16

Can an Intervention Program in Kindergarten Augment the Effects of Educational TV and Websites in Promoting Literacy?

Iris Levin, Michal Schleifer, Rachel Levin, and Tali Freund

There is ample evidence that early literacy in the first years of school. Results, however, are not entirely consistent across measures. For example, the best predictors have been found to be phonological awareness, rapid naming, invented spelling, and letter knowledge (see e.g., Badian, 1998; Kirby, Parrila, & Pfeiffer, 2003; Levin, Share, & Shatil, 1996; McBride-Chang & Kail, 2002; Morris, Bloodgood, & Perney, 2003; Parrila, Kirby, & McQuarrie, 2004; Scanlon & Vellutino, 1996). Linguistic skills like vocabulary or morphological awareness, however, have been found to be inconsistently associated with later school literacy (see e.g., Aram, 2005; Chaney, 1998; Levin, Ravid, & Rapaport, 2001; Schatschneider, Fletcher, Francis, Carison, & Foorman, 2004; Storch & Whitehurst, 2002). Still, the indisputable conclusion is that literacy from an early age on is highly predictive for the later learning of reading, spelling, and language in school.

The continuity between kindergarten and school grades in literacy is believed to be causal. Consequently, numerous training or intervention studies have been designed to promote early literacy in preschools or kindergartens and most have proved advantageous for literacy achievement later in school (Bus & van IJzendoorn, 1999; Ehri, Nunes, Willows, Yaghoub-Zadeh, & Shanahan, 2001). Three groups of children have been mainly targeted in these studies: children performing poorly at a young age on literate skills (see, e.g., Vellutino, Scanlon, Small, & Fanuele, 2006; O'Connor, Harty, & Fulmer, 2005), children at risk due to familial dyslexia (see e.g., Elbro & Petersen, 2004), or children from socio-culturally disadvantaged populations (see e.g., Gunn, Smolkowsky, Biglan, Black, & Blair, 2005). These studies recognize that it is particularly important to determine how best to promote the literacy skills of socially disadvantaged children because they, by definition, comprise a high proportion of their cohort, and also because they often belong to discriminated sectors on either ethnic–religious or cultural grounds.

A different and new vehicle for promoting literacy, namely educational television programs, has been in use in the last 30 years. In comparison with other more traditional types of intervention programs, this vehicle can be highly cost effective because television is accessible to almost all children rather than only to the small samples used in intervention programs. Moreover, educational programs can be used repeatedly for years without additional cost.

However, there are very few studies on the effects of educational television programs on literacy among preschoolers or kindergarten children. Wright et al. (2001) found a positive association between frequency of viewing child-oriented informative programs like *Sesame Street* at the very young age of 2–3 years and later scores on letter-word skills, receptive vocabulary, and school readiness. In preschool or kindergarten age the frequency of viewing ceased to be related to literacy skills probably because these programs are less attractive for preschoolers and kindergarteners as can be derived from a decline in viewing time.

In contrast, the viewing of the television program *Between the Lions* has been found to promote phonological awareness in kindergarteners (Linebarger, Kosanic, Greenwood, & Doku, 2004; Uchikoshi, 2006; this volume) even though there are certain constraints. For example, Uchikoshi (this volume) found that viewers of *Between the Lions* made more gains in phonological awareness than viewers of the narrative enriching program *Arthur*. Linebarger et al. (2004) found greater gains in phonological awareness among viewers of *Between the Lions* than nonviewers, but the effects were moderated by children's preliminary reading risk status. Those who gained significantly from viewing the program were moderately at risk for reading failure, as assessed by their pretest phonemic awareness. Gains were lower and statistically insignificant for children highly at risk or not at risk for reading failure. Linebarger and colleagues suggest that high-risk children were unable to profit from viewing the program because their teachers were asked to refrain from giving any support in comprehending the program or its print.

In another study by Uchikoshi (2005), gains in narrative skills were found among viewers of *Arthur*, compared with viewers of *Between the Lions*. The results of the aforementioned studies suggest that some educational television programs can enhance code-related skills, like phonological awareness, whereas other programs may promote supra-lexical linguistic skills, like narrative skills.

The study reported in this chapter tests whether support by teachers can improve the effects of a high-tech educational package including a television series and a website. This public package included an educational broadcast on cable television, short interactive interstitials, and a website aimed to improve both code-related and linguistic skills. We wondered whether any effects of this package on kindergarteners' literacy growth could be

expended when there was a synergy of information sources (Neuman, this volume) and when teachers' initiated activities were designed to build on the package.

In this study, at the time teachers were introduced to the package, they were simultaneously instructed in how to use it in the kindergarten by scaffolding children's learning. They were also equipped with literacy-enriching games, as well as print materials with content similar to the rest of the program. Parents were also introduced to the package, and encouraged to share the activities with their children. Comparisons were made between children involved with the teacher intervention program in the kindergarten who also had access at home to the public domain package (i.e., intervention group) and children who only had access at home to the same public domain package on the TV and the website (i.e., comparison group) but no support in school.

Children from the intervention and comparison groups were recruited from kindergartens serving the low socioeconomic strata, with relatively low parental education levels and poor home literacy. These factors are known to hinder growth of early literacy (Aram & Levin, 2001; Christian, Morrison, & Bryant 1998; Roberts, Jurgens, & Burchinal, 2005) as well as the acquisition of reading, spelling, and language in school (Korat & Levin, 2001; Sénéchal, 2006; Yuet-Han-Lau & McBride-Chang, 2005). Separate analyses were carried out for two groups with an additional at-risk factor, namely new immigrants and kindergarten children with special needs.

Two institutions, the Center for Educational Technology (CET) and Hop! joined forces to make possible this ambitious project. CET is a leading Israeli, nonprofit, nongovernmental organization, established to improve Israel's educational system. The organization's mission is the introduction of innovation, change, and large-scale implementation of general educational initiatives and, specifically, of educational technology. CET develops traditional devices like games and books, as well as programs for promoting literacy in a broad age range. Hop! is a commercial company that established itself as the major nursery–preschool TV channel in Israel. It is ranked as the fourth most viewed channel among the 120 cable channels in Israel. An educational psychologist from Tel Aviv University with expertise on early literacy served as the project's academic consultant.

The Public Projects' Components

Children in the intervention and the comparison groups had access at home to a *television series, interactive television interstitials* on the Hop! channel, and a *website with educational games* developed by CET. Broadcasting started about 5 months earlier than implementation of the intervention program in kindergarten and continued then for a 7-month period. Each of the components listed above are described in detail below.

TV series

Forty TV broadcasts, 15 minutes each, comprised the series entitled *Nachshon Can Do All*. The series was developed by Hop! based on discussions with CET experts and the academic consultant. A program from this series was launched five times a week during the channel's prime time of late afternoon. As mentioned above, the intervention group had access to the program in advance of the kindergarten intervention program.

The TV series had a leading figure named Nachshon. According to Talmudic literature, Nachshon was the first to walk into the Red Sea, upon which the sea separated as promised by God, letting the Israel people escape to liberty. In the present context, Nachshon solves problems related to literacy and language. The basic idea of the series was to introduce the children to metalinguistic knowledge and motivate them to acquire skills in this domain. The playful games featured in the series were premised on the assumption that learning about language can be fun and useful. Each broadcast, Nachshon runs into a problem and solves it successfully using insights related to language and literacy. The programs cover a wide range of topics, including subsystems of Hebrew morphology, genre distinctions, enrichment of lexicon, and phonological awareness.

One broadcast, for instance, aims at increasing sensitivity to the morphological structure of Hebrew (Ravid, 2004; Ravid & Bar-On, 2005). In this edition, Nachshon discovers that names of colors relate to names of objects with this color. He discovers that the word "rose" is related to the name of the color "pink" (*vered* to *varod*), "ash" to "gray" (*efer* to *afor*), and "vegetable" to "green" (*jerek* to *jarok*). Insight into root structure helps Hebrew speakers grasp the meaning of new lexical items as well as how to spell regular words (Ravid, 2001; Ravid & Schiff, 2006).

Another edition introduced children to the metaphorical use of language. Nachshon tries to find a child while playing "hide and seek." However, he does not understand helpful suggestions rich in metaphorical idiom, such as "to look for a needle in a haystack" or "he lost his hands and feet" (confused). By first taking the metaphorical language too literally and therefore making mistakes, children are made aware of metaphorical and literal use of language, a distinction that is significant for comprehending spoken and written language (Berman & Ravid, 2006).

In yet another edition, Nachshon tries to understand instructions via a telephone but it is not working properly. As the initial syllables of words keep fading he has to guess them. The situation alerts the children to the sound structure of words, an important precursor of reading, thus promoting children's phonological awareness (Bus & van IJzendoorn, 1999; Ehri et al., 2001).

An attempt was made to make Nachshon into a figure with which the children could identify to increase their interest in language and literacy.

Nachshon is therefore depicted on the games and other materials to strengthen the link between the intervention program and the television series.

Interactive Television Interstitials

More than 100 interactive quiz games were developed, each lasting 5 minutes. They served as interstitials and were broadcasted about eight to ten times a day, sometimes using an interactive technology. As previously mentioned, the children in the intervention group had access to these interstitials before the intervention program in the kindergarten started. The interstitials dealt mainly with naming or sounding out letters. For instance, the Hebrew alphabet was presented and each letter was highlighted and named. Many interstitials showed a letter that was simultaneously named in addition to three words in print with matching pictures. Children are instructed to click on the picture with a name starting (or ending) with the focal letter. When children click on one of the wrong pictures the letter name is repeated, till the correct response is selected and approved.

Website Educational Games

A website developed by CET included seven interactive games practicing code-related skills: letter knowledge, phonological awareness (e.g., retrieval of initial or final sounds), and grapho-phonemic awareness. (e.g., retrieval of initial or final letters). Text production and word spelling were encouraged via a creative center: the children could compose texts by selecting letters from the keyboard or by dragging items from a file of preprinted words and phrases (e.g., "How are you?" or "Happy birthday") that were pronounced when touched by the cursor. Colorful drawings and decorative patterns could be dragged from another file. The program enabled children to print their text.

Most participating families had access to this rich package either through cable television (83%) or through internet-connected computers (62%). However, the effects of this package were dependent on scaffolding by parents or siblings. Children who were left alone to watch a television series, to manipulate interactive television, or to use a website of educational games, if not supported through family interaction, might gain little because of a lack of understanding, discouragement, or frustration. Consequently, another aim of our study was to assess if the intervention program in school stimulating similar skills added to the effects of this package. Teachers in the intervention group encouraged parents to take a scaffolding role at home.

The Project in Kindergartens

Teachers' Scaffolding

The teachers had via video cassettes access to the *Nachshon Can Do All* series and to the interactive interstitials, and were instructed in how to support children while watching or playing. Children also had access to the website of games and the creative center. In addition, the teachers got feedback about the child users: how often and how long individual children used each game and how well they did on a time scale. The teacher could watch and present on the web children's products in the creative center and assess their spelling and text production. With the help of this rich source of information teachers could decide who needed additional help and in which area. The website also had features that enabled communication between teachers and parents and between teachers and consulting CET experts.

Printed Material

Kindergartens were enriched with printed devices to train code-related skills: cards with Hebrew letters, card games, activity books, and posters. Other print materials were present to enhance language: posters that invite story production and communication with teachers and classmates, 24 storybooks with folk tales and short stories, and a dictionary for young children.

Parental Involvement

Parents were invited to attend two presentations by the teachers with suggestions on how to enhance literacy skills at home. Parents received a special parent–child activity guide for sharing fun games related to the TV broadcasts. Parents were encouraged to watch the TV broadcasts jointly with their children and to participate with their children playing games on the website. Parents had access to the parents' forum on the website that enabled them to share experiences and ideas.

Teachers' Study Group

The teachers participated in seven sessions of about 4 hours, spread over the period of the intervention but mainly taking place in the first 3 months of the project. A CET expert on language and literacy planned and guided the course. Teacher training was considered essential for deepening teachers' knowledge of literacy and language, strengthening their professional skills as educators, and encouraging their cooperation with and commitment to the implementation of the program (e.g., Dickinson & McCabe, 2001). Topics were: development of emergent literacy; incorporating the educational materials into the regular curriculum; guidance of parents in promoting literacy at home; using different genres as reading materials in the kindergarten; developing their own materials and activities to enhance literacy;

and clarification of the goals of the current literacy curricula in Israeli preschools and kindergartens.

Devices Assisting Implementation

To help teachers with pedagogical and technical matters they were visited four times by the expert responsible for the teachers' study group and weekly by CET experts during the first 3 months of the project. Throughout the year CET experts were available by phone or email for any personal assistance needed by the teachers. Teachers used the teachers' forum on the program's website, to share problems and ideas with other teachers and with the experts. In addition, every teacher received written materials concerning the rationale of the program.

Evaluation Study

Participants

Children in 15 kindergartens formed the intervention group and children in 14 kindergartens formed the comparison group. Altogether the sample numbered 449 children, divided between the intervention (233 children) and comparison (216 children) group. All participating kindergartens served primarily low socioeconomic strata, according to criteria developed by the Israeli Ministry of Education.

Evaluation Components

The evaluation included four components: testing children in the intervention and comparison groups, observations in the kindergartens of the intervention group, interviewing teachers, and interviewing parents involved in the intervention. A group of university graduates was trained for about 10 hours on testing children and interviewing parents and teachers as well as on documenting responses.

Children's Performance on Tests

Children were tested twice with a period of about 5 months in between, once at the beginning and once at the end of the program. Children who attended the kindergartens on the testing dates took part in the evaluation study. Seven tests were used to assess letter knowledge, phonological awareness, morpho-phonological awareness, and vocabulary. Each type of test has been used in previous studies and found to be reliable and informative. On *Naming Letters* children were asked to name each Hebrew letter printed on a card (see e.g., Treiman, Levin, & Kessler, 2006b). On *Retrieval of Initial Letter* children named the first letter of the stimulus words presented to them orally, and on *Retrieval of Final Letter* they named the last letter of the words (see e.g., Levin, Patel, Margalit, & Barad, 2002; Treiman, Tincoff, & Richmond-Welty, 1996). On *Isolating Initial CV* children isolated the first

two phonemes of monosyllabic spoken words with a CVC structure, and on *Isolating Final VC* they did the same for final VC sounds (see e.g., Levin, Shatil-Carmon, & Asif-Rave, 2005; Share & Blum, 2005). On *Pluralization of Nouns* children were asked to provide the plural form of an orally presented noun in singular form (see e.g., Ravid & Schiff, in press). On the *Vocabulary Antonym Test* children were asked to supply the antonym of given lexical items (see e.g., Peyser, Shimborsky, Wolf, & Hazany, 1996).

Comparisons between the intervention and comparison groups were carried out on each test separately. Mean scores at the start of the program

Both groups exhibited "growth" because all children attended kindergarten, had access at home to the *Nachshon Can Do All* series and the interstitials on cable television, and were able to access the games on the public website on the internet.

Table 16.1 Pretest, posttest and progress scores for each test and t-values as indicators of differences in progress

Test and timing	Intervention group			Comparison group			t-value and significance
	M	SD	N	M	SD	N	
Naming letters: Pretest	35	30	193	37	31	214	
Naming letters: Posttest	76	25	194	70	27	211	
Naming letters: Progress	40	24	185	33	23	209	t = 2.99**
Retrieval of Initial Letter: Pretest	22	25	201	26	31	210	
Retrieval of Initial Letter: Posttest	68	33	194	61	33	212	
Retrieval of Initial Letter: Progress	46	30	193	34	29	206	t = 3.89**
Retrieval of Final Letter: Pretest	8	15	199	11	20	213	
Retrieval of Final Letter: Posttest	52	36	188	39	31	208	
Retrieval of Final Letter: Progress	44	33	186	28	27	206	t = 5.25**
Retrieval of Initial Sound: Pretest	33	27	199	30	29	213	
Retrieval of Initial Sound: Posttest	64	30	191	54	29	211	
Retrieval of Initial Sound: Progress	32	31	188	25	30	209	t = 2.52*
Retrieval of Final Sound: Pretest	13	26	200	14	25	211	
Retrieval of Final Sound: Posttest	58	41	189	45	37	208	
Retrieval of Final Sound: Progress	45	39	187	31	33	204	t = 3.95**
Vocabulary (Antonyms): Pretest	41	16	202	41	17	216	
Vocabulary (Antonyms): Posttest	56	15	193	56	19	212	
Vocabulary (Antonyms): Progress	15	13	193	14	15	212	t = 0.20 ns
Morphology (Plurality): Pretest	72	13	202	73	12	216	
Morphology (Plurality): Posttest	81	11	194	80	10	208	
Morphology (Plurality): Progress	9	11	194	7	9	208	t = 1.46 ns
Total Score: Pretest	32	15	202	34	18	216	
Total Score: Posttest	65	23	194	58	21	212	
Total Score: Progress	33	17	194	24	14	212	t = 5.40**

Notes
Progress scores are based on scores of children tested on pre- and on posttest.
$*p < 0.05$; $**p < 0.01$.

and at the end, as well as progress from beginning to end, for each test and each group separately, appear in Table 16.1. Analyses by t-tests contrasting progress in the intervention and comparison group revealed that the intervention enhanced growth in all code-related skills (i.e., letter naming, retrieval of initial and final letters, and isolating initial CV and final VC sounds) but not in vocabulary and morphology (i.e., vocabulary antonym test and pluralization of nouns). Hebrew morpho-phonology and vocabulary, key focus points in a few episodes of the *Nachshon Can Do All* series, were promoted by posters and storybooks. The reasons for less growth may therefore not be that the program overlooked these skills but may lie in the density and complexity to practice and assess these skills.

This project targeted children at academic risk since they were recruited from classrooms mainly attended by children from low SES. However, children with additional risk factors attended the same classrooms: immigrants and children with special needs. To analyze whether high-risk children gained from the program as much as low SES mainstream children, the impact of the intervention program on mainstream children was compared to that on high-risk children.

Immigrants came from two main sources: Asian Republics of the former Soviet Union and Ethiopia. Immigrants to Israel in general and from Ethiopia in particular are at risk in terms of academic achievements in school (Levin, Shohami, & Spolsky, 2003). Shany (2006) documented that Israeli kindergarten children from an Ethiopian background were relatively poor on many measures of language and literacy relative to their classmates and to the normative cohort in Israel. Schleifer (2003) did not find statistically significant differences between Ethiopian and native Israeli low SES students in grades 5–11 but both groups performed worse than their middle SES counterparts. The children with special needs were mainly slow learners or pupils who received professional remedial help for diagnosed behavioral problems.

Table 16.2 presents mean scores across all tests at the beginning and the end of the intervention period among the four groups. Three Way Analysis of Variance (ANOVA) with as independent variables Time (pretest and posttest), Group (intervention and comparison), and Population (mainstreamers, immigrants, children with special needs) revealed the following picture. Overall performance improved from pretest to posttest, (F (1, 398)=412.05, $p<0.001$). Most importantly, there was more improvement in the intervention than in the comparison group, as reflected by a Time by Group interaction (F (1, 398)=6.29, $p<0.02$). Overall, the four populations differed significantly from each other: mainstreamers and immigrants gained more than Israeli born or immigrants with special needs, (F (3, 398) = 4.86, $p<0.002$). No significant difference emerged between Israeli mainstreamers or immigrants. In the same vein, no difference emerged between Israeli born and immigrants, both of which had special needs. Population did not interact

Table 16.2 Mean scores on pre- and posttests across all tests, by population, group and time

Population	Pretest		Posttest	
	M	SD	M	SD
Intervention group				
Mainstream children (n = 117)	35	16	67	23
Immigrants (n = 46)	30	14	65	21
Children with special needs (n = 27)	27	12	58	24
Immigrants with special needs (n = 4)	32	10	56	20
Comparison group				
Mainstream children (n = 121)	36	19	60	21
Immigrants (n = 46)	32	16	59	20
Children with special needs (n = 35)	26	15	50	21
Immigrants with special needs (n = 10)	35	23	56	23

with Group, with Time, or with Group and Time, suggesting that the intervention had a similar effect on all populations suggesting that children with special needs who possibly may have greater difficulty in using the educational materials make similar gains as their mainstream counterparts. However, the gains in literacy skills exhibited by the children with special needs, though promising, did not narrow the gap between the risk group and mainstream children (see Table 16.2).

Observations in Kindergartens

Planned visits took place twice in each kindergarten: 2 months after the beginning of the intervention program and close to the end of the program. Each visit lasted for about 2 hours. Observations focused on one of the following activities: watching videocassettes of the *Nachshon* series, playing games on the website, and using printed materials.

Small groups of 14–20 children watched the *Nachshon* series together on a regular basis. The observers reported that children appeared interested and as having fun. Many sang along with the opening song of the broadcast. The level of scaffolding varied across teachers. Most teachers watched the video with the children and stopped it from time to time for questions or clarification of issues. A few teachers remained passive or occupied themselves with something else. One teacher during the first visit and two during the second prepared printed material or organized a game providing additional practice of the skill taught in the program.

The website games were carried out either by a single child or jointly by two children for about 20 minutes. The teachers who mostly designated children to play games had a preference for weak children to promote their motivation to learn and advance language and literacy skills. On the other hand, they were careful to give turns to all children. Sometimes they comprised

dyads varying in academic skills to facilitate and encourage peer teaching. At one extreme, the teachers were totally uninvolved; in the moderate involvement range, teachers approached the children when a problem arose or to suggest changing games; and at the other extreme, teachers sat with the children, made suggestions, and provided help and encouragement. The observers reported that children were highly motivated about using the website and, in general, exhibited no recurrent difficulties or frustrations.

Often, the children were highly involved in the games and interacted extensively with each other. The teachers always participated and guided the children in problem solving. The games observed dealt mostly with code-related skills.

Teachers' interviews. Most teachers mentioned that they utilized the materials. The website presenting games and a creativity center was unanimously perceived as most attractive to children. Some children often arrived earlier than usual at school "to be the first in line." Some parents reported buying a computer so that their children had access to the games at home.

The teachers found the videocassettes broadcasting the *Nachshon Can Do All* series to be enjoyable and stimulating. As many children watched the television series at home, to the extent that they cited sections of the text by heart, they were not as eager to watch them as often in school.

The printed materials, including cards, literacy games, books, and a dictionary, were used several times a week. Teachers developed a classroom library where children could borrow the provided storybooks.

Teachers were asked an open-ended question about how successful they thought the program had been in their kindergartens. All teachers expressed a high level of satisfaction with the program and its impact on children's development and their own professional development and motivation. One teacher said:

My children's literacy is at a more advanced level, earlier than in the previous years. The ideas in the guidebook for teachers led me to invent new materials. The program increased my motivation to work harder and aspire for higher levels of achievement. It heightened my sense of responsibility concerning children's achievements.

A second teacher commented: "Although I worked on literacy in kindergarten for many years, the program updated me and made me demand more from the kids. Now I am computer-literate and can use the internet." A third teacher said: "The contents were delivered in a game-like atmosphere. It was a delight for the entire class."

Parents' interviews. A total of 95 parents, randomly selected of the children in the intervention group (40%) were interviewed. Most parents (85%) had

access to cable television at home. Among those parents, 87% reported that their children watched the *Nachshon Can Do All* series at home on cable television, a highly impressive number—40% reported a high rate of five to six times a week, 28% a rate of three to four times a week, and the rest a low rate of once or twice a week. Access to the internet website with games, the creativity center, and the communication center for parents was present in 64% of the homes. Among those parents, 84% reported that their children were using the website, again, a highly impressive number—21% reported a high rate of five to six times a week, 27% reported a rate of three to four times a week, and the rest a low rate of once or twice a week. The intensive use of TV and the website may be promoted by the intervention program in school. Children probably improved on the trained skills, were motivated to deepen their learning, a motivation that corroborated the motivation of parents to get involved.

A total of 97% of the interviewed sample reported working on the parent-child activity book, a remarkable high rate of involvement. This result suggests that exclusion of print materials like activity books and working sheets is not desirable taking into account that the device is simple and inexpensive and can easily be developed by teachers.

Overall parents responded positively to an open-ended question about how successful they thought the project in the kindergartens has been, perhaps more positively than they really felt because of social desirability. Nevertheless, the degree of support and the variety of issues praised were encouraging. One mother said: "Since the project started, my child has made great progress, recognizes letters, and almost reads. I am very satisfied. The project is a success." Another mother referred to spelling and school readiness:

The program is very good. It helped my son. Thanks to the program, he now knows how to spell words aloud ... thanks to the program he is well prepared for first grade. It's too bad that such a program did not exist before.

A third mother mentioned discourse skills as well as code-related skills: "The program is excellent and contributes greatly to learning how to follow instructions, listening, learning the alphabet, and rhyming." A fourth mother talked about parental involvement:

It's good that there is a program that involves the parents. It is very important to get ready for first grade. My daughter already knows all of the letters and is very good with letters. It's important that the parents take part. Usually, in kindergarten, parents don't participate.

Discussion

This study is unique in that it examined the impact of an intervention program in kindergarten that was planned to enhance the effects of programs on television and the internet that were accessible at home. The program was as effective in promoting code skills for mainstream children as for immigrants and for children with special needs, all of whom were at risk academically to some extent because of their low SES background.

The results of our study can be compared with those of Linebarger et al. (2004) who, unlike us, found no positive effects on high-risk children who watched the television literacy-related program *Between the Lions*. They concluded that high-risk children probably need scaffolding in understanding the program and its print. In our study, the more positive results can be explained by the fact that the children in the intervention group got a high amount of scaffolding by teachers and by parents.

Our program was effective in promoting code-related skills but did not seem to enhance the children's vocabulary or morphology skills. The failure of the program to boost vocabulary and morphological awareness is perhaps related to the density, complexity, and difficulty of the competencies tested. It has been claimed that learning to name letters follows the same principles as those involved in learning new words (Treiman, Kessler, & Pollo, 2006a; Treiman et al., 2006b). However, letter names in many alphabets form a close class of 20 to 30 items whereas the lexicon is an open class of a huge number of items. Therefore, it may be easier to trace growth in letter names by asking the children to name all the letters in the alphabet than to show growth in vocabulary by testing them on a sample of lexical items, not necessarily those that were dealt with in the program. In an evaluation study of an intervention program in kindergarten, Levin, Aram, Biron, and Shemesh (2003) reported that vocabulary growth was found to occur when children were tested on words practiced by the program but not when they were tested on children using the Antonym Vocabulary Test that we administered in the current study. It is possible that our intervention program may have familiarized children with new words or helped them in understanding other words having the same roots, but that it had no effect on children's scores obtained in a general test of vocabulary.

Phonological awareness at the level used here (CV or VC sound isolation) develops from preschool to first grade (Levin et al., 2005; Share & Blum, 2005) and, therefore, suitable for training in kindergarten. Pluralization in Hebrew as measured in our study taps knowledge of the complex morphophonological system of Hebrew, a skill that develops later (Ravid & Schiff, in press). Our program perhaps enhanced children's acquisition of plural forms, but at a preliminary level rather than at the more complex level in the test. Our observations and teachers' reports clearly show that interacting with computers is attractive to young children. A new medium of electronic books

used on the computer might have had an added impact on vocabulary and related competencies (Bus et al., this volume; Korat & Shamir, this volume; Verhallen, Bus, & de Jong, 2006).

A main limitation of this study is that the intervention comprised a multitude of components. We do not know which component or combination of components accounted for the positive effects we found on literacy in kindergarten. The conclusion that the educational effects of TV programs and websites in the public domain can be expanded by related interventions in school is a fascinating result awaiting further systematic research.

References

Aram, D. (2005). The continuity in children's literacy achievements: A longitudinal perspective from kindergarten to second grade. *First Language, 25, 259–289.*

Aram, D., & Levin, I. (2001). Mother–child joint writing in low SES: Sociocultural factors, maternal mediation, and emergent literacy. *Cognitive Development, 16, 831–852.*

Badian, N.A. (1998). A validation of the role of preschool phonological and orthographic skills in the prediction of reading. *Journal of Reading Disabilities, 31, 472–481.*

Berman, R., & Ravid, D. (2006, July 6–8). Children's knowledge of novel and traditional suffixes. The impact of schooling. Paper presented at the 2006 Conference of the Society for the Scientific Study of Reading, Vancouver, Canada.

Bus, A.G., & van IJzendoorn, M.H. (1999). Phonological awareness and early reading: A meta-analysis of experimental training studies. *Journal of Educational Psychology, 91, 403–414.*

Chaney, C. (1998). Preschool language and metalinguistic skills are links to reading success. *Applied Psycholinguistics, 19, 433–446.*

Christian, K., Morrison, F., & Bryant, F.B. (1998). Predicting kindergarten academic skills: Interactions among child care, maternal education, and family literacy environment. *Early Childhood Literacy Research Quarterly, 13, 501–521.*

Dickinson, D.K., & McCabe, A. (2001). Bringing it all together: The multiple origins, skills, and environmental supports of early literacy. *Learning Disabilities Research & Practice, 16, 186–202.*

Ehri, L.C., Nunes, S.R., Willows, D.M., Yaghoub-Zadeh, Z., & Shanahan, T. (2001). Phonemic awareness instruction helps children learn to read: Evidence from the National Reading Panel's meta-analysis. *Reading Research Quarterly, 36, 250–287.*

Elbro, C., & Petersen, D.K. (2004). Long-term effects of phoneme awareness and letter sound training: An intervention study with children at risk for dyslexia. *Journal of Educational Psychology, 96, 660–670.*

Gunn, B., Smolkowsky, K., Biglan, A., Black, C., & Blair, J. (2005). Fostering the development of reading skills through supplemental instruction: Results for Hispanic and non-Hispanic students. *Journal of Special Education, 39, 66–85.*

Kirby, J.R, Parrila, R.K., & Pfeiffer, S.L. (2003). Naming speed and phonological awareness as predictors of reading achievement. *Journal of Educational Psychology, 95, 453–461.*

Korat, O., & Levin, I. (2001). Maternal beliefs, mother–child interaction, and child's literacy: Comparison of independent and collaborative text writing between two social groups. *Applied Developmental Psychology, 22, 397–420.*

Levin, I., Aram, D., Biron, S., & Shemesh, K. (2003). Technion lekidum oriunut bejaraf [Programs for promoting literacy in preschool in Japhat]. *Hed Hagan, 2, 1–3.* (Hebrew).

Levin, I., Patel, S., Margalit, T., & Barad, N. (2002). Letter-names: Effect on letter saying, spelling, and word recognition in Hebrew. *Applied Psycholinguistics, 23, 269–300.*

Levin, I., Ravid, D., & Rapaport, S. (2001). Morphology and spelling among Hebrew-speaking children: From kindergarten to first grade. *Journal of Child Language, 28, 741–772.*

Levin, I., Share, D.L., & Shatil, E. (1996). A qualitative-quantitative study of preschool writing: