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A Lurian systemic-dynamic approach to teaching illiterate adults a new language with literacy

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Abstract

The Israeli educational system faces the specific challenge of teaching Hebrew as a second language to new immigrants from Ethiopia, who are illiterate in their mother tongue. Despite good will and substantial efforts, the success of these immigrants in achieving literacy in the Hebrew language has been limited. To better meet their social and vocational needs, we revised the existing model of literacy teaching for adults and developed an alternative *communicative-multicultural-neuropsychological model*. This approach is based on cultural-historical approaches developed by Vygotsky and Luria and cultural neuropsychology. The analysis of neuropsychological aspects of illiteracy and changes in brain function related to literacy acquisition allowed us to suggest adding exercises that seek to train phonological awareness and visual perception to processes of learning to read and write. Forty-five students of the experimental (Orit) program had significantly better scores than a group who received an equivalent amount of literacy classes (175 h). This overall effect of the program was reflected by mean improvements in word and sentence production from pictures and letter recognition and increased self-efficacy for language learning. Such a program can be used as a research platform to teach a second language for illiterate adults who lack formal schooling. **Keywords**: Luria, education, culture, illiteracy, new language learning, adult literacy acquisition.

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Introduction

Language development in an individual's native language, including acquisition of the highest level of functioning, written language (both reading and writing), usually occurs in childhood when neural plasticity is still rather high. Learning and teaching a second language in adults is a challenge, especially to those who have not attained literacy in their native language.

The Israeli educational system faces a substantial challenge of teaching Hebrew as a second language to new immigrants from Ethiopia who are illiterate in their mother tongue. The most remarkable attainment is when an adult immigrant, who is a first-time reader, learns to read and write in a language that he scarcely speaks in a new culture. Such immigrants who did not have the opportunity to receive formal instruction throughout their lives now must simultaneously cope with the enormous endeavors of social integration and reading and writing in a second language.

Israel has a population of approximately 135,000 Ethiopian immigrants. These immigrants come from a community with a high illiteracy rate (70-80%). Illiteracy among Ethiopian Jews occurs naturally as a consequence of sociopolitical circumstances in which it was once common in Ethiopia for only one of the boys of the family to attend school. People in this agrarian, traditional society have lived mostly in villages and relied on oral culture rather than the written word (Anteby, 1994; Ben Ezer, 1992; Levin-Rozalis, 2000).

A special curriculum and culture-sensitive language assessment tests were developed to suit the specific needs of these immigrants (Rubinstain, 2012). Unfortunately, many adult immigrants fail in their attempts to acquire reading and writing skills. After intensive language courses, they usually only achieve a very limited understanding of the Hebrew language (Habib, 2001). Several reasons may underlie such a failure. Adult illiterate Ethiopian immigrants are unable to rely on any previous acquaintance with the features of the written word. They may also fail to cope with the sharp

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transition from traditional to modern society (Fanta-Vagenshtein, 2011). Some of the Ethiopian immigrants' cultural norms and linguistic behaviors may conflict with the norms and educational processes of their new society, in this case Israeli society (Schleifer, 2010).

Other countries also face similar problems related to teaching literacy to adults in their mother tongue or teaching illiterate immigrants. Thus, analyzing the efficiency of programs sponsored by the World Bank, Helen Abadzi (an education specialist and senior officer at the Operations Evaluation Department of the World Bank) concluded that the donor community has made sustained efforts to empower the very poor, who are often illiterate, by providing access to social services and financial resources. However, some community-driven projects have not produced the expected outcomes (Abadzi, 2005). She suggested that we cannot approach a solution to adult illiteracy without understanding the "brain architecture" of the process. Data from cross-cultural neuropsychology become especially relevant for newly developing multicultural societies for decisions related to language policy in education.

However, this poses a difficult task. Trying to be politically correct to be respectful and provide equal rights may lead to the encouragement of similar approaches and methods of teaching and learning a new language for all immigrants or other disadvantaged populations. For illiterate adults, however, this can result in only frustration and failure.

Below we discuss some of the neuropsychological factors that impede successful language learning and must be addressed to achieve progress in literacy acquisition. We discuss the brain mechanisms involved in reading and changes in brain function that result from neural plasticity and literacy acquisition.

Our approach is based on the cultural-historical Vygotskian approach to learning and on Lurian systemic-dynamic neuropsychology (Luria, 1973). This approach considers that human development results from the concomitant influence of phylogenetic, cultural-historical, ontogenetic, and microgenetic processes on the developing person (Vygotsky, 1998; Wertsch, 1985).

According to this cultural-historical approach, higher mental functions are "...social in origin and complex and hierarchical in their structure and they all are based on a complex system of methods and means..." (Luria, 1973, p. 30). Language is a perfect example of higher mental function, especially with regard to most cultural aspects of language (i.e., reading and writing to advance spoken language based on symbolic visual representation).

Cultural-historical neuropsychology

Neuropsychological investigations of cognitive processes were initially performed with people who received their education in Europe, North America, and the former Soviet Union. These investigations yielded an Eurocentric worldview that supports a universal concept of behavior and cognition. All people were assumed to manifest the same behavioral responses to the same stimuli in the brain (Fletcher-Jansen, Strickland, & Reynolds, 2000). Josef Henrich and his colleagues formulated the problem in even stronger terms. Samples were drawn entirely from "Western, Educated, Industrialized, Rich, and Democratic" (WEIRD) societies (Henrich, Heine, & Norenzayan, 2010, p. 61).

Today, however, neuropsychologists also work in countries with differing cultures, with immigrants of different origins and illiterate people and children in developing countries (Ardila, Rosselli, & Rosas, 1989; Ardila, Ostrosky, & Mendosa, 2000) where educational systems are still in their early stages of development or where access to education is limited. In some countries, many "refugee and immigrant students in secondary and adult education classrooms arrive not only without speaking the dominant language of the community, but also with little or no print literacy. Such newcomers are faced with a double challenge: they must learn the local language while learning to read for the first time" (Vinogradov & Bigelow, 2011, p. 1). In Portugal, 30% of the population older than 55 is totally illiterate because of socioeconomic circumstances. This figure is higher in small rural or fishing communities (Castro-Caldas & Reis, 2000). Perhaps it is even higher in former Portuguese and other colonies.

It is not by chance that those who initiated inquiries into the cultural aspects of brain functions were students of Luria (Lurila & Goldberg, 1990; Ardila, 1995; Kotik-Friedgut & Ardila, 2004). Today, this field has become a focus of interest for many young researchers in different countries. The research by Vygotsky and Luria in Uzbekistan was mainly developmental and cross-cultural[1] in nature. It was also concerned with the specific influence of schooling and literacy on general cognitive development. Only later did Luria begin his groundbreaking work in neuropsychology. He always stressed that the systemic-dynamic approach started from revising the main relevant concepts, including function, localization, and symptoms (Luria, 1973).

An intrinsic factor in the systemic organization of higher mental function is the engagement of external artifacts (e.g., objects, symbols, signs, and writing systems) that have an independent history of development within culture (Kotik-Friedgut, 2006).

Thus, according to the concept of "extracortical organization of complex mental functions," the role of external factors in establishing functional connections between various brain systems is universal in principle. However, different mediators and means or significantly different specifics within them (e.g., the direction of writing, degree of letter-sound correspondence, orientation by maps, or orientation by the behavior of sea-birds.) may develop and are in fact developed in various cultures. Therefore, analyses of higher mental

[1]See Cole (1990) for detailed review of Luria as a cultural psychologist.

functions must necessarily consider these cross-cultural differences. Brain-behavior relationships are interwoven and depend on environmental influences (Fletcher-Jansen et al., 2000).

When dealing with the development of knowledge in both adults and children, we need to consider the social context of development. According to Vygotsky, this "represents the initial moment for all dynamic changes that occur in development during the given period. Therefore, to study the dynamics of any age, one must first explain the social situation of development" (Vygotsky, 1998, p. 198).

Some basic cognitive abilities and their corresponding brain mechanisms are universal and inherent to any human being, independent of language and environment, but even they must undergo refinement via experience. The process of internalization in the development of higher mental functions occurs under the influence of a specific cultural context, thus shaping and mediating the processes of the development and functioning of these basic cognitive abilities.

The results of research with newborn infants suggest that organized visual perception is an unlearned capacity of the human organism. Moreover, the preference for proper face stimuli in infants who have not seen a real face prior to testing suggests that an unlearned or "evolved" responsiveness to faces may be present in human neonates (Goren, Sarty, & Wu, 1975). Neonates are "pre-wired" for pattern recognition related to the social environment. With experience, they learn to differentiate their mother and other family members from strangers.

Even a basic and seemingly biological ability for which a newborn is presumably "hardwired," such as crying, undergoes refinement with neonatal experience within a specific cultural/linguistic environment. An international group of researchers analyzed the crying patterns of 30 French and 30 German newborns (2-5 days of age) with regard to their melody and intensity contours. The French group preferentially produced cries with a rising melody contour, whereas the German group preferentially produced falling contours. The data showed an influence of the surrounding speech prosody on newborns' cry melodies, possibly via vocal learning based on biological predispositions (Mampe, Friederici, Christophe, & Wermke, 2009).

Brain organization of speech and education

All changes that result from experience are possibly attributable to plasticity of the brain. A reasonable expectation is that most of the obvious cross-cultural differences in functional or structural brain organization will be reflected in higher psychological functions such as speech, reading, writing, executive function, and professional skills. These functions mostly depend on learning in a specific cultural-historical environment.

As a general rule, more phylogenetically recent behavioral patterns are likely to show greater variability within the species as a result of their place within evolutionary history. Thus, finding cultural-neurological differences in reading and writing (as opposed to speech) may be easier as a function of written language's relatively recent place in human evolution (Kennepohl, 1999). In this respect, the study of differences in the functional organization of brain mechanisms in literate *vs*. illiterate subjects and changes in brain organization as a consequence of learning to read are crucially important.

The concept of literacy presents is complex. The development of reading and writing skills also has intermediate stages. UNESCO defines adult illiteracy as characteristic of people aged 15 years and older who can neither read nor write a comprehensible short, simple statement in their everyday life.

The acquisition of literacy is usually associated with schooling, and its profound effect is reflected in all spheres of cognitive function. Illiterate individuals perform worse on various neuropsychological variables than people who went to primary school, such as the ability to utilize data for deductive reasoning, short-term memory, categorization, visuospatial discrimination, numerical ability, and abstract speech. People with at least 3 years of effective schooling perform better on neuropsychological tests than illiterate people. Practically all European children around the age of 12 years perceived pictures with perspective as three-dimensional. African children and illiterate Bantu and European laborers, in contrast, responded to the picture as flat and not three-dimensional (Hudson, 1962). They cannot interpret three-dimensional figures that are presented on paper. This also generally holds true for illiterate people (Ardila et al., 1989). The fact of schooling *per se*, independent of a specific culture in India or Europe, has a significant effect predominantly on the processes of simultaneous and successive synthesis. In tasks of picture recall or tasks of the Piagetian type, performance was similar in illiterate and schooled children (Baral & Das, 2004).

Castro-Caldas and Reis compared the repetition of words and pseudowords in literate and illiterate women. The repetition of pseudo-words was significantly worse in the illiterate group than in the literate group. This difference was reflected in positron emission tomography images. A small difference was observed between groups when they repeated real words. A significant difference was also found between groups when they repeated pseudo-words. The authors concluded that "social and/or economic circumstances (lack of educational opportunity in this case) can be reflected in changes in the pattern of brain activation in humans and that these changes in brain activation, in turn, can shape behavior" (Castro-Caldas & Reis, 2000).

Visual training associated with the act of reading modifies the way we perceive printed words. The results of Nazir, Ben-Boutaya, Decoppet, Deutsch, and Frost (2004) appear to indicate that reading modifies the functional structure of early stages of the visual pathway. The cortical network that supports reading

appears to include components of the visual cortex of both hemispheres before it lateralizes to the left hemisphere. This indicates that even early development of the visual pathway undergoes experience-dependent changes that then continue to occur throughout life. Comparing perceptual and linguistic skills in three groups of adults of Ethiopian origin with varying levels of print exposure (i.e., illiterate adults who did not receive literacy training, emerging literate adults with limited literacy training, and literate adults with early literacy training), Stoppelman, Germai, Schleifer, Kotik-Friedgut, and Ben-Shachar (2014) reported selective group differences in both the perceptual and language domains. The differences observed in shape matching but not contour integration suggest that literacy training affects higher-level visual processing. Additionally, differences in temporal processing acuity were found in the auditory domain but not in the visual domain. Although causal inferences are limited, the results suggest that literacy training also improves Hebrew vocabulary, which is an important factor in the cultural integration of adult immigrants.

Reading skills can influence the spatial organization of perception. A cross-cultural comparison of the direction of picture naming in Russian and Arab children in Israel revealed no cultural differences in preschool children. In the third grade, after children are immersed in studies within their specific cultures (i.e., Arab children learn to read and write in Arabic and Hebrew from right to left, whereas Russian children learn to read and write in Russian from left to right), differences in the spatial organization of perception are revealed. All Arab children name pictures starting from the right and moving left, whereas all Russian children do this in the opposite direction (Badarni, 2002).

All of these processes develop new functional connections between brain zones, with connections that serve specific activities. New functional systems in the brain, both visual and auditory, develop via an external graphic symbol related to sound in learning to read. Learning to write demands the addition of a graphic-motor function that develops functional connections between visual and motor systems. These are processes that serve automated skills. As a result of the training needed for any procedural knowledge, when these functional links are established, a person generates a powerful instrument for further development and education, opening new methods of problem solving in different domains.

The impact of literacy is reflected in all spheres of cognitive function. Learning to read reinforces certain fundamental abilities such as verbal and visual memory, phonological awareness, executive function, and visuospatial and visuomotor skills.

The principle of the extracortical organization of higher mental functions serves as a plausible framework for analyzing literacy and schooling. At the preliterate stage, the analysis of speech begins from auditory inputs. The visuo-auditory link is limited to the identification of the source of the utterance, whereas this link in reading is mediated by visual symbols. In reading, the brain integrates signals from cortical regions that are specialized for processing visual, phonological, and linguistic information. Learning to read essentially sets up an association between sounds and graphic symbols-letters, synthesizing rows of these symbols into meaningful words and synthesizing groups of words into sentences that describe things and events. Learning to write requires the use of significant graphomotor and visuospatial abilities that are not crucial for reading and not reinforced when the subject is learning only to read. Learning the written form of language (orthography) interacts with the function of oral language (Castro-Caldas et al., 1998). Skilled reading requires proficient processing in gray matter areas of the brain, appropriate connection topologies, and efficient signal transmission within white matter pathways.

Peterson and colleagues used magnetic resonance imaging (MRI) to investigate the importance of literacy for functional lateralization. After listening to lists of word pairs, the subjects were tested with a cued-recall test. Literate subjects performed better than illiterate subjects on both tasks (semantic word pairs: 73% correct in literate subjects, 53% correct in illiterate subjects; phonological word pairs: 60% correct in literate subjects, 25% correct in illiterate subjects). The results showed that illiterate individuals are consistently more right-lateralized than their literate controls for both listening and repeating words and pseudo-words and semantic or phonological word pairs. These results provide evidence that a cultural factor (i.e., literacy) influences functional hemispheric balance in reading and verbal working memory-related regions. In another sample, these authors investigated gray and white matter using voxel-based morphometry. The results showed differences between literacy groups in white matter intensity. This suggests that literacy influences brain structures related to reading and verbal working memory by affecting large-scale brain connectivity more than gray matter *per se* (Petersson, Silva, Castro-Caldas, Ingvar, & Reis, 2007). Ardila and colleagues made an additional point based on the aforementioned findings. Hemispheric specialization may also be related to the strategy used to solve the problem (e.g., verbal, spatial, etc.), which depends on the individual's skills acquired by learning (Ardila et al., 2010).

Modern neuroimaging techniques have allowed us to see differences in functioning, intact brains of literate *vs*. illiterate adults, children before and after learning to read, and people who learned to read and write after puberty.

Using functional MRI (fMRI), Prof. S. Dehaene's research group measured brain responses to spoken and written language and visual stimuli (i.e., faces, houses, tools, and checkers) in adults with variable literacy (10 were illiterate, 22 became literate as adults, and 31 were literate in childhood). Literacy enhanced left fusiform activation evoked by writing. It also induced

some competition with faces at this location but also broadly enhanced visual responses in the fusiform and occipital cortices, extending to area V1. Literacy also enhanced phonological activation in response to speech in the planum temporale and caused top-down activation caused by orthography from spoken inputs. Most changes occurred even when literacy was acquired in adulthood, emphasizing that both childhood and adult education can profoundly refine cortical organization (Dehaene et al., 2010).

Newer imaging methods have been used to identify correlations between white matter activation patterns and reading skills in adults and children. Fiber tracking provides valuable and unique information and yields valid and repeatable results within certain regions of white matter to follow changes in white matter and the corresponding development of functional connections between different brain zones as a result of learning new skills, reading in particular (Ben-Shachar, Dougherty, Deutsch, & Wandell, 2007).

Ben Shachar and colleagues described the first longitudinal fMRI study to document individual changes in cortical sensitivity to written words as reading develops. They conducted four annual measurements of brain function and reading skills in a heterogeneous group of children, initially 7-12 years old. All of these children experienced intensive word stimulation in school and the cultural environment. The results showed age-related increases in the children's cortical sensitivity to word visibility in the posterior left occipito-temporal sulcus (LOTS), in proximity to the anatomical location of the visual word form area. Moreover, the rate of increase in LOTS word sensitivity specifically correlated with the rate of improvement in sight word efficiency, a measure of rapid overt word reading. These results revealed circuitry that extracts visual word forms quickly and efficiently, highlighting the importance of developing cortical sensitivity to word visibility in reading acquisition. The growth of signals in the LOTS of individual children provides an interesting glimpse into the way culturally guided education is coupled to experience-dependent plasticity to shape both cortical processing and reading development (Ben-Shachar et al., 2011). Importantly, in adult illiterates, such sensitivity does not develop, and much more time and effort may be needed to develop it (for a comprehensive review of functional and anatomic differences between literate and illiterate subjects, see Ardila et al., 2010.

Based on the observation that illiterate subjects score significantly lower on some neuropsychological tests, Ardila et al. (2000) developed a method for learning to read, called NEUROALFA. This method seeks to reinforce these particular undeveloped abilities during the process of learning to read. This method has proven to be significantly more effective than traditional methods in teaching illiterate Mexican adults (Ostrosky-Solis, Ardila, & Rosselli, 1999). What also seems important is that after learning to read, all of the subjects in both the experimental and control groups improved their performance on neuropsychological tests, although the gain in the group who had studied using the NEUROALFA method was significantly higher on some subtests, especially on the recall tasks, verbal tasks, and such tasks as Orientation in Time, Digits Backward, Visual Detection, Copy of a Semi-complex figure, Similarities, Calculation Abilities, and Sequences. Notably, in this study, the correlation between pretest scores on a neuropsychological test and reading ability scores was generally low and nonsignificant. However, the correlation between posttest neuropsychological test scores and reading ability scores was significant in several subtests. This observation supports the assumption that neuropsychological test scores do not precisely predict learning-to-read scores, but learning to read reinforces the abilities that are required to achieve high performance on neuropsychological tests. This observation may be the most important in the cognitive testing domain and when analyzing the relationship between education and cognitive test performance. The importance of neuropsychological knowledge for education is becoming increasingly better understood and considered in implementation, which benefits the student population (Sousa, 2010).

This short review reveals that the basic plasticity of our brains allows every sufficiently prolonged experience to change brain function, especially during the early stages of life. Adult learning, including literacy acquisition and learning a new language, is possible but must be approached differently for illiterate people compared with those who acquired literacy skills in early childhood.

Methods

Meeting the challenge of teaching Hebrew with literacy to adult immigrants from Ethiopia who are illiterate in their native language[2]

To better meet the social and vocational needs of adult Ethiopian immigrants, we revised the existing model of literacy teaching for adults and developed an alternative *communicative-multicultural-neuropsychological model* based on the following assumptions that are congruent with Lurian cultural neuropsychology and empirical research findings.

The plasticity of the illiterate adult brain allows changes in its functioning if learning is sufficiently prolonged, even in mature stages of life (Castro-Caldas et al., 1998). Reading comprehension is developed by the activation of background experience and knowledge

[2]Starting from 2009, this program was sponsored by the Joint Distribution Committee (JDC), N.Y. Federation. Based on a pilot stage, the Orit (the Ethiopian version of the Bible) second-language program was developed and implemented. Teachers' training of the second stage of the program was sponsored by the Division of Adult Education of the Israeli Ministry of Education. The program was managed by the Adult Education Association. The description of Orit is based on an article by Olshtain, E., Schleifer, M., Golan-Cook, P., Kotik-Friedgut, B. Rubinstain, S., and Goldstein, K., in preparation.

(Gebre, Rogers, Street, & Openjuru, 2009). Second-language programs for Ethiopian learners should encourage listening, speaking, reading, and writing by explicitly drawing on the learners' cultural-traditional oral knowledge, their cultural norms and codes, and their literacy (Schleifer, 2009).

The following neuropsychological abilities should be reinforced when teaching a second language to Ethiopian illiterate adults: (*i*) phonological abstraction (exercises that emphasize phonological awareness, phoneme discrimination, phonemic fluency, phonological similarity, the decomposition of words to sounds and letters, the grouping of words with common phonemes, and cross-words), (*ii*) semantic categorization, (*iii*) identification of similarities, (*iv*) visuoperceptual abilities (spatial exercises, including the spatial orientation of words, spatial discrimination of letters, discrimination of ambiguous pictures), (*v*) exercises that emphasize verbal memory (i.e., recalling sentences), and (*vi*) abstraction abilities and proverb interpretation (Kotik-Friedgut, 2012).

Communicative realistic language materials, especially real-life dialogues that use authentic language, promote natural conversations. Consideration of the cultural specificity of the target audience of students and their concrete and personal situations should be a preferred strategy and used as prominently as possible. Examples of such topics might include family issues, home activities, the everyday use of written language, and personal documents (Kotik-Friedgut, 2012; Condelli & Spruck Wrigley, 2006).

The initial focus in second-language programs should be on oral skills and separating speaking and listening skills from reading and writing skills (Condelli & Spruck Wrigley, 2006).

The optimal method is to have a bilingual teacher implement such a program. The use of examples from the mother tongue and cross-linguistic comparisons may make this process even more effective. Use of the learner's native language for clarification to explain concepts and provide instructions improves reading comprehension and oral communication skills in the target language, thus enhancing the learner's sense of language self-efficacy, reducing anxiety, and generating motivation and cultural pride (Schleifer, 2009; Kotik-Friedgut, 2012; Condelli & Spruck Wrigley, 2006; Fanta-Vagenshtein, 2011).

The implementation of this model consisted of two stages. A pilot study used printed materials that were developed for Ulpan[3] courses. The experimental program stage developed and implemented new digital and printed materials. Teachers received intensive training that provided a theoretical basis, including knowledge of the neuropsychological aspects of reading and writing. Special attention was devoted to stimulating the development of basic neuropsychological abilities that are important for beginning to read, including phonological awareness and visual perception. The exercises on phonological awareness were introduced first in the native language of the students (i.e., Amharic) to use familiar vocabulary and then in Hebrew.

For reading Hebrew, visual letter discrimination requires special training because of the similarity of letter forms, especially in some fonts that are even more similar than in others. For example, the reader can see that the differentiation of two letters in different fonts (consonants d and r), specifically ד ר ד ר ד ר or ו ז ו ז (representing z and a letter that may sound like v or o) is not an easy problem for a beginning reader. Therefore, in addition to exercises on phonological awareness, in the pilot stage of the project we introduced training visual perception with pictures that demand simultaneous synthesis (pictures by Octavio Ocampo that were carefully selected for cultural appropriateness) and pictures that demand visual thinking (pictures from Akhutina & Pylaeva, 2012).

In the second stage of the project, an Orit program was developed, consisting of a combination of digital and printed materials (i.e., computer software, a learner's printed booklet, and a teacher's guide developed by Michal Schleifer and Eli Ziv). The Internet component in Orit uses unique reading software (Oryanit, developed by Eli Ziv), which is meant to embed phonemes, syllables, letters, words, and language patterns into short- and long-term memory to improve phonological awareness of the structural units of the spoken language. To train visual perception, all of the stimuli (i.e., letters, words, and sentences) were presented at different locations on the screen. The stimuli could also be moved diagonally across the screen and change with regard to size, color, time, and rate of appearance on the screen. The teacher could control all of these characteristics. The learners could write every stimulus in the air with their hands as well as on paper. The teachers also underwent practice sessions using the printed and computer materials.

The software also used video clips to express authentic everyday communicative dialogues among Hebrew speakers of Ethiopian origin. The learners could identify which characters from their own community have an Amharic accent in Hebrew, similar to their own. This similar pronunciation in Hebrew also enhanced the immigrants' phonological awareness.

The thematic content of the videos was "survival-related" (e.g., how to buy products at the grocery store, how to communicate with the pediatrician in the clinic, how to find an apartment to rent, etc.).

Each lesson in this program ended with a reflective feedback session in which the learners recounted (in Amharic) their success and difficulties during the lesson. They were also asked to reflect on what they would like to learn in the subsequent lessons. Such discourse helps learners become more active in the learning process and more responsible for their achievements, with the goal of promoting autonomy (Kotik-Friedgut, 2008).

[3]Ulpan (studio) courses are traditional government-sponsored Hebrew courses for all new immigrants, usually consisting of a program of 5 months of studies per four to five lessons daily.

Subjects

Two similar groups began literacy classes in three different absorption centers where new immigrants from Ethiopia live and study for approximately 1 year, with 63 participants in the intervention classes and 61 participants in the comparison classes. They studied for approximately 3 h three times per week with two teachers, one of whom was a native Amharic speaker.

We obtained results from the pre- and posttest for 45 members of the program group and 39 members of the comparison group. The populations appeared to be sufficiently similar to test the effects of the program.

The average ages of the learners were approximately 34 and 32 years for the program and comparison groups, respectively. The comparison classes had 51% female participants, and the program groups had 45% female participants. Both groups arrived in Israel approximately 2 years prior to the study. The average amount of time spent formally studying Hebrew was the same for both groups of students. The students in both groups had no formal schooling in Ethiopia and were illiterate in Amharic.

Program evaluation

Program implementation was monitored and evaluated through ongoing interviews, intermittent observations of the program in progress, and teacher feedback questionnaires that were administered to teachers in both the experimental (program) and comparison classes at the end of the regular, traditional (Ulpan) program. These questionnaires addressed their experiences with program implementation, the materials and methods used in both the program intervention and regular Ulpan classes, and student responses to both the regular curriculum and program innovations.

Program outcomes with regard to improved Hebrew language proficiency were assessed using tests that were designed by program developers to monitor student performance. The students' perceptions of their Hebrew proficiency and sense of self-efficacy were evaluated using attitude questionnaires that were administered in the form of an interview in both the intervention and comparison classes.

Statistical analysis

The test scores of students in both the intervention and comparison classes were calculated at the beginning of the program (pretest) and end of the program (posttest), based on an average (mean) score that was standardized to a scale of 0 to 10. An analysis of variance (ANOVA) of "change scores" (i.e., the difference between posttest and pretest scores) was performed for learners in the experimental program group compared with learners in the regular classes (comparison group). We conducted a *t*-test to examine differences in test improvement between the program group and comparison group. The equation below shows the calculation for the *t*-test we used, where x^- is the average (mean) improvement score for each group, and x_i is the improvement score for each student. Because the sample sizes were slightly different, we did not use a pooled *t*-test. The statistical analyses were performed using SAS software.

$$T = \frac{(\bar{x}_{program} - \bar{x}_{comparison})}{\sqrt{\left(\frac{\left(\frac{\sum(x_{iprogram} - \bar{x}_{program})^2}{n_{program}}\right)}{n_{program}}\right) + \left(\frac{\left(\frac{\sum(x_{icomparison} - \bar{x}_{comparison})^2}{n_{comparison}}\right)}{n_{comparison}}\right)}}$$

$\bar{x}$ = average group posttest score – average group pretest score

x_i = individual posttest score – individual pretest score

Results

Program implementation was monitored through a formal evaluation performed by an external evaluation team. The data were collected using an internal language test that was especially designed for this program, external midterm tests that were administered by the Ministry of Education, learner attitude questionnaires, ongoing interviews, intermittent observations of the program in progress, and teacher feedback questionnaires that were administered to teachers in both the experimental program classes and comparison classes at the end of the Ulpan program.

The test results are presented in Table 1.

Table 1. Results of internal tests that assessed the effect of the Orit intervention.

	Language skills tested					
	Word production from pictures	**Sentence production from pictures**	**Letter recognition**	**Reading familiar words**	**Reading unfamiliar words**	**Overall scores**
Mean improvement program group (n = 45)	2.90	5.02	16.64	1.89	1.13	27.97
Mean improvement comparison group (n = 39)	1.75	2.15	3.62	1.26	0.92	10.39
Significance of differences	p = .008	p = .01	p = .0001	p = .26	p = .71	p = .0001

Overall, the mean improvement scores for the program group were significantly higher than those for the comparison group (D = .28 and .10, respectively; p < .0001), indicating an overall effect of the program. This effect was reflected by mean improvements in the areas of word and sentence production from pictures and letter recognition. No significant differences were found between improvement scores for the two groups in the areas of reading familiar and unfamiliar words, but the initial gaps between the program and comparison groups, which favored the comparison group in the pretest, were significantly reduced after the intervention. There was no indication that this program favored "weaker" or "stronger" students.

Notably, students in the comparison Ulpan classes also improved, although somewhat more moderately, in the areas tested. Thus, with comparable study programs, the changes in language proficiency that the learners achieved were more significant in the Orit program groups.

An analysis of qualitative data that was gathered through teacher questionnaires showed that teachers in the experimental intervention classes welcomed the innovative methods and materials introduced by the Orit program. The innovativeness and structure of Orit's digital program were seen as potentially strong additions to the teaching/learning process.

The students' responses to the Orit program, as reported by the teachers, were mixed. Some students displayed initial resistance to the program, voicing concern that the materials and methods were unrelated to language-learning and/or were different from those of other classes. Over time, however, these students reportedly exhibited high levels of engagement and cooperation during the learning process. These reports were also substantiated by classroom observations in experimental classes. The students' responses to the use of technology were also reported by the teachers to be mixed, with responses ranging from immediate enthusiasm for the digital presentation to some resistance toward this innovative, unfamiliar methodology.

Each lesson in this program ended with a reflective feedback session in which the learners recounted (in Amharic) their success and difficulties during the lesson. They were also asked to reflect on what they would like to learn in subsequent lessons. Such discourse helped the learners become more active in the learning process and more responsible for their achievements, with the goal of promoting autonomy (Kotik-Friedgut, 2008).

Although the learners' attitudes about the importance of learning the Hebrew language were similar in both the comparison and Orit program groups, the perception of language proficiency and self-efficacy was significantly higher in the experimental group. Students in the experimental group were more confident in their ability to read street signs and read newspaper headlines in Hebrew, complete personal questionnaires, and interview for a job. The learners became more involved in the process of developing significant literacy experiences that were suited to their preferences and wishes. This change in self-efficacy perception may serve as an indicator of expected changes in the social situation of these people. We expect that they will continue their studies.

Discussion

The preliminary results of the *communicative-multicultural-neuropsychological model* of teaching a new language with literacy to illiterate Ethiopian adults in their native language showed that such a program was feasible. The experimental program was more efficient than the traditional Ulpan program, although that program was also revised to meet the learners' cultural background. The experimental program was complex. It included all of the factors that are important for the systemic-dynamic approach. In addition to language teaching *per se* (as in comparison classes), the program took into consideration the students' social situations and cultural backgrounds, which are very different from the culture of the host society. The participation of teachers who had the same cultural background, spoke their native language, and were educated as teachers in Israel was very helpful not only for communication but also for their serving as role models. In our opinion, the most important innovation in this program was the consideration of basic neuropsychological factors that are important for learning to read and write. Training phonological awareness and visual perception, including visual simultaneous synthesis, promotes letter recognition. The inclusion of such components is easier because of the use of the computer as a main learning tool in class. We found that even illiterate learners who were unfamiliar with digital technology rapidly developed immediate control and enthusiasm for the digital presentation. Special workshops on the psychology and neuropsychology of literacy for teachers who participate in the Orit program, which would be conducted before implementation, might add to the efficiency of program implementation.

Neurocognitive research on different illiterate populations worldwide is needed to determine the most practical means and resources that support the development of skills that help such populations acquire reading and writing in the most efficient way.

Further research is needed to determine the overall effect of the program and especially the contribution of the special exercises that reinforce neuropsychological abilities that are critical to the acquisition of reading and writing. Such research depends on further financing and enlargement of the representative sample.

These were only preliminary results because the analysis of all of the data is still in progress, but we are confident that the Orit program can be used as a research platform to teach a second language to illiterate adults in Israel who lack formal schooling and exhibit no print awareness before immigration. With adaptation to other languages, such a program may be able to be adjusted for the benefit of other illiterate second-language learners.

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