Longitudinal effects of different aspects of morphological awareness skills on early reading development

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Morphological awareness (MA), the metalinguistic skill responsible for identifying and intentionally manipulating the morphemic units of words (e.g., Carlisle, 1995; Kuo & Anderson, 2006) **is a significant predictor of word reading** (e.g., Casalis & Louis-Alexandre, 2000; Kirby et al., 2012; McBride-Chang et al., 2005; Vaknin-Nusbaum et al., 2016 ; see also Ruan et al., 2018, for evidence from a recent meta-analysis).

- That MA predicts word reading performance beyond the effects of phonological skills is well established in English (see Kim et al., 2013 ; Kirby et al., 2012; McCutchen et al., 2008).

- Studies in English have reported a significant effect of MA on both **reading accuracy** (e.g., Mann & Singson, 2003; Deacon & Kirby, 2004 ; Deacon et al., 2013) and **fluency** (e.g., Apel & Diehm, 2014; Desrochers et al., 2017).

In orthographies with high consistency from graphemes to phonemes, MA seems to have a limited effect on word reading in early years (until Grade 2), at least after controlling for phonological awareness (see e.g., Finnish: Müller & Brady, 2001; Greek: Manolitsis, Grigorakis, & Georgiou, 2017; Rothou & Padeliadou, 2015; Korean: Kim, 2011)

Greek is characterized by a very high feedforward (reading) orthographic consistency (95%) and lower feedback (spelling) consistency (80.2%) (Protopapas & Vlahou, 2009).

MA appears to be prominent on early spelling development (Grigorakis & Manolitsis, 2016, 2018 for Grades 1 and 2; Desrochers et al., 2018, for Grade 2)

The longitudinal relation between early morphological awareness and word reading in Greek

- MA in Kindergarten and in G1 did not predict word reading fluency, after controlling for the effects of vocabulary, phonological awareness and RAN, at the end of G1 and G2 (Manolitsis et al., 2017)
- MA in Kindergarten predicted reading accuracy for both words and pseudowords but not text reading fluency, after controlling for the effects of vocabulary and phonological awareness , in G1 (Diamanti et al., 2017)

Children in Greece receive phonics instruction to learn to read (e.g., Protopapas, 2017)

Importance of the study

Most previous studies have only examined a limited number of MA skills (see Rispens et al., 2008; Apel et al., 2013; Tibi and Kirby, 2017, for a few exceptions)

It remains unclear if different aspects of MA (inflectional, derivational, compounding) predict word reading ability the same way

The inflectional and derivational aspects of MA in K as well as all aspects of MA in G1 accounted for 2–5% of unique variance in reading comprehension in G2 (Manolitsis, Grigorakis, & Georgiou, 2017)

Because most previous studies have examined the role of MA in word reading after children had received formal reading instruction, it is possible that the observed effects were confounded by the effects of earlier reading ability on MA (e.g., Deacon et al., 2013; Kruk and Bergman, 2013; Cheng et al., 2016)

- The longitudinal contribution of MA aspects must be tested in the presence of other key predictors of word reading ability such as **general cognitive ability** (non verbal IQ and vocabulary), **mother's educational level**, **literacy related skills** (letter-sound knowledge, phonological awareness, RAN) and even of word reading ability at an earlier point in time (**autoregressor**)

- The reading tasks should include inflected, derived and compound words. If the reading tasks do not include morphologically complex words this may reduce the effects of MA in word reading (accuracy and fluency)

- Burani, et al. (2002) examined the morphological processing during reading and they found that Italian children aged 8–10 years named pseudo-derived forms that were made up of roots and derivational suffixes more quickly and accurately than matched pseudo-words with no morphological components

- Even in a consistent orthography reading compounds and derived polysyllabic words should force children to activate multiple strategies beyond phonological decoding in order to read them accurately and efficiently. MA "might help children to better decode morphologically complex words' (Kuo & Anderson, 2006 , p. 171)

Greek characterized as a fusional type of language (Ralli, 2005), which has more than one morpheme per word

Greek is a language with rich inflectional and derivational morphology. Compounding is also highly productive as new adjectives, nouns, and verbs can be created from existing stems and words (Diamanti et al., 2017)

Aim of the study

This is a 3-year longitudinal study examining the role of three MA skills (inflectional, derivational, and compounding) in word reading in a sample of Greek children followed from kindergarten to grade 2

Specifically our study aimed to answer the following two questions:

1. Do skills representing different morphological processes (inflection, derivation, and compounding) in kindergarten and grade 1 predict reading accuracy of inflected, derived and compound words in grades 1 and 2 respectively?
2. Do skills representing different morphological processes (inflection, derivation, and compounding) in kindergarten and grade 1 predict reading fluency of inflected, derived and compound words in grades 1 and 2 respectively?

Method

Predictors

Participants:
Initial pool of 229 monolingual Greek-speaking children (117 boys) attending Kindergarten followed until Grade 2 (N=215)

General cognitive ability – *assessed at K*

- **Non-verbal ability** (Raven's Coloured)
- **Vocabulary**

  Receptive vocabulary adapted version of PPVT (see Simos et al., 2011)

  Expressive Vocabulary adapted version of WFVT (see Vogindroukas et al., 2009)

Literacy related skills – *assessed at K and G1*

- **Letter sound knowledge** _K
- **Rapid Automatized Naming**

  Object Naming _K

  Digit Naming_G1
- **Phonological awareness**

  Syllable deletion - words (see Manolitsis, 2000)_K

  Elision – nonwords (see Porpodas, 2008)_K and G1

Mother's educational level was recorded for the purpose of a different project and it was representative of that of urban regions in Greece

Morphological awareness – *assessed at K and G1*

a battery of tasks - see Grigorakis, 2014; Manolitsis, Grigorakis, Georgiou, 2017).

Inflectional awareness

1. Inflection word analogy *(e.g. walk-waked, help-…….)*
2. Production of inflected forms *(e.g. Clean. Yesterday, John….)*

Derivational awareness

1.Derivation word analogy *(e.g. sing-singer, dance-……)*

2. Manipulation of derived forms *(e.g. Fish. My uncle is ……)*

Compound word awareness

1.Compound word segmentation *(e.g. doorbell > door + bell)*
2.Compound word reversal *(e.g. bittersweet→sweet bitter)*
3.Compound word production *(e.g. How can we say the juice of the tomato → tomatojuice)*

Word Reading – *assessed at G1 and G2*

Reading accuracy was assessed by three tasks:

(a) Inflected words: 16 words (8 high and 8 low frequency items) with different inflected forms (3-syllable nouns, adjectives and verbs)

(b) Derived words: 16 words (8 high and 8 low frequency items) with different derived types (3-syllable nouns, adjectives, and verbs)

(c) Compound words: 16 compounds with 4-5 syllable length (8 high and 8 low frequency nouns)

Reading fluency was assessed **for each one of the three reading accuracy tasks**. A child's score in each RF task was the total number of correctly read items within 30 seconds.

Statistical Analyses

We calculated composite scores for:

(a) inflectional, derivational and compounding morphology in kindergarten and G 1

(b) phonological awareness in kindergarten, and

(c) vocabulary in kindergarten

In all instances, the composite scores were calculated by averaging the z-scores of the respective component measures

We run 2 models of regression for each one of the reading measures in Grade 1 and 3 models of regression for each one of the reading measures in Grade 2

- In all models we included in the 1st step the general cognitive ability (Raven's and vocabulary scores in Kindergarten) and mother's educational level as control variables

Correlations of kindergarten and grade 1 measures with reading accuracy and reading fluency skills in grades 1 and 2

Time	Reading skills	Kindergarten measures									Grade 1 measures				
		NV	VOC	MEd	LN	RAN	PA	InflA	DerA	CompA	RAN	PA	InflA	DerA	CompA
Grade 1	InW_Ac	.25	.37	.32	.49	.42	.49	**.37**	.39	.43					
	DeW_A	.23	.39	.32	.55	.45	.49	.38	.40	.43					
	CoW_A	.23	.49	.36	.56	.45	.55	.40	.43	**.50**					
	InW_F	.27	.39	.29	.58	.53	.59	.42	.40	**.48**					
	DeW_F	.18	.38	.35	.58	.52	.57	.40	**.36**	.46					
	CoW_F	.23	.43	.33	.57	.49	.56	.39	.38	.47					
Grade 2	InW_Ac	.21	.35	.33	.47	.37	.47	.40	.37	.44	.46	.47	.41	.43	.47
	DeW_A	.23	.34	.24	.47	.36	.45	.30	.33	.39	.46	.45	**.31**	.43	.43
	CoW_A	.17	.48	.39	.54	.30	.55	.45	.47	.53	.45	.55	.51	.55	**.58**
	InW_F	.21	.41	.28	.57	.44	.53	.38	.38	.46	.55	.53.	.40	.40	.50
	DeW_F	.18	.39	.30	.52	.46	.49	.32	.36	.43	.59	.49	**.37**	.39	.46
	CoW_F	.15	.45	.35	.57	.44	.58	.44	.41	.50	.58	.58	.47	.48	**.55**

The three MA skills in K correlated moderately with word reading accuracy and fluency.

In G1 the MA skills correlated moderately to strongly with reading measures.

Notes: for r > .14 *p* < .05 ; for r > .17 *p* < .01; for r > .24 *p* < .001

NV: Non-Verbal ability; VOC: Vocabulary; Med: Mother's education ; LN: Letter sound knowledge ; RAN: Rapid Naming; PA: Phonological Awareness; InflA: Inflectional awareness ; DerA: Derivational awareness ; CompA: Compounding awareness ;InW_Ac: Inflected words accuracy ; DeW_A: Derived words accuracy ; CoW_A: Compound words accuracy ; InW_F: Inflected words fluency ; DeW_F: Derived words fluency ; CoW_F: Compound words fluency

Results of Hierarchical Regression Analyses with MA skills in Kindergarten as Predictors of Word Reading Skills in Grade 1

	Reading Inflected Words		Reading Derived Words		Reading Compound Words	
	RAcc	RFlu	RAcc	RFlu	RAcc	RFlu
	Beta		**Beta**		**Beta**	
Model A						
(1) Control variables (K)						
Non-verbal IQ	.13	.13	.08	.03	.02	.05
Vocabulary	.27**	.30***	.28***	.29***	.40***	.37***
Mother's education	.21**	.16*	.21**	.25**	.22**	.19**
	ΔR^2 .21	**ΔR^2 .21**	**ΔR^2 .19**	**ΔR^2 .20**	**ΔR^2 .28**	**ΔR^2 .24**
(2)Morphological awareness						
a) Inflection	.15	.22*	.16	.20*	.07	.10
b) Derivation	.19*	.18*	.18*	.13	.13	.10
c) Compounding	.24*	.33**	.23*	.33**	.27**	.30**
	ΔR^2 .01/.02/.03	**ΔR^2 .03/.02/.05**	**ΔR^2 .01/.02/.02**	**ΔR^2 .02/.01/.05**	**ΔR^2 .00/.01/.03**	**ΔR^2 .01/.01/.04**
Model B						
(2) Literacy-related skills (K)						
Rapid naming	.20**	.30***	.24**	.30***	.19**	.28***
Letter Sound Knowledge	.20*	.23*	.30**	.27**	.25*	.30**
Phonological Awareness	.14	.24*	.09	.21*	.13	.13
	ΔR^2 .12	**ΔR^2 .24**	**ΔR^2 .17**	**ΔR^2 .25**	**ΔR^2 .13**	**ΔR^2 .21**
(3)Morphological Awareness						
a) Inflection	-.08	-.10	-.10	-.13	-.16	-.15
b) Derivation	.00	-.11	-.02	-.16	-.07	-.16
c) Compounding	-.06	-.10	-.12	-.10	-.03	-.09
	ΔR^2 .00/.00/.00	**ΔR^2 .01/.01/.00**	**ΔR^2 .00/.00/.00**	**ΔR^2 .01/.01/.00**	**ΔR^2 .01/.00/.00**	**ΔR^2 .01/.01/.00**

Notes: The beta coefficients reported are taken from the step in the regression equation in which the predictor variables were entered.
RAcc= Reading Accuracy score; RFlu = Reading Fluency score; * $p < .05$; ** $p < .01$; *** $p < .001$

Results of Hierarchical Regression Analyses with MA skills in Kindergarten as Predictors of Word Reading Skills in Grade 2

	Reading Inflected Words		Reading Derived Words		Reading Compound Words	
	RAcc	RFlu	RAcc	RFlu	RAcc	RFlu
	Beta		Beta		Beta	
Model A						
(1) Control variables (K)						
Non-verbal IQ	.14	.07	.07	.00	.00	.01
Vocabulary	.27**	.38***	.28**	.39***	.42***	.42***
Mother's education	.22**	.14*	.14	.17*	.25***	.21**
	ΔR^2 .21	**ΔR^2 .23**	**ΔR^2 .15**	**ΔR^2 .22**	**ΔR^2 .30**	**ΔR^2 .27**
(2) Morphological awareness						
a) Inflection	.19*	.12	.02	.02	.17*	.21*
b) Derivation	.16	.10	.10	.12	.20*	.15
c) Compounding	.29**	.23*	.17	.18	.33***	.31**
	ΔR^2 .02/.01/.04	**ΔR^2 .01/.01/.02**	**ΔR^2 .00/.01/.01**	**ΔR^2 .00/.01/.01**	**ΔR^2 .02/.02/.05**	**ΔR^2 .03/.01/.04**
Model B						
(2) Literacy-related skills (K)						
Rapid naming	.17*	.20**	.11	.22**	.02	.21**
Letter Sound Knowledge	.18	.35***	.24*	.25*	.20*	.23*
Phonological Awareness	.14	.07	.13	.07	.27**	.26**
	ΔR^2 .09	**ΔR^2 .16**	**ΔR^2 .10**	**ΔR^2 .13**	**ΔR^2 .12**	**ΔR^2 .19**
(3) Morphological Awareness						
a) Inflection	.00	-.13	-.13	-.14	-.03	-.08
b) Derivation	.00	-.11	-.07	-.07	.02	-.10
c) Compounding	.06	-.12	-.12	-.14	.05	-.09
	ΔR^2 .00/.00/.00	**ΔR^2 .01/.01/.01**	**ΔR^2 .01/.00/.00**	**ΔR^2 .01/.00/.00**	**ΔR^2 .00/.00/.00**	**ΔR^2 .00/.00/.00**

***Notes*:** The beta coefficients reported are taken from the step in the regression equation in which the predictor variables were entered.
RAcc= Reading Accuracy score; RFlu = Reading Fluency score; * $p < .05$; ** $p < .01$; *** $p < .001$

Results of Hierarchical Regression Analyses with MA skills in G1 as Predictors of Word Reading Skills in Grade 2

	Reading Inflected Words		Reading Derived Words		Reading Compound Words	
	RAcc	RFlu	RAcc	RFlu	RAcc	RFlu
	Beta		Beta		Beta	
Model A						
(1) Control variables (K)						
Non-verbal IQ	.14	.07	.07	.00	.00	.01
Vocabulary	.27**	.38***	.28**	.39***	.42***	.42***
Mother's education	.22**	.14*	.14	.17*	.25***	.21**
	ΔR^2 .21	**ΔR^2 .23**	**ΔR^2 .15**	**ΔR^2 .22**	**ΔR^2 .30**	**ΔR^2 .27**
(2) Morphological Awareness (G1)						
a) Inflection	.26**	.16	.08	.15	.30***	.26**
b) Derivation	.29**	.17	.32***	.18*	.38***	.27**
c) Compounding	.39***	.35***	.32**	.33***	.43***	.40***
	ΔR^2 .04/.04/.07	**ΔR^2 .01/.01/.06**	**ΔR^2 .00/.05/.05**	**ΔR^2 .01/.02/.05**	**ΔR^2 .05/.07/.08**	**ΔR^2 .03/.04/.07**
Model B						
(2) Literacy-related skills (G1)						
Rapid naming	.29***	.40***	.29***	.48***	.23**	.43***
Phonological Awareness	.25**	.26***	.22**	.14	.30***	.24***
	ΔR^2 .15	**ΔR^2 .22**	**ΔR^2 .13**	**ΔR^2 .23**	**ΔR^2 .14**	**ΔR^2 .24**
(3) Morphological Awareness (G1)						
a) Inflection	.06	-.03	-.16	-.05	.12	.10
b) Derivation	.14	-.02	.16	-.01	.23**	.12
c) Compounding	.14	.04	.07	.03	.23*	.14
	ΔR^2 .00/.01/.01	**ΔR^2 .00/.00/.00**	**ΔR^2 .01/.01/.00**	**ΔR^2 .00/.00/.00**	**ΔR^2 .01/.02/.02**	**ΔR^2 .00/.01/.01**
Model C						
(2) Autoregressor (G1)	.53***	.63***	.57***	.59***	.54***	.60***
	ΔR^2 .22	**ΔR^2 .31**	**ΔR^2 .26**	**ΔR^2 .28**	**ΔR^2 .21**	**ΔR^2 .27**
(3) Morphological Awareness (G1)						
a) Inflection	.15	.05	-.08	-.02	.23**	.22**
b) Derivation	.15	.04	.19*	.03	.27**	.18*
c) Compounding	.21*	.08	.12	.04	.29***	.22**
	ΔR^2 .01/.01/.02	**ΔR^2 .00/.00/.00**	**ΔR^2 .00/.02/.01**	**ΔR^2 .00/.00/.00**	**ΔR^2 .02/.03/.04**	**ΔR^2 .02/.01/.02**

Notes: The beta coefficients reported are taken from the step in the regression equation in which the predictor variables were entered.

RAcc= Reading Accuracy score; RFlu = Reading Fluency score; * $p < .05$; ** $p < .01$; *** $p < .001$

Discussion (K to G1 and G2)

-In relation to both questions none of MA skills in Kindergarten predicted reading accuracy and reading fluency of inflected, derived and compound words in grades 1 and 2 after controlling for the effects of literacy-related skills (letter sound knowledge, phonological awareness, RAN).

-These findings further confirm the suggestion of previous studies that word reading fluency in grade 1 relies more on phonological rather than morphological processing (e.g., Manolitsis et al.,2017; Müller & Brady, 2001) as we included words to be read from all three morphological categories (inflected, derived and compound words).

-It is remarkable that MA skills did not predict reading accuracy in any morphological category after controlling of literacy-related skills. These findings are consistent to those of Manolitsis (2006) who found that preschool MA longitudinally did not predict Grade 1 single word reading accuracy, after controlling for PA.

-Studies reporting a contribution of early MA to word reading accuracy (Diamanti et al., 2017) and to word reading fluency in grade 1 (Rispens et al., 2008) have not included at the same time two key predictors of word reading accuracy and fluency such as letter sound knowledge and RAN respectively.

Discussion (G1 to G2)

-In relation to both questions two MA skills (derivational awareness and awareness of compounds) predicted reading accuracy but not reading fluency of compounds in grade 2 after controlling for the effects of literacy-related skills (phonological awareness, RAN). RAN is one of the best (if not the best) predictors of word reading fluency in transparent orthographies. Reading fluency requires both accuracy and speed.

-In terms of reading accuracy the effects of two MA skills on reading polysyllabic compound words beyond the effects of phonological skills indicate that the simple ‘‘sounding out’’ strategy may not be efficient with long words (Ramirez et al., 2010), even in the consistent orthography of Greek.

-On the other hand all MA skills predicted both reading accuracy and reading fluency of compounds in grade 2 after controlling for the autoregressor. This finding is in line with prior study (Grigorakis & Manolitsis, 2017) and strengthens the hypothesis that children may be processing polysyllabic morphologically complicated compound words not only by phonological strategies in order to read them accurately and efficiently.

Conclusion

In grade 1 the relation between MA processes (inflection, derivation, and lexical compounding) and word reading (regardless of their morphological category) is mediated by phonological factors

MA processes (inflection, derivation, and lexical compounding) skills are important for reading accuracy and fluency of compound words beyond grade 1

Lexical compounding awareness is an important predictor of reading of morphologically complicated words beyond grade 1

The morphological mark and the two components (stems or words) of compounds may facilitate children to recognize the morphological structure during reading.

Our findings suggest that Greek teachers should perhaps reconsider the way they teach reading by complementing phonics instruction with some MA activities (see Manolitsis, 2017).