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# The Effects of a Multimodal Intervention on the Reading Skills of Struggling Students: An Exploration Across Countries

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## ABSTRACT

The purpose of the present study was to investigate the effects of a multimodal program, designed for practicing reading, on reading development in struggling readers in two different countries. The research question was whether one specific training method will have a positive effect on pupils' reading development in two different countries with different educational systems and as diverse orthographies as the shallow Croatian and the relatively deep Swedish orthography. It became clear that the Swedish teachers have a tradition of implementing interventions as opposed to in Croatia where there is no tradition of teachers conducting intervention studies in school. Comparing different school systems is difficult which is evident in the results that differ between the two countries. However, the results indicate that the multimodal reading training program used in the intervention had positive effects on pupils' literacy development, including decoding, spelling, and reading comprehension in both countries.

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## Introduction

Reading competence at school is vital as pupils that do not understand the texts they read will not be able to learn from text material. It is therefore a central part of the primary school curriculum. Using a multimedia interaction strategy through a computerized intervention combining different modalities, where the child is the constructor of the events, might be one way to increase the ability to understand a text. Studies have shown that multimodal programs (Morgan, 2013), including Omega-IS, the program used in the present study (Fälth et al., 2013), can be used as motivational tools to develop reading ability. Omega-IS is constructed to be motivational as well as interactive for the child. The different modalities, text, speech and animations are closely linked as the text-to-speech function allows the pupil to hear the words at the same time as they are illustrated with an animation created immediately as a response to the pupil's actions. The program is a complement to ordinary teaching and has both individual exercises and exercises encouraging joint attention together with teachers or parents. Multimodal texts are essential for pupils as they create interest and motivation for reading. The combination of two or more modalities increases the ability to capture pupils' attention and interest (Hobbs, 2001).

The simple view of reading (SVR) defines two necessary factors, decoding and language comprehension (Gough & Tunmer, 1986). In a recent study, Lonigan and colleagues (Lonigan et al., 2018) showed that SVR a useful model. They found that between 50% and 90% of the variation in reading comprehension can be explained by decoding and language comprehension (see Lonigan et al., for references). The program used in this study (Omega-IS) combines decoding and language comprehension, the two factors in the SVR, through exercises that stimulate the comprehension of the text as pupils practice decoding. Quick and automatic decoding of words requires that you have the word in your mental lexicon as well as the image of the printed word saved together with meaning, pronunciation, and all other related information. When decoding a word that you have in your mental lexicon it becomes easy to determine whether you have read correctly or not (Whitehurst & Lonigan, 1998). The Swedish and Croatian pupils in the present study had difficulties with both decoding and language comprehension. The training program used in this study is intended to stimulate pupils' language comprehension as well as word decoding. One conclusion Lonigan et al., (2018) drew is that pupils, with English as their first language, who have difficulties with both linguistic understanding and decoding need support and training in both areas.

Orthographic depth varies between different languages (Seymour et al., 2003). Swedish has a more transparent orthography than English that has many inconsistencies and complexities. Croatian is even more transparent than Swedish. Previous studies show that decoding is automatized earlier in more transparent languages (e.g., Caravolas et al., 2013; Zaretsky et al., 2009). It could therefore be assumed that the importance of language comprehension for reading is also greater in the lower grades in Croatia and Sweden compared to English-speaking countries. Although both Swedish and Croatian are alphabetic languages, they differ in the complexity of their grapheme-phoneme correspondence rules (Lukatela et al., 1995; Pérez Cañado, 2005). Croatian orthography is transparent with a highly consistent grapheme-phoneme correspondence, one sounds out what one sees. Swedish has a relatively deep orthography where the vowel grapheme-phoneme correspondence in speech and writing is high as opposed to the consonants which have considerably lower consistency. According to earlier research, the predictability of letter-sound correspondences in Croatian is 99% and about 75% in Swedish.

Not only do Swedish and Croatian children learn to read and write languages with different orthographies, they also experience different school systems and different language curricula. During the first four grades comprising lower elementary education in Croatia (with one classroom teacher teaching all school subjects), Croatian pupils have five hours of Croatian language instruction per week. In comparison, Swedish pupils have six hours of Swedish language instruction per week. Croatian struggling readers only receive one hour of remedial reading instruction per week, provided by their classroom teachers in small groups. The teachers are rarely offered professional help within the school system as it lacks special education teachers. In contrast, Sweden has a special education teacher available to the classroom teacher during remedial reading instruction. At the time of this study, the Croatian language curriculum in primary grades was characterized by the prevalence of literature and grammar instruction, both often not at an appropriate developmental level, at the expense of practicing language and literacy skills. The present study investigates whether one training method will have a positive effect on pupil's reading development in the two diverse orthographies and school systems.

A considerable amount of research on reading has centered on the prevention of reading difficulties and early intervention (Lo-Oh & Muofo, 2020; Mariage et al., 2020). A key finding has been that systematic instruction with focus on essential skills such as letter knowledge, phonemic awareness, decoding, vocabulary and, comprehension can prevent and remedy early reading difficulties for many pupils (Torgesen, 2000). Intervention studies (e.g., in the field of reading) are mostly designed

as pretest–posttest comparisons at group level (Lo-Oh & Muofor, 2020; Torgesen, 2000). These include one measurement of the respective competencies before the start of the intervention (pre), one immediately after the end of the intervention (post), and one some time after the end of the intervention (follow-up). The effects of a treatment can thus be computed by comparing (1) the pre- to posttest results of the treatment group, or by (2) comparing the posttest results of a treatment group to the posttest results of a comparison group. Because educational research contexts (e.g., schools) do not always allow randomization of the individual pupils, the present study used a cross-over design where the participants served as their own matched controls (see the method section for more details). In the context of the present study, a comparison was made between the absolute gain in outcomes between baseline period, intervention periods and post-intervention period, with two countries taken into account. Intervention studies with comparisons between different orthographies are unusual. There are more studies on the effect of different orthographies of an individual's first language compared to the individual's second language (Escudero & Wanrooij, 2010).

Recently, Gersten et al. (2017) conducted a comprehensive literature review of small-group reading interventions in Grades 1 through 3. The results of the review indicated statistically significant positive impacts on word reading, passage fluency, and comprehension. All but 1 of the 20 reading interventions evaluated in the 23 studies found positive effects in at least one area of reading performance. In summary, there is a well-established line of research examining the effects of intensive small-group reading interventions in the primary grades. The results of these studies support the overall benefits of small-group intensive reading interventions on the literacy outcomes of young pupils (see also Vaughn et al., 2019; Wanzek et al., 2016). Instructional intensity includes ensuring that interventions (a) use an evidence-based platform with content that is aligned to the needs of the pupils, (b) supplement classroom reading instruction to increase the total amount of time with reading instruction, (c) are delivered with consistency (i.e., the same number of minutes per day, days per week, total weeks), (d) are implemented with fidelity and (e) are implemented with quality (i.e., maximize explicit instruction, opportunities to respond, and high levels of engagement). In the present study, the same interventions were carried out in two different countries with different orthographies and school systems. The same amount of training, consistency and, quality were ensured. In Sweden, there has throughout the last decade been a tradition of different reading interventions for school children (see for example Svensson et al., 2019; Wolff, 2016). In Croatia, there is no such tradition in educational settings (Novak et al., 2017).

The focus of this study was to increase text passage fluency among the participants. How passage fluency is conceptualized has important implications for theory, instruction, and measurement (Pikulski & Chard, 2005). A simple definition of fluency, such as speed and accuracy of reading connected text, may result in instructional approaches that focus exclusively on helping pupils read faster. A broad definition of passage fluency would encompass vocabulary knowledge, lexical access, semantic skills, syntactic understanding, background knowledge, as well as literal and inferential comprehension. In this conceptualization, instruction targeting fluency would likely integrate a broad range of skills including comprehension and vocabulary knowledge (Pikulski & Chard, 2005). The aim of the present study is to investigate the effects of a multimodal program, designed for practicing reading, on reading development in struggling readers in two different countries. The research question is whether one training method, a multimodal reading training program, will have a positive effect on pupil's reading development in two different countries with different school systems and as diverse orthographies as the shallow Croatian and the relatively deep Swedish orthography.

## Method

### *Participants and Procedure*

#### *Screening*

**Croatia.** The screening was conducted in four Croatian primary schools attended by a total of 752 children in second and third grade (381 children second and 371 in third grade). Parents were informed about the project at meetings between teachers and parents and/or letters containing a detailed description of the project's aim and procedure. Nineteen parents (2.5%) did not give consent for participation, leaving 733 children to participate in the screening. Test materials were administered by researchers and psychology students (trained particularly for this project) in group settings comprising 1.5 hours. Results from 9 children were not included in further analyses. They did not participate in the screening procedure as they could not understand the instructions.

**Sweden.** The screening was conducted in 11 Swedish primary schools attended by a total of 634 children in second and third grade (339 children in second and 295 in third grade). Parents were informed about the project at meetings between teachers and parents and/or letters containing a detailed description of the project's aim and procedure. Two

parents (0.4%) did not give consent for participation, leaving 634 children to participate in the screening. Test materials were administered by one researcher (Z) in group settings comprising 1.5 hours.

### *Selection and characteristics of intervention groups*

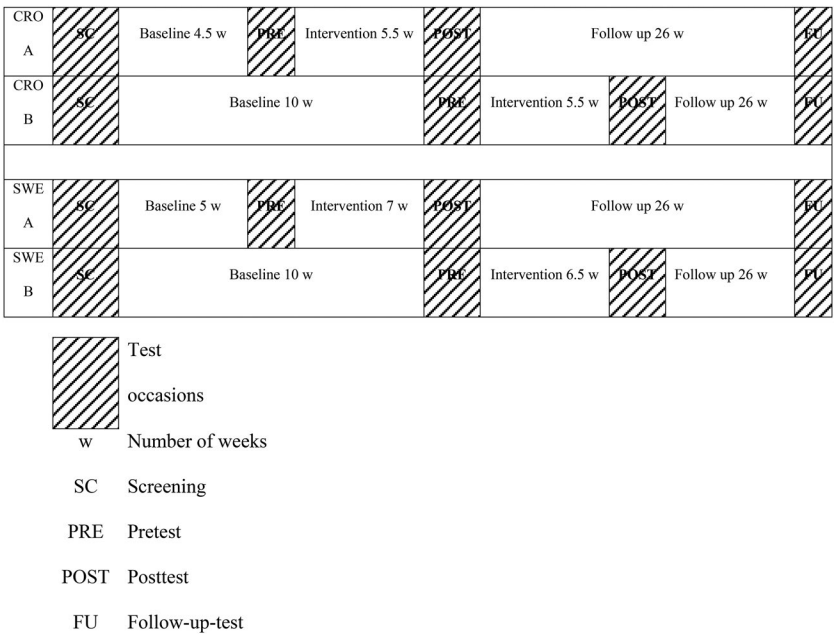
**Croatia.** The poorest readers were selected based on the results of three screening tests: Word decoding (WD), Spelling Test (WS) and Reading Comprehension Test (RC). The cutoff point was equal to, or below, the 20th percentile on all three screening tests. Using these criteria, a total of 55 children were selected to be included in the intervention, 7.8% of all the second and 7.4% of all the third graders. The average age at the pretest was 8.42 ( $SD=.45$ ) and 9.49 ( $SD=.41$ ) years for second and third graders, respectively.

**Sweden.** The poorest readers were selected based on the results of three screening tests: Word decoding (WD), Spelling Test (WS) and Reading Comprehension Test (WC). The cutoff point was equal to, or below, the 20th percentile on all three screening tests. Using these criteria, a total of 46 children were selected to be included in the intervention, 7.7% of the second and 6.3% of the third graders. The average age at the pretest was 8.4 ( $SD=.32$ ) and 9.5 ( $SD=.39$ ) years for second and third graders, respectively.

### *Intervention design*

The intervention sample was randomly divided into two groups (A and B) using a cross-over design with switching replications (Cook & Campbell, 1979). Group A received intervention first, with group B as control, Group B received the intervention after group A. In the Croatian sample, no significant differences in age ( $t(53)=1.188$ ,  $p=.240$ ), gender ( $\chi^2=.022$ ,  $p=.549$ ) and test results ( $t_{WD}(53)=.793$ ,  $p=.432$ ;  $t_{WS}(53)=-.010$ ,  $p=.992$ ;  $t_{RC}(53)=.427$ ,  $p=.671$ ) were found between group A and B. As in the Croatian sample, the Swedish sample did not show any significant differences in age ( $t(45)=-.511$ ,  $p=.612$ ), gender ( $\chi^2=.004$ ,  $p=.949$ ), and test results ( $t_{WD}(45)=.513$ ,  $p=.610$ ;  $t_{WSL}(45)=-.969$ ,  $p=.337$ ;  $t_{RC}(45)=-.318$ ,  $p=.752$ ) between groups A and B.

**Croatia.** The number of weeks (Figure 1) refers to weeks at school, excluding holidays. Test sessions included screening (SC), pre-intervention test (PRE; 4.5 weeks after screening), post-intervention test (POST; 5.5 weeks after PRE), and follow-up (FU, 6 months after training was completed, consequently giving different follow-up dates for group A and B). Outcome tests were individually administered by school psychologists, who were not involved in the training, on four occasions.



**Figure 1.** Time plan including test periods, baseline and intervention.

**Sweden.** The number of weeks refers to weeks at school, excluding holidays. Test sessions included screening (SC), pre-intervention test (PRE; 5–10 weeks after screening), post-intervention test (POST; 6.5–7 weeks after PRE), and follow-up (FU, 6 months after training was completed, consequently giving different follow-up dates for group A and B). Outcome tests were individually administered by author X.

**Training Procedure**

**Croatia.** Children received a total of 24 individual training sessions with their Omega-IS-trainer over a five and a half week period during ordinary school attendance (for the time plan, see Figure 1). Prior to intervention, the trainers ( $N=10$ ; speech therapists, psychologists and special education teachers) were instructed in the Omega-IS application by authors X and Y during a one-day training in group settings. They also received individual consultations during the intervention. The number of children per trainer ranged between one and five in each intervention group. The average duration for a child’s training session ranged from 23 to 36 minutes ( $M=28.40$ ,  $SD=2.76$ ). The duration of the training sessions did not differ for the A and B group ( $M_A=28.23$ ,  $SD_A=2.83$ ,  $M_B=28.56$ ,  $SD_B=2.73$ ,  $t(53)=-.443$ ,  $p=.660$ ), for boys and girls ( $M_{boys}=28.12$ ,  $SD_{boys}=2.79$ ,  $M_{girls}=28.73$ ,  $SD_{girls}=2.75$ ,  $t(53)=-.805$ ,  $p=.425$ ), or for

second and third grade pupils ( $M_2 = 28.58$ ,  $SD_2 = 2.90$ ,  $M_3 = 28.19$ ,  $SD_3 = 2.65$ ,  $t(53) = .509$ ,  $p = .613$ ).

**Sweden.** Children received a total of 24 individual training sessions with their Omega-IS-trainer over a 6-week period during ordinary school attendance. Prior to intervention, the trainers ( $N=11$ ; teachers and special education teachers) were instructed in Omega-IS application by authors X. and Y. during a one-day training in group settings. They also received individual consultations during the intervention. The number of children per trainer ranged between one and four in each intervention group. The average duration for a child's training session ranged from 29 to 34 minutes ( $M = 30.91$ ,  $SD = 1.13$ ). The duration of the training sessions did not differ for the A and B group ( $M_A = 30.98$ ,  $SD_A = 1.31$ ,  $M_B = 30.84$ ,  $SD_B = 1.08$ ,  $t = -.395$ ,  $p = .590$ ), for boys and girls ( $M_{boys} = 30.71$ ,  $SD_{boys} = 1.41$ ,  $M_{girls} = 31.20$ ,  $SD_{girls} = 1.45$ ,  $t = -1.459$ ,  $p = .152$ ), or for second and third grade pupils ( $M_2 = 30.88$ ,  $SD_2 = 1.61$ ,  $M_3 = 30.94$ ,  $SD_3 = 1.45$ ,  $t = -.194$ ,  $p = .847$ ). As there were no differences in either of the two countries between the A and B groups, boys and girls and second and third grades, these variables will not be further analyzed.

In both countries, the fidelity of the training implementation was monitored two-fold. The trainers noted the activities and observations in individual protocols for every session with every child. The training sessions were also recorded by the program's built-in feature. After the intervention was concluded, a one-day seminar was organized with researchers and teachers. The purpose was to exchange overall feedback about the project implementation as well as gaining insight into experiences and observations from experts working directly with the children.

## The Omega-IS Training Program

Omega-IS is a multimedia program uses a top-down strategy where phrases and sentences are constructed (Heimann et al., 2004). Immediate feedback is obtained for both words and sentences in the form of speech and animations providing corresponding one-to-one semantic comprehension, thus inviting the child to explore the written text. The lessons included in the program went from two- (noun + verb) and three-word sentences (noun + verb + noun) to stories where the children could construct their own stories and choose different actors and scenarios. This was done to increase the children's motivation to explore the possibilities of reading and writing. In total, it was possible to construct more than 1900 different sentences with immediate feedback in the form of speech and animations as described above. The language material of the program

is meant to be explored by the learner with help from, and in interaction with, a teacher or parent. This, and the appended animations, not only offer motivational literacy training but also give the learner an opportunity to express his or her imagination and thoughts in conversations with the adult. The goal is to achieve an errorless co-construction of meaning from text through multimedia and supportive interaction. Omega-IS comprises built-in tests where the learner can test his or her proficiency by first viewing the event, then choosing words and creating the sentence that best represents what he/she has just viewed. The test results are stored by the program that provides data with the number of correct words, sentences and, response time. Significant progress in letter knowledge, word and sentence reading as well as in phonological awareness has been found in studies based on this top-down strategy (Heimann et al., 1995; Tjus et al., 1998, 2004).

### Test Battery and Materials

The authors (X & Y) were responsible for the adaptation and development of the Croatian versions of the tests. Word decoding was assessed by a Swedish word chain test (Jacobson, 2001; Wolff 2016). This was also adapted for the Croatian language (Keresteš et al., 2019). The child silently read chains of words where the blanks between the words have been removed. The task was to mark word boundaries with vertical lines using a pencil, as many as possible in two minutes. Each chain consisted of three or four semantically unrelated words. Test–retest correlations for the word chain test at a 12-month interval range from  $r = .80$  to  $.90$  in different groups of children in Grades 1–6 (Jacobson, 2001; Wolff 2016). Test–retest correlations for the Croatian word chains test were  $.90$  for the two-month period and  $.80$  for the 13-month period (Keresteš et al., 2019).

Spelling was assessed by a Swedish test (Elwér et al., 2011) which included 25 items. The child wrote down the words as the researcher read them out loud, each of them twice. An analogue spelling test was used in Croatia. The reported test–retest reliability for children in Sweden aged 6–9 at this test was  $.87$ . Cronbach-alpha indicators of internal consistency for Croatian data ranged from  $.64$  to  $.67$ , and from  $.65$  to  $.69$  for Swedish data, across measurement occasions. The total maximum score was 25.

Reading comprehension was assessed by a Swedish test, Which picture is correct?, (Lundberg, 2001) which included 38 items, each item consisting of four pictures accompanied by two or three sentences. Only one picture corresponded exactly to the sentences. The task was to mark the correct picture. The time limit was 10 minutes. The test was translated

into Croatian. Test–retest correlations for the Croatian version of the reading comprehension test were .82 for a two-month period and .65 for a 13-month period (Keresteš et al., 2019).

## Results

Individual results for all outcomes were calculated as change scores between screening, pre-intervention, post-intervention and follow-up, divided by the number of weeks at school passed between each occasion of testing. In this way, the raw results were adjusted for differences in the time duration between each occasion of testing and could be compared between intervention periods and analogously interpreted for both countries. Three indicators were calculated for every child: Baseline gain (the difference between pre-intervention results and screening results), Intervention gain (the difference between post-intervention results and pre-intervention results), and Follow-up gain (the difference between follow-up results and post-intervention results). Results will be presented as follows: WD gain (Number of words per minute gained per week on the word chain test), WS gain (Number of words gained per week on the Word spelling test), and RC gain (Number of items gained per week on the Reading comprehension test). Descriptive statistics are presented in Table 1. For each outcome a separate 2×3 mixed-ANOVA analysis was conducted, with a country (Sweden and Croatia) as between-subjects and gain period (Baseline gain, Intervention gain and Follow-up gain) as a within-subject effect.

For all three outcomes, Mauchly's tests indicated that the sphericity assumption was violated ( $\chi^2(2)_{\text{WD Gain}} = 42.045$ ,  $p = .000$ ;  $\chi^2(2)_{\text{WS Gain}} = 40.241$ ,  $p = .000$ ;  $\chi^2(2)_{\text{RC Gain}} = 39.845$ ,  $p = .000$ ), therefore, the degrees of freedom were adjusted using Greenhouse-Geisser ( $\epsilon_{\text{WD Gain}} = .743$ ;  $\epsilon_{\text{WS Gain}} = .750$ ), or Huynh-Feldt estimates ( $\epsilon_{\text{RC Gain}} = .751$ ). There were no differences

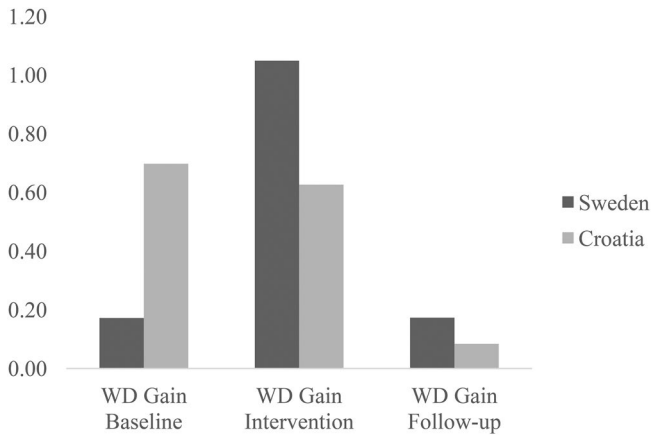
**Table 1.** Descriptive statistics of gain per week in the Croatian and Swedish sample.

	Baseline M(SD)	Intervention M(SD)	Follow-up M(SD)
Croatia (N=55)			
WD Gain	0.70 (0.77)	0.63 (0.82)	0.08 (0.18)
WS Gain	0.36 (0.48)	0.32 (0.46)	0.05 (0.11)
RC Gain	0.86 (0.72)	0.56 (0.42)	0.12 (0.11)
Sweden (N=47)			
WD Gain	0.17 (0.20)	1.05 (0.74)	0.17 (0.18)
WS Gain	0.13 (0.14)	0.65 (0.54)	0.16 (0.12)
RC Gain	0.14 (0.12)	0.81 (0.44)	0.16 (0.07)

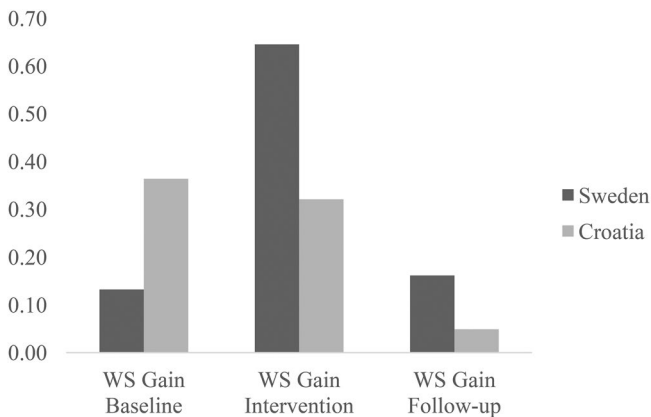
WD-Word decoding test

WS-Word spelling test

RC-Reading comprehension test



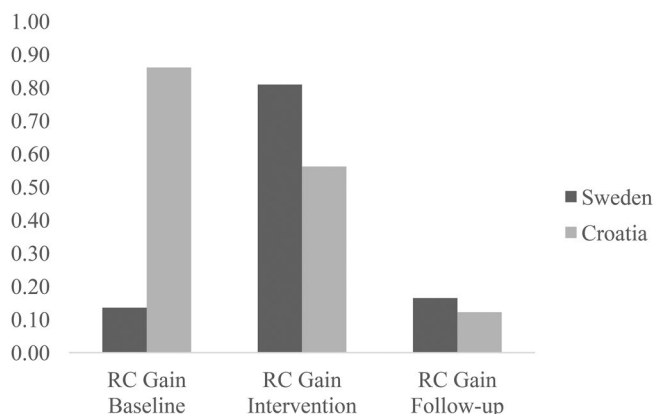
**Figure 2.** Gain per week in Word decoding test.



**Figure 3.** Gain per week in Word spelling test.

between the two countries for Word decoding test ( $F_{WD\ Gain}(1)=0.08$ ,  $p=.930$ ) and Word spelling test ( $F_{WS\ Gain}(1)=3.660$ ,  $p=.059$ ), but for Reading comprehension test Croatian children performed significantly better ( $F_{RC\ Gain}(1)=12.377$ ,  $p=.001$ ).

The main within-subject effects were significant for all three outcomes ( $F_{WD\ Gain}(1.49, 148.585)=33.675$ ,  $p=.000$ ;  $F_{WS\ Gain}(1.50, 149.92)=24.707$ ,  $p=.000$ ;  $F_{RC\ Gain}(1.54, 153.54)=43.177$ ,  $p=.000$ ), indicating that the gain in results was different between three periods. The average gain for each period and country are presented in Figures 2–4. The Bonferroni corrected post hoc tests showed the same pattern of results for all three outcomes: Intervention gain was strongest, followed by Baseline (the waiting period after screening) gain, while Follow-up gain was the lowest.



**Figure 4.** Gain per week in Reading comprehension test.

All pairwise comparisons were statistically significant, meaning that Intervention gain was higher than both Baseline gain ( $p_{WD} = .001$ ,  $p_{WS} = .002$ ,  $p_{RC} = .037$ ), and Follow-up gain ( $p_{WD} = .000$ ,  $p_{WS} = .000$ ,  $p_{RC} = .000$ ), and Baseline-gain was higher than Follow-up gain ( $p_{WD} = .000$ ,  $p_{WS} = .001$ ,  $p_{RC} = .000$ ).

The interaction effects Country x Gain period were significant for all three outcomes ( $F_{WD\ Gain}(1.49, 148.585) = 15.399$ ,  $p = .000$ ;  $F_{WS\ Gain}(1.50, 149.92) = 13.386$ ,  $p = .000$ ;  $F_{RC\ Gain}(1.54, 153.54) = 43.1737.4067$ ,  $p = .000$ ). These results suggest that the pattern of change in the gain was not the same for the two countries. We see from [Figures 2–4](#) that, in Sweden, Intervention gain appears stronger than both Baseline and Follow-up gain, while in Croatia, Baseline gain and Intervention gain appear similar. To verify this interpretation we additionally tested, separately for Croatia and Sweden, pairwise comparisons between three periods. We confirmed that, in Croatia, there was no significant difference between the Baseline gain and the Intervention gain ( $p > .05$ ), while in Sweden Intervention gain was significantly higher ( $p < .01$ ) than the Baseline gain.

## Discussion

It is crucial to conduct interventions that enable poor readers to practice decoding to increase their understanding of texts. Reading competence is a central educational objective of primary school education and an essential cross-curricular competence. Reading intervention is thus of paramount importance in the primary grades to ensure the educational success of children in secondary school. In this study, the research question was whether one training method, a multimodal reading training program, will have a positive effect on pupils' reading development in

two countries with different school systems and different orthographies as the shallow Croatian and the relatively deep Swedish orthography. The results show that the multimodal reading training program used in the intervention had positive effects on pupils' reading development, including decoding, spelling and reading comprehension, in both orthographies and school systems. The study adds further evidence of the positive effects of a well-structured intervention for reading strategies where students also practice fluent and strategic reading in an interactive mode together with adults. Combining different modalities seems to be a successful way of intervening in reading development (Fälth et al., 2013). Many intervention studies compare one or two different types of interventions with one nonintervention group (Jamshidifarsani et al., 2019; Vaughn et al., 2019). In contrast, our study investigated the results of the same intervention in two countries with different languages.

In Croatia, the intervention gains were much larger than the gains at the follow-up. However, the intervention gains were equally as large as the baseline gains. There are two possible reasons for this discrepancy. In the Croatian setting, it seemed that the teachers took action already after having identified the intervention sample and, according to the teachers, parents were alerted to the children's screening results and in connection with that, also the importance of reading. Therefore, it is likely that parents increased the effort to encourage and support their child's reading at home before the intervention started. Future studies in Croatia should therefore aim to disentangle the effects of interventions, such as the Omega-IS training applied in the present study, directed at practicing children's reading skills from the effects of interventions directed at increasing teachers' and parents' knowledge and awareness of the importance of reading skills. In the current study, we were not able to separate these effects. We speculate that, as expected, the Omega-IS training led to high reading gains during the intervention period, while increased teacher and parental investment in children's reading resulted in high reading gains during the baseline period. This did not take place in the Swedish intervention.

In Sweden, it is common practice that the special education teachers and classroom teachers together decide which pupils may receive special education after identifying their strengths and weaknesses in, for example, reading. In Croatia, the school system differs compared to Sweden as it does not have the same cooperation between special education teachers and classroom teachers, as there is a shortage of special education teachers in Croatian schools. Interventions, in general, are rare in Croatia but were appreciated by the teachers involved in the present project. In Sweden, where there is a tradition of intervention studies, the patterns of the results consistently differ from those found in the Croatian data. The teachers did

not take action before the start and the baseline results do not show gains to the extent of the Croatian cohort. In the Swedish data, the results correspond with earlier intervention studies in the field of reading (Torgesen et al., 2001; Vaughn et al., 2019), which would be expected.

Studies have shown that with one-to-one teaching, one teacher and one pupil, it is possible to achieve the necessary effective time-on-task that can have a positive outcome (Torgesen et al., 2001; Vellutino et al., 1996; Wolff, 2016). In the present study, special education teachers confirm the positive impact of one-to-one teaching. The child initiates the exercises and focuses on what is happening on the screen while the teacher supports throughout the intervention session. Working together with exercises develops communication as well as social interaction. As the exercises in the program increase relevant information and decrease irrelevant information it is also less demanding for the working memory. Furthermore, it is likely that the program's rapid feedback increases motivation.

Limitations that should be taken into consideration are that readers are naturally different in terms of language skills and cognitive abilities as well as their motivation and reading strategies for understanding a text. Another limitation is that the measurements were all Swedish tests which were translated or adapted to Croatian. Additionally, the familiarity with conducting an intervention and implementing relevant special needs efforts was very different between the two countries.

## Conclusion

Pupils with reading and writing difficulties need to receive qualified educational assistance. Earlier studies have shown the positive effects of multimodal programs in reading interventions (Fåltch et al., 2013; Torgesen et al., 2001). The interpretation of the results shows difficulties with comparing the two different countries' school systems. The countries have a different socio-cultural history as well as different languages based on different orthographies. The Swedish teachers have a tradition of implementing interventions and did not do anything outside the framework of the intervention. The Croatian teachers and parents however, put focus on children's reading before the start of the intervention which reflects unfamiliarity with reading interventions. This indicates a need for such interventions in Croatian schools. This is evident in the results that differ between the two countries. However, pupils in both countries significantly developed their reading skills which suggests that a multimodal reading training program works on an individual level. Though the gains in both countries were low at follow-up, the children kept on improving their literacy skills at this stage. Due to the intervention, this improvement was rooted in a higher level of skills than otherwise would

have been the case. The fact that the reading skills developed at a very slow rate in both countries when the intervention stopped is noteworthy. It indicates that in both countries, despite very different traditions and teaching practices, “teaching as usual” is not enough for pupils with weak reading and writing skills. In conclusion, the multimedia intervention used in this study shows that a not too demanding intervention can improve levels of reading skills among pupils in need of special support. Researching such complex contexts as two countries with different orthographies is of importance as connecting research and practice in this way reveals question formulations for further research. The results of this study found some areas of interest to further explore. For example, a need for investigating what contextual factors are necessary to ensure the feasibility of the intervention, and also, given that the multimodal training program Omega-IS showed promising effects, further research to replicate and extend these findings is warranted.

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We have no known conflict of interest to disclose.

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