in populations who struggle with reading, such as bilinguals whose L2 knowledge is somewhat impoverished. In the literature, a range of possible interventions based on morphological awareness instructions is reported. Kuo and Anderson (2006), for instance, suggest that, in reading, placing a syllable break based on the morphological structure of the word would help children to recognize the deep structure of a word. To exemplify, the pronunciation of *-ive* in *suggestive* would involve a syllable break as it is a derivational suffix but it would not if it is part of a word such as *arriv-e*. Again, for words like *peeled* (involving two morphemes: peel-ed) and *field* (one morpheme), which sound similar but involve a different spelling, stressing the -ed morpheme in *peeled* would offer students a clarification of the different spellings (Nunes et al., 2006). By doing so, children will be more conscious of the fact that apparently similar sub-units (or pseudo-units) of words involve a different and specific relationship to grammar. Another evidence suggesting the benefits coming from hyphenation in marking morphological structure come from an eye-tracking study by Häikiö et al. (2011). These authors showed that Finnish children in the early stage of reading processed more easily hyphenated compound words than concatenated ones, suggesting that they strongly rely on morphemes when processing compounds (see Colé et al., 2012 for similar evidence from French children). In general, knowledge of the deep morphological structure of a word would allow children to improve their phonological processing difficulties in reading and spelling (Goodwin and Ahn, 2010).

We are conscious of the fact that this research presents some limitations. First, we cannot exclude that the morphological tasks used in this study, involving real words' root and real derivational suffixes were meant to measure morphological awareness could, in fact, be influenced by lexical knowledge of the suffixed and/or pseudo-suffixed words. In our study, by using accuracy to the lexical Task 4 as a measure of vocabulary skills, we were able to disentangle any influence of lexical competence on reading fluency that was exerted by the morphological variables. Note however that, since we used a non-standardized measure of lexical ability, that was not yet correlated with other (standardized) measures of vocabulary, we might not be completely sure whether such lexical measure assessed vocabulary size or a more general lexical comprehension ability. As a consequence, one might not exclude that the difference that emerged between L1 and L2 groups could have been due to lexical knowledge (or vocabulary size) and not only to morphological knowledge *per se*. Note, however, that this might be considered a problem for most of the tasks in the literature on (derivational and inflectional) morphological awareness (cf. Carlisle, 2000, Singson et al., 2000; Kieffer and Lesaux, 2012), involving the transformation of real roots into new derived words by using real suffixes. Therefore, even in those studies, one cannot exclude the contribution of lexical competence on morphological awareness achievement.

One way out of this dilemma would be creating a series of morphological awareness tasks involving pseudoword material, attesting that children are able to apply productive rules to generate derivations of novel words. If the child can provide the correct derived form of a non-existing word, we might have rather uncontroversial evidence that the child possesses and is able to apply the derivational rules. To date, morphological tasks involving non-words appear to be mostly used to test competence for inflectional rules (as in the popular Wug Test; see in Italian, for instance, Vender et al., 2017). It appears therefore that a morphological awareness task constructed on nonsense material might represent a promising future path of our work.

Second, we did not directly test children on measures of linguistic processing in L1 and L2, such as phonological skills and awareness, syntactic competence and working memory, as well as a standardized measure of vocabulary. By evaluating linguistic abilities, one could possibly assess to what extent other linguistic components interact with morphological awareness in reading achievement along the course of development. In particular, it would be of interest to test the relationship between morphological processing and phonological elaboration. As we proposed previously, it is possible that in the initial stages of learning to read the awareness of the linguistic units of a word is strictly intertwined with its phonemic representation. Therefore, the relationship of phonological and morphological awareness deserves further investigation in future studies, also with reference to the possible interventions targeting the extent to which morphological processing might improve depleted phonological abilities.

Considering the bilingual group, to draw clear conclusions regarding differences between them and their monolingual peers, a more detailed account of the role of proficiency in their L1 as well as L2 should be more specifically addressed in further studies. In addition, this study does not offer an exhaustive evaluation of the role of SES and of cumulative length of exposure to Italian (rather than traditional; cf. Unsworth, 2013). To reconcile with these limitations, note, however, that all the children were selected from the same school and therefore they lived in the same area and had comparable educational exposure. As reported earlier, an important contribution in this direction would be disentangling to what extent (L2) children show the ability to apply derivational rules irrespective of their lexical knowledge. In this study, we observed such tendency, however, due to the low number of errors produced we could not analyze the data.

In summary, this findings suggest that morphological awareness is a crucial construct to consider in reading development not only in monolingual children but in bilingual too, as it might offer an independent contribution earlier to reading decoding and comprehension in later grades of primary school.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of The Ethical committee of the University of Milano-Bicocca with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the Ethical committee of the University of Milano-Bicocca.

AUTHOR CONTRIBUTIONS

MV: conception and design of the work; data collection; data analysis and interpretation; drafting the article. EP: critical revision of the article. MV and EP: final approval of the version to be publishable.

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APPENDIX A

Task 1. List of the 32 experimental sets of words involving an opaque (1–16) vs. transparent morphological relationship (17–32). [English translation in brackets].

1. mulo (mule) mulino (mill); 2. botto (blow) bottone (button); 3. pulce (flea), pulcino (chick); 4. fiore (flower), fioretto (foil); 5. matto (mad), mattino (morning); 6. spunto (cue), spuntino (snack); 7. burro (butter), burrone (ravine); 8. bolla (bubble), bolletta (bill); 9. pollo (chicken), pollice (thumb); 10. latte (milk), lattuga (lettuce); 11. spina (thorn), spinacio (spinach); 12. lente (lens), lenticchia (lentil); 13. riva (shore), rivale (rival); 14. lava (lava), lavagna (blackboard); 15. tappo (cap), tappeto (carpet); 16. pista (trail), pistola (gun); 17. fieno (hay), fienile (barn); 18. calcio (soccer), calciatore (soccer player); 19. sasso (stone), sassata (throwing of a stone); 20. neve (snow) nevicata (snowfall); 21. tovaglia (cloth), tovagliolo (napkin); 22. forno (oven), fornaio (baker), 23. giardino (garden), giardinaggio (gardening); 24. cane (dog), canile (kennel); 25. lago (lake), laghetto (pond); 26. tubo (tube), tubetto (little tube); 27. zaino (backpack) zainetto (small backpack); 28. porta (door) portone (doorway); 29. anello (ring) anellino (little ring); 30. casa (house) casina (small house); 31 fontana (fountain) fontanella (small fountain); 32. asino (donkey) asinello (*little donkey*).

Task 2. List of the 16 sets of words (prime and target). [English translation in brackets].

Gelato (ice-cream), gelataio (ice-cream man); 2. Giardino (garden), giardiniere (gardener); 3 pane (bread), panettiere (baker); 4 dente (tooth), dentista (dentist); 5 libro (book), libreria (bookshop); 6 campana (bell) campanile (bell tower); 7 ghiaccio (ice) ghiacciolo (ice lolly); 8 gioco (game) giocattolo (toy); 9 borsa (bag) borsetta (handbag); 10 cesto (basket) cestino (trash can); 11 pentola (pot) pentolone (cauldron); 12 sacco (bag) sacchetto (small bag); 13 cappello (hat) cappellino (cap); 14 cioccolato (chocolate) cioccolatino (chocolate praline); 15 tazza (cup) tazzina (small cup); 16 villa (house) villetta (small house).

Task 3. List of the experimental materials used in the morphological awareness production task. [English translation in brackets].

Le piante amano il sole. I suoi raggi ne favoriscono la crescita/crescenza. [Plants love the sun. Its rays favor its growth/growth (unusual)].

In estate andiamo nel bosco a raccogliere i lamponi/lampi. [In summer we go on the countryside to pick up the raspberries/thunders].

Il caffè è in dispensa nel suo barattolo/baratto. [Coffee is in the pantry in its jar/barter].

Aprendo tutto il rubinetto l'acqua esce con un bel getto/gettone. [By opening up the tap the water comes out with a nice jet/coin].

Il cane lo ha morso al polpaccio/polpo. [The dog has bitten him on the calf/octopus].

Carlo ha preparato l'arrosto di tacchino/tacco. [Carlo has prepared roasted turkey/heel].

La casa è sollevata dal tifone/tifo. [The house was raised by the typhoon/typhus].

Intorno allo stadio si sono verificati degli scontri/scontrini. [Around the stadium there have been clashes/sales receipts].

Nel suo orto Silvia coltiva la salvia/salvietta. [In his garden Silvia cultivates sage/towel].

In quella foto il nonno indossava una bombetta/bombola. [In that photo granpa wore a bowler hat/tank].

Il quadro è appoggiato sul cavalletto/cavallo. [The picture is resting on the easel/horse].

Sabato Marina è andata al circo/circuito. [Saturday Marina went to the circus/circuit].

Task 4. List of experimental materials used in the lexical comprehension task. [English translation in brackets]. In each row of the following list, the first word refers to the target item that was orally named by the experimenter; the second one refers to an item morphologically (items 1, 3, 4, 5, 7, 12, 15, 16, 18, 19, 21, 23, 26)/phonologically (items 2, 6, 8, 9, 10, 11, 13, 14, 17, 20, 22, 24, 25) related to the target; the third one to an item semantically related to the target; the fourth to an item unrelated to the target.

(1) ombrello [umbrella], ombra [shadow], bastone [stick], albero [tree];
(2) petali [petals], pedale [pedal], foglia [leaf], pentola [pan];
(3) ortaggi [vegetables], orto [vegetable garden], frutta [fruits], vaso [flower pot];
(4) bagno [bathroom], bagnino [lifeguard], acqua [water], guardia [policemen];
(5) campanile [bell tower], campana [bell], chiesa [church], mongolfiera [hot-air balloon];
(6) calice [chalice], camice [doctor's coat], tazza [cup], teiera [teapot];
(7) tubo [pipe], tubetto (dentifricio) [tube], canale (d'acqua) [gutter], boccia (pesci) [fish bowl];
(8) ardere [burn], radere [shave], fulminare [strike (by lightning)], nascere (pulcino) [to be born];
(9) vitello [calf], vite [grapevine], mucca [cow], gallina [chicken];
(10) stoppino [wick], stop [stop (road sign)], torcia [torch], regalo [present];
(11) gomitolo [ball of wool], gomito [elbow], ago e filo [needle and thread], coltello [knife];
(12) manubrio [handlebars], mano [hand], volante [steering wheel], gomito [elbow];
(13) pinna [fin], penna [pen], balena [whale], latte [milk];
(14) lampo [lightening], lampone [raspberry], pioggia [rain], cavallo [horse];
(15) palo [pole], paletto [stake], tronco [trunk], cime montuose [mountain peaks];
(16) coppetta [bowl], coppa [cup (winner)], tazza [mug], scacchi [chess];
(17) colla [glue], collina [hill], forbici [scissors], albero [tree];
(18) lancette [hands (clock)], lancia [spear], ago [needle], ascia [ax];
(19) scuola [school], scolaro [pupil], libri [books], letto [bed];
(20) boccia [fish bowl], doccia [shower], cuccia [dog's bed], chiesa [church];
(21) pallottola [bullet], palla [ball], pistola [gun], torta [cake];
(22) castagna [chestnut], castoro [beaver], ghianda [acorn], tazzina [mug];

(23) tavolozza [palette], tavolo [table], pennello [brush], occhiali [glasses];
(24) nido [nest], dito [finger], pulcini [chicks], scoiattolo [squirrel];
(25) vela [sail boat], tela [canvas], nave [boat], mongolfiera [hot-air balloon];
(26) maglietta [t-shirt], maglione [sweater], gonna [skirt], mela [apple].