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Lexical inference in L2: predictive roles of vocabulary knowledge and reading skill beyond reading comprehension

Anat Prior · Anna Goldina · Michal Shany · Esther Geva · Tami Katzir

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Abstract The current study examined the predictive roles of L2 vocabulary knowledge and L2 word reading skills in explaining individual differences in lexical inferencing in the L2. Participants were 53 Israeli high school students who emigrated from the former Soviet Union, and spoke Russian as an L1 and Hebrew as an L2. L2 vocabulary knowledge and decoding accuracy predicted L2 reading comprehension, which in turn was strongly related to lexical inferencing abilities in the L2. In addition, decoding accuracy predicted additional variance in lexical inferencing, beyond the role of reading comprehension. These findings support the idea that beginning L2 readers with more precise and efficient lexical representations demonstrate better lexical inferencing abilities, most likely due to the increased automatization of word reading, which frees up resources for higher level processing. These results suggest that lexical inferencing from text in the L2 might be limited not only by vocabulary knowledge and higher order comprehension processes, but also by basic decoding skills.

Keywords Lexical inference · Reading comprehension · L2 · Vocabulary · Decoding

A. Prior · A. Goldina · M. Shany · T. Katzir (✉)
Department of Learning Disabilities, Edmund J. Safra Brain Research Center for the Study of Learning Disabilities, The University of Haifa, Haifa, Israel
e-mail: katzirta@gmail.com

E. Geva
Department of Human Development and Applied Psychology, OISE-University of Toronto, Toronto, Canada

Introduction

Much of vocabulary knowledge is acquired through incidental learning in spoken or written language in various situations (Graves, 1987), and it is widely accepted that many words are learned through exposure to written text, in both the first language (L1; Sternberg, 1987) and the second language (L2; Hulstijn, 2003; Dupuy & Krashen, 1993; Knight, 1994). Research on vocabulary acquisition from text in the native language has focused to date on the relations between lexical inferencing and reading comprehension. However, less is known about the possible independent contributions of vocabulary knowledge and word level reading skills to lexical inferencing abilities, beyond their contribution through reading comprehension. This dearth is far more pronounced for lexical inferencing in the L2, and therefore the goal of the present study was to investigate the linguistic and reading-related skills underpinning the ability of readers to successfully infer the meaning of novel words from text in their second language.

Previous research has identified strong relations between lexical inferencing abilities and reading comprehension (Cain & Oakhill, 1999; Cain, Oakhill & Elbro, 2003), raising the possibility that beyond the link between these two higher order abilities, they might rely on similar underlying skills. We therefore adopted the "simple view of reading" model (SVR; Gough & Tunmer, 1986; Hoover & Gough, 1990) as a framework to examine shared and unique underlying skills of reading comprehension and lexical inferencing. The SVR model posits that reading comprehension abilities are based on the interaction of word level reading skill and oral language comprehension. Many studies within the reading comprehension literature have measured oral vocabulary knowledge as a proxy for oral language comprehension (e.g., Landi, 2010), an approach that was also adopted in the current study. The SVR model has been found to successfully predict individual differences in reading comprehension in L1 (Vellutino, Tunmer, Jaccard & Chen, 2007) and in L2 (Gottardo & Mueller, 2009; Geva & Farnia, 2012; Pasquarella, Gottardo, & Grant, 2012).

In the current study, we wish to examine the same components indicated in the SVR and ask specifically whether the ability to infer the meaning of novel words from context in the L2 similarly draws on existing vocabulary knowledge in the target language, and on decoding skill, beyond the contribution of reading comprehension per se. Thus, we examined the contribution of language and reading skills to the reading comprehension and lexical inferencing abilities of adolescent native speakers of Russian in Hebrew, their L2. In the remainder of the introduction we will describe the predictors of successful meaning inference in L1, present background on lexical inference in L2, and finally outline the current study.

Inferring word meaning in L1

Children with normally developing language have a remarkable ability to acquire new vocabulary items with estimations ranging from 1,000 new word stems (Anglin, 1993; Biemiller, 2005; Nagy & Scott, 2001) to approximately 3,000 individual word forms per year (Cain et al., 2003). According to the incidental

learning approach, there are far too many words to teach by means of direct instruction, and students can easily learn words from context after they have learned how to read. By high school, individuals learn most of these new words from text (Landauer & Dumais, 1997), without the help of formal definitions, explicit explanations, or instruction (Sternberg, 1987). Indeed, several studies have shown that children acquire knowledge of new vocabulary through exposure while reading (Nagy, Anderson, & Herman, 1987), with an estimate that of 100 unfamiliar words encountered in one reading, a reader may retain 3–15 (McKeown & Beck, 2004).

Most of the studies on inferring new words from context in L1 have been conducted on elementary school children. Among elementary school children, the lexical inference ability has been linked to strong comprehension skills (Cain et al., 2003; Nicholson & Whyte, 1992; Swanborn & de Glopper, 1999), and to existing vocabulary knowledge. For example, Shefelbine (1990) found that 6th grade students with the poorest vocabulary knowledge at the outset also learned the fewest words from context, even though they had the greatest room for improvement. He proposed that children with smaller vocabularies face two difficulties in expanding their vocabulary: (a) They have to learn more words, and (b) Their understanding of the words they already know is less well developed (see also Perfetti, 2007).

Recently, Seipel (2011) demonstrated that additional reader characteristics might also affect the likelihood of incidentally acquiring words from text. Seipel (2011) examined elementary school children who were native speakers of English, and found that passage reading fluency and a composite score consisting of reading comprehension and vocabulary knowledge made significant contributions to lexical inferencing abilities. The study further found that implicit learning abilities (as measured by an artificial grammar learning task) did not contribute unique variance to meaning inference, but did contribute significantly to remembering the forms of novel words. Along similar lines, Ricketts, Bishop, Pimperton, and Nation (2011) examined the ability of 7 year old monolingual children to infer the meaning of a novel item encountered in text and match it with a picture of the designated object. The study found that both decoding accuracy and oral vocabulary knowledge significantly contributed to the ability to learn the meaning of new vocabulary while reading. It is noteworthy that task demands in the two studies were different: Ricketts et al. (2011) used a picture matching task, whereas Seipel (2011) utilized a receptive recognition task. Nevertheless these two studies expand on previously identified factors and show that word level decoding, text level fluency, and existing vocabulary knowledge contribute to lexical inferencing form text in monolingual young readers. Although there is much less extant research on the ability of adolescents or adults to infer the meaning of novel words from texts in their native language, there is some evidence linking this ability to independent assessments of vocabulary knowledge and memory capacity (Daneman & Green, 1986).

Inferring word meaning from context in L2

Research to date on lexical inferencing in the L2 has focused on several aspects of the process. First, it has been demonstrated that L2 readers do not always attempt to

guess the meaning of unfamiliar items (e.g., Bensoussan & Laufer, 1984; Parry, 1993), especially if they think the word does not have central importance for text comprehension. Additional research has demonstrated that the ability to generate a successful guess, even when an attempt is made, is quite variable (Haastrup, 1991; Paribakht & Wesche, 1999). Indeed, readers mostly rely on meaning cues that are either part of the word itself or that appear in the immediate surrounding context, specifically in the same sentence (de Bot, Paribakht & Wesche, 1997; Haynes & Baker, 1993; Wesche & Paribakht, 2010). These processes are similar to aspects of lexical inferencing discussed in the L1 literature (Cain et al., 2003).

While it is reasonable to assume that a significant portion of vocabulary learning in L2 occurs incidentally from reading novel words in context (Gass, 1999), opinions are still divided on this issue (Hulstijn, 2003; Hulstijn, Hollander, & Greidanaus, 1996). Specifically, the efficiency of incidental vocabulary learning and lexical inference from reading in L2 is still a focus of research (Huckin & Coady, 1999; Wesche & Paribakht, 2010). There is great variability across studies in the demonstrated ability of L2 learners to infer the meaning of unfamiliar words from text, even when the surrounding context supports such inferences (Bensoussan & Laufer, 1984; Haynes, 1993; Haynes & Baker, 1993; Huckin & Bloch, 1993; Knight, 1994; Pulido, 2007).

An important factor contributing to the ability to infer the meaning of words from written context for L2 learners is proficiency in the language. This construct has been investigated in different ways, for example by contrasting learners at different levels of L2 acquisition (e.g., Haastrup, 1991) or by measuring the role of individual differences in L2 proficiency in predicting successful inferencing (e.g., Pulido, 2007). The general finding is that with increased proficiency in the L2, L2 learners become more skilled at lexical inferencing from context (but see Bensoussan & Laufer, 1984, for a different finding). However, the construct of proficiency is complex, and may include several underlying language skills, including vocabulary and morphosyntactic knowledge (Lesaux & Kieffer, 2010), but also word reading fluency (Seipel, 2011). Most extant research has focused on vocabulary knowledge in the L2, but much less is known about the possible role of other components of L2 proficiency in predicting L2 lexical inferencing from text.

The role of existing vocabulary knowledge in the L2 in facilitating successful lexical inferencing was demonstrated by Haynes and Baker (1993), who found that the ability of native Chinese speakers to successfully guess the meaning of new words from text in English, their L2, was more strongly correlated with their existing English vocabulary knowledge than with their English grammatical knowledge. Similarly, Nassaji (2004) reported that depth of vocabulary knowledge in L2 significantly predicted the success of ESL learners in making lexical inferences. One explanation for the important role of vocabulary knowledge in facilitating lexical inference is that unless a reader is already familiar, in terms of orthography and semantics, with a high percentage of the words in a text they might find it very difficult to rely on the context to extract cues to support lexical inferencing of unknown vocabulary (Wesche & Paribakht, 2010). It has been suggested that in order to reach sufficient comprehension of a text, L2 learners need to know between 90 and 95 % of tokens. This also underscores the notion that

enhanced word reading abilities as well as reading comprehension are important for allowing subsequent lexical inference.

While the role of word level reading has been included in the L1 literature on lexical inferencing, it was not systematically addressed in the L2 studies. Perfetti's (2007) model of automatization in reading suggests that efficiency of single word reading processes allows allocation of attentional resources to processing textual information, leading to improved reading comprehension. Here we suggest that similar processes may underlie the ability to infer the meaning of novel words from text. Namely, efficient recognition of single printed words would enable the L2 reader to allocate more cognitive resources to higher processing and to successfully infer the meaning of unfamiliar words. However, although the relations between language proficiency, reading comprehension and vocabulary knowledge and L2 lexical inferencing have been demonstrated in the past (Haynes & Baker, 1993; Nassaji, 2004; Pulido, 2007), no studies to date examined the contribution of basic reading skills such as word decoding accuracy and fluency to L2 lexical inferencing. Thus, one of the issues addressed in the current study is to what extent might the automatization of basic reading also contribute to successful L2 lexical inferencing over and above the contribution of word reading skills to reading comprehension.

The current study

In the experiment reported below, we directly measured the success of adolescent native speakers of Russian at inferring the meaning of novel words embedded in text in Hebrew, their L2. Adolescent learners are a special population, in the sense that they approach learning the L2 after having mastered both oral and written forms of their native language. Adolescent learners' proficiency development in foreign language learning contexts has been described (van Gelderen, Shoon, de Gloper, & Hulstijn, 2007; Sparks & Ganschow, 2001; Sparks, Patton, Ganschow, & Humbach, 2009), but has not focused specifically on lexical inference. Most research to date on L2 lexical inferencing has examined young adults, and the target language has almost exclusively been English (Wesche & Paribakht, 2010; Nassaji, 2004). Thus, the current results will broaden our perspective on L2 lexical inferencing by involving a different L1–L2 language combination (Russian-Hebrew), and by targeting adolescent learners.

We examined the predictive roles of language proficiency and reading abilities in explaining individual differences in lexical inferencing in the L2. These are the same underlying components described by the SVR as critical for reading comprehension. Previous research has demonstrated that readers who are good comprehenders tend to also be more successful in inferring the meaning of unfamiliar lexical items in the L1 (Cain et al., 2003) and in the L2 (Pulido, 2007). The SVR model posits that reading comprehension abilities are based on an interaction of command of elements of the spoken language, often measured by vocabulary knowledge, and word level reading skills, including decoding and fluency. Vocabulary knowledge has also been identified as having a central role in successful lexical inferencing in L1 (Shefelbine, 1990) and in L2 (Haynes & Baker,

1993). Finally, the direct contribution of word decoding and word reading fluency skills to lexical inferencing has only recently been investigated in the context of L1 of elementary school children but not with older L2 learners. Therefore, in the present study we examined the independent contributions of Hebrew reading comprehension, Hebrew vocabulary and single word reading ability in Hebrew to lexical inferencing abilities in Hebrew as an L2.

The current study examined speakers of Russian and Hebrew, languages that are typologically different in terms of both their orthography and morphology, though both are based on alphabetic scripts. Russian is a Slavic language, with a complicated phonological structure and a rich inflectional morphology (Leikin, Share, & Schwartz, 2005). Hebrew is a Semitic language, based on a complex root and pattern morphology (e.g., Ravid & Schiff, 2006). Because of the large distance between the languages and in the writing system, we chose to focus on vocabulary and reading skills in the L2 (Hebrew) as predictors of lexical inferencing in Hebrew. We did not expect any significant transfer from vocabulary or reading skills in Russian, the L1, to Hebrew, the L2, because the languages do not share lexicon (cognates), morphology, phonology or orthography. Further, because the study used novel Hebrew–like words that were invented specifically for this purpose, and none were cognates with Russian, participants could not rely on Russian vocabulary knowledge to assist them in inferring the word meanings (e.g., de Bot et al., 1997; Lesaux, Crosson, Kieffer, & Pierce, 2010). However, we did measure participants' vocabulary knowledge in Russian, and examined its correlation with the other variables, to validate these assumptions.

Method

Participants

Participants were 53 12th graders (30 females) who immigrated to Israel from the former Soviet Union with the "Na'aleh" program. The Na'aleh program is a 3-year program designed for youths who immigrate to Israel before their parents, attend Hebrew speaking high schools, and graduate from high school in Israel (http://naale.org.il/en/). Students in the program receive intensive instruction in Hebrew ("Ulpan") and take other high school subjects with their classmates in Hebrew. According to recent statistics, over 85 % of students in the Na'aleh program graduate successfully from high schools in Israel.

The students in the current study were an inclusive sample that came from three schools in the Haifa municipality in northern Israel. All students from the Na'aleh program in the participating schools were included in the study. The participants' L1 was Russian, and none of them had had any exposure to Hebrew before arriving in Israel. Three students who immigrated from republics of the former Soviet Union where a language other than Russian is used (i.e., Georgian and Armenian) were not included in the study. At the time of testing the average age of the participants was 17.9 years, with a standard deviation of 7.05 months. All students were in their third year of living in Israel and attended grade 11.

Tools

Background measures

Cognitive ability Nonverbal intelligence was measured using the Raven's Standard Progressive Matrices test (SPM; Raven, Raven, & Court, 1976), which includes five subtests. Scores range from 0 to 60, and split-half reliability, is 0.88.

Vocabulary knowledge was tested using an adaptation of the Peabody Picture Vocabulary Test (PPVT). The Hebrew version of the test (Solberg & Nevo, 1979) includes 110 items, each of which contains four pictures. The participant is told to point to the correct picture for each word that is said by the experimenter. The items appear in order of increasing difficulty. Administration of the tests is discontinued after six errors out of eight items. The split-half reliability of the Hebrew version is 0.90 and the test has national norms. A standard Russian version of this test does not exist, but it was translated from Hebrew by one of the authors, a native Russian-speaker. Split half reliability for the Russian version is 0.87. The Hebrew and the Russian versions of the vocabulary task were administered on different days. The Russian version was administered in order to evaluate participants' relative proficiency in Russian and Hebrew, and to examine possible cross-language correlations.

Word reading ability in Hebrew was tested using an isolated word reading task, from a nationally standardized battery developed by Shany, Zieger, and Ravid (2001). Hebrew has a fully vowelized script that includes diacritic marks, and an unvowelized script, where most of the vowel information is missing. Hebrew speaking children acquire literacy using the vowelized script, and after 3–4 years of instruction normally progress to the unvowelized script. Because participants in the current study were in their third year of learning Hebrew, the vowelized version of the word reading text was deemed more appropriate for the study population. The test includes 50 voweled words of varying frequency, length, and morphological structures. Participants are asked to read the words on the list one at a time, accurately and quickly. Internal consistency for the accuracy measure is high (Cronbach $\alpha = .88$) (Shany, Zieger, & Ravid, 2001). Based on the participants' performance in reading the word list, two measures of performance were calculated: Word reading accuracy (number of words read correctly) and word reading fluency (number words read correctly per minute).

Reading comprehension in Hebrew was examined using an eighth grade level text taken from the national "Meytzav" test (Ministry of Education, Culture, and Sports, 2005). The text was expository describing the problem of ocean pollution. The text was unvowelized, except for low frequency lexical items. Participants read the text and responded to 12 multiple choice and 2 open-ended questions. Each correct answer was worth one point. Cronbach's α was .78. The difficulty level of the text was set during a pilot stage (Cain, Oakhill & Lemmon, 2004).

Experimental task: lexical inference from text

The task is an adaptation of Cain et al. (2003), Cain et al. (2004) that evaluates the ability to infer the meanings of novel words that appear in short narrative texts, using context clues and other linguistic information. Eight short stories were written, each containing a made-up word for a real object that does not have a single-word label in Hebrew, according to the Hebrew dictionary (Even Shoshan, 2009) (e.g., a bathtub mat (שטיח אמבטיה). All novel words were nouns that referred to concrete objects. The meaning of the target word could be derived from information contained in one or two sentences that occurred immediately after the target word (see sample story translated from Hebrew to English in the "Appendix"). As has been done in previous studies in this domain (e.g., Haynes, 1993; Webb, 2007), we chose made up words to make sure that none of the participants would have any previous knowledge of the lexical items. The texts were presented unvoweled, but the novel items were vowelized to allow for full phonological specification (Shimron & Sivan, 1994).

Participants were read the following instructions: "Today I have brought along a few stories that I would like you to read silently. The person who wrote the stories got stuck sometimes because s/he did not always find the right word for some things, so s/he used a funny, made-up word, instead. I want you to tell me what you think the funny word means. At the end of each story, I will ask you to explain the meaning of the word. For example, if I asked you what 'bed' means, you might tell me that it is 'a long piece of furniture that we sleep on". The stories were written in font size 16 and each appeared on a separate sheet. After indicating that they had finished silently reading each text, participants were asked what they thought the funny word might mean. The text remained in front of the participant so s/he could reread it, and no feedback was given. Responses were recorded in writing by the examiners.

The definitions given by participants were scored off line by two judges, based on the scheme developed by Cain et al. (2003). A score of 0 was given if the definition was incorrect; that is, when the participant did not manage to extract the meaning of the word (e.g., "soap"). One point was given for a partially correct definition; namely, when the participant gave a definition that belonged to the same semantic field, but did not cover the full features of the item (e.g., "a mat,"). Two points were given for a complete definition (e.g., "a mat that prevents slipping in the bathtub"). Scores on this task could range from 0 to 16, and in a previous study using this task inter-rater reliability in scoring definitions was very high, 0.9.

Procedure

Schools were approached after receiving approval from the "Na'ale" program manager, and students gave individual consent to participate in the study. The Raven's matrices task was administered in a group setting, and all other tasks were administered individually, in random order, during two individual testing sessions in a quiet room at the school.[1]

[1] Additional measures were collected from participants but not analyzed in the context of the current study. These include RAN and WM measures in Hebrew and Russian as well as single word decoding in Russian.

Results

Participant characteristics and performance on the cognitive, language and reading measures are reported in Table 1. An examination of vocabulary performance showed that their Hebrew vocabulary knowledge was at the level expected of native speaking children who are under age six, demonstrating that participants were clearly Russian dominant, and at a low-intermediate level of Hebrew acquisition. Further, participants' performance of the Raven's non-verbal IQ task was within the normal range.

The zero-order correlations between non-verbal intelligence, single word reading skills, vocabulary, reading comprehension and lexical inferencing in Hebrew are presented in Table 2. The lexical inferencing score was highly correlated with Hebrew vocabulary, Hebrew word reading accuracy and reading comprehension, but not with word reading fluency. In fact, word reading fluency was not significantly correlated with any of the other measures, and therefore was not included in subsequent predictive regression models. Likewise, the Ravens score was not significantly correlated with other measures, and was not included in the predictive regression models.

Hebrew and Russian vocabulary scores were moderately correlated, most likely reflecting underlying verbal skills of participants. As such, Russian vocabulary also

Table 1 Participant characteristics: descriptive statistics (n = **53)**

Variables	Mean	SD
Non-verbal ability (Raven's # of correct responses out of 60)	50.79	5.31
Vocabulary in Hebrew—Peabody (# correct out of 110)	35.34	11.41
Vocabulary in Russian—Peabody (# correct out of 110)	102.8	2.71
Hebrew word reading accuracy (# of correct words out of 50)	39.06	5.58
Hebrew word reading rate (WPM)	31.95	11.18
Lexical inferencing task in Hebrew (# correct out of 16)	9.17	4.01
Reading comprehension in Hebrew (# correct out of 18)	9.14	4.03

Table 2 Correlation matrix of experimental variables

	1	2	3	4	5	6
1. Ravens						
2. Hebrew decoding accuracy	.024					
3. Hebrew words per minute (Log)	−.283*	.233				
4. Hebrew vocabulary (PPVT)	.140	.588**	.108			
5. Russian vocabulary (PPVT)	.280*	.300*	−.268	.373**		
6. Hebrew reading comprehension	.273	.492**	.045	.611**	.467**	
7. Hebrew lexical inferencing	.181	.618**	.210	.535**	.368**	.542**

* $p < .05$; ** $p < .01$

correlated with Hebrew reading comprehension and Hebrew inferencing skill, but in both cases this correlation was weaker than the correlation of Hebrew vocabulary with these dependent measures. We therefore decided to include Hebrew vocabulary as a predictor in the regression models.

We conducted two multiple regression analyses. In the first, we examined the contributions of Hebrew word decoding accuracy and Hebrew vocabulary knowledge to reading comprehension in Hebrew as an L2. In the second analysis, we then examined whether decoding accuracy and vocabulary contributed to lexical inferencing abilities above and beyond the direct contribution of reading comprehension.

To examine the relative contribution of vocabulary and decoding accuracy to reading comprehension, we conducted a hierarchical regression analysis using the Enter method (Table 3). Following the model presented by Pasquarella et al. (2012), decoding accuracy entered on step 1 explained 24.2 % of the variance; higher decoding accuracy was associated with better reading comprehension. Vocabulary knowledge was entered on step 2 and contributed significantly, explaining an additional 15.8 % of the variance in reading comprehension. Overall, Hebrew word reading accuracy and vocabulary knowledge were significant predictors of reading comprehension ability explaining jointly 40 % of the variance. These findings support the SVR model for reading comprehension in adolescents in the early stages of acquiring Hebrew an L2 (Pasquarella et al., 2012).

In a second hierarchical regression analysis, we examined the predictors of successful lexical inferencing in Hebrew (see Table 4). Reading comprehension, entered on step 1, explained 29.3 % of the variability in lexical inferencing ability; Participants with higher reading comprehension abilities in Hebrew were better able to successfully infer the meaning of novel lexical items. We then examined whether Hebrew vocabulary knowledge and decoding accuracy explained any additional variance in the model. When Hebrew vocabulary knowledge was entered on step 2 it was a significant predictor, explaining an additional 7.7 % of the variance, and word decoding accuracy entered on step 3 significantly explained an additional 10.3 % of the variance. However, when the order of variables entered into the model was reversed, decoding accuracy entered on step 2 significantly explained an additional 16.7 % of the variance beyond reading comprehension, but vocabulary entered on step 3 no longer made a significant contribution to the model ($F < 1$).

Table 3 The contribution of vocabulary and decoding accuracy to variance in reading comprehension: a summary of hierarchical regression analysis ($n = 53$)

Predictors	β	t	R^2	ΔR^2	ΔF
Step 1			.242	.242	15.31**
Word reading accuracy	.492	3.91**			
Step 2			.400	.158	12.34**
Word reading accuracy	.200	1.42			
Heb vocabulary—Peabody	.493	3.51**			

* $p \leq .05$; ** $p \leq .01$

Table 4 The contribution of reading comprehension, vocabulary and decoding accuracy to variance in lexical inference: A summary of hierarchical regression analysis ($n = 53$)

Predictors	β	t	R^2	ΔR^2	ΔF
Step 1			.293	.293	19.94**
Hebrew reading comprehension	.542	4.46**			
Step 2			.371	.077	5.76*
Hebrew reading comprehension	.333	2.24*			
Heb vocabulary—Peabody	.123	2.40*			
Step 3			.474	.10.3	8.99**
Hebrew reading comprehension	.243	1.76			
Heb vocabulary—Peabody	.161	1.08			
Word reading accuracy	.407	2.99**			

* $p \leq .05$; ** $p \leq .01$

To summarize, reading comprehension in Hebrew was explained by vocabulary and decoding accuracy. Lexical inferencing ability was indeed explained by reading comprehension, but decoding accuracy explained additional variance, beyond the contribution of reading comprehension.

Discussion

The results of the current study demonstrate that despite the high correlations reported in the literature between reading comprehension and lexical inferencing abilities, which were also evident in the current data, these constructs are not entirely equivalent. Of greatest interest, for the current population of adolescents in the beginning stages of developing language and reading proficiency in their L2, Hebrew decoding accuracy contributed significantly to lexical inferencing ability beyond the role of reading comprehension. This pattern of relations between variables is similar to previous reports in the L1 literature, but also sheds new light on the relative importance of language and reading variables in the early stages of L2 learning (Cain et al., 2003; Geva & Farnia, 2012; Pasquarella et al., 2012; Pulido, 2007).

The simple view of reading (Gough & Tunmer, 1986), as well as its extension for L2 reading (Gottardo & Mueller, 2009; Geva & Farnia, 2012), posit that comprehension stems from efficient word reading and language comprehension. This model is supported in the current study, showing that for adolescents in the early stages or learning Hebrew as an L2, variability in reading comprehension abilities is well explained by command of the vocabulary and by word reading skills (Lesaux et al., 2010; Geva & Farnia, 2012; Pasquarella et al., 2012). Recent research shows that in older skilled readers, reading comprehension is more strongly associated with vocabulary and language skills, and gradually comes to rely less on basic decoding abilities. Thus, Landi (2010) demonstrated this pattern for adult skilled readers of English, and Tilstra et al. (2009) in a developmental study from

childhood to adolescence found a decreasing role for decoding accuracy in predicting reading comprehension. In a direct comparison of L1 and L2 adolescent readers of English Pasquarella et al. (2012) found that decoding skills continue to be a significant predictor of reading comprehension abilities for the adolescent L2 learners, even though they no longer contribute to the reading comprehension of adolescent native English speakers. The current findings likewise show that word reading skills play an important role in the reading comprehension performance of adolescent L2 Hebrew learners, whose language skills are not on par with those of their native speaking peers. This pattern aligns well with previous literature, and extends these findings to adolescent learners of Hebrew, a semitic language. Taken together, these recent studies support the notion that L2 learners likely go through a progression of building language and reading skills that is in some aspects similar to the progression that characterizes younger children acquiring literacy in the L1 (Ricketts et al., 2011).

Having set the stage with a characterization of the reading comprehension performance of the L2 learners in the current study, we turn to examining lexical inferencing abilities in this population. Previous research in both L1 (Cain et al., 2003) and L2 (e.g. Pulido, 2007) has mostly linked the ability to infer novel meaning with higher levels of reading comprehension. The current findings of a strong correlation between reading comprehension and lexical inferencing abilities suggest that similar underlying mechanisms might support both reading comprehension and lexical inference. The process of lexical inference requires the reader to integrate information from the text, identify the lexical gap in his or her knowledge that the novel item might map onto, and finally to synthesize a well formed oral definition. Many of these processes, most specifically integration of information and synthesis of the knowledge gained, also characterize skilled comprehenders more generally (Cain et al., 2004).

In the current study, we expanded upon the relation between reading comprehension and lexical inference from text by asking whether basic level skills, specifically vocabulary and single word decoding, might predict lexical inference abilities beyond reading comprehension. Our results point to the significant role of single word decoding accuracy in lexical inferencing in the L2. We demonstrate that greater skill in single word processing in the L2 was associated with greater success in lexical inferencing from text in this language, beyond reading comprehension abilities. Hebrew and Russian do not share orthography and are unrelated typologically, and can thus be considered distant orthographies, making it very difficult for the learners to rely on decoding abilities developed in the L1 when reading in the L2. We therefore suggest that especially in this case, L2 readers who are more efficient in decoding single words can better use their cognitive resources towards generating guesses regarding the meaning of unfamiliar lexical items. The current results align well with recent findings involving monolingual children, showing that children's ability to infer the meaning of novel words from text in their L1 is also predicted by word reading skills (Seipel, 2011; Ricketts et al., 2011). Thus, the current study supports the idea that expertise in specific aspects of spoken and written language in L2 (Geva, 2006) projects onto the ability to infer novel word meanings and thereby enhances vocabulary acquisition in L2 (Arden-Close,

1993; Nation, 2001), especially when a language with a very different orthography than the L1 is involved.

The Lexical Quality Hypothesis (LQH, Perfetti, 2007) stresses the critical role of the quality of single word representations in supporting higher level comprehension and inference. Under this hypothesis, lexical quality encompasses orthographic, phonological and semantic representations of words. Although a majority of the research in this framework has focused on L1 reading, the extension to L2 reading seems straightforward. The current findings support the idea that readers with more precise and efficient mapping from orthography to phonology (decoding accuracy) demonstrate better lexical inferencing abilities, thus supporting the LQH in the context of L2.

The role of vocabulary knowledge in predicting lexical inferencing beyond reading comprehension was less robust in our results. Indeed, when vocabulary was entered in the predictive model following reading comprehension and decoding accuracy it no longer accounted for any additional unique variance. One possible explanation for this pattern is that due to the high correlation between reading comprehension and vocabulary knowledge in the current data set, most variability arising from vocabulary knowledge was captured by performance in reading comprehension. Therefore, we believe that the current results do not contradict previous studies finding robust correlations between vocabulary knowledge and lexical inferencing (Haynes & Baker, 1993; Nassaji, 2004; Pulido, 2003). Further, the current findings are also in keeping with the generally accepted claim that acquiring new vocabulary in L1 and L2 is based to some extent on existing vocabulary knowledge in the target language (Biemiller & Boote, 2006; Hirsch, 2003; Penno, Wilkinson, & Moore, 2002).

The predictive role of vocabulary knowledge in explaining variability in lexical inferencing might be understood in three complementary ways. First, there may be some threshold of vocabulary in a given text that readers need to achieve in order to be able to successfully generate lexical inferences of unfamiliar words (Webb, 2007). Second, because the participants in the present study had been immersed in an academic setting in Hebrew for 3 years, their vocabulary knowledge at time of testing might to some degree reflect their previous success in lexical inferencing from texts they were exposed to over this period. Thus, for this group of adolescents learning Hebrew as an L2, vocabulary knowledge in and of itself might be partially driven by individual differences in inferencing ability and reading comprehension. And third, because the participants were only moderately proficient in Hebrew, those individuals with more extensive vocabulary knowledge might have gained an improved understanding of the structure of the language (e.g., extracting the roots of words and noticing morphological regularities; Frost et al., 2013), which further facilitated comprehension and inferencing processes. These possibilities are of course not mutually exclusive and most likely work in concert.

We believe that the current findings can inform discussions on best practices for enriching the vocabularies of L2 learners by exposure to new lexical items through text. Thus, there is some debate in the literature regarding the properties of texts and contexts that are maximally supportive for vocabulary extension through lexical inference in the L2 (e.g., Hulstijn et al., 1996; Laufer, 2001; Webb, 2007). Within

this framework, there is also research considering the "vocabulary load" of texts that should be assigned to L2 readers in order to foster vocabulary growth and comprehension (e.g., Nation, 1997)—suggesting that readers should be familiar with approximately 95 % of vocabulary appearing in the text. However, in light of our findings that single word decoding accuracy of the individual reader is a significant predictor of lexical inferencing, this aspect of reading skill should also be taken into consideration when making pedagogical decisions regarding the introduction of texts that include unfamiliar vocabulary. Specifically, the current findings suggest that intensive reading programs should be implemented after students have acquired significant basic L2 vocabulary, but also after they have developed sufficiently efficient decoding skills in the L2 that will allow them to benefit from the exposure to novel words in text. To further illustrate, for L2 readers who are still having difficulty with decoding, instruction time and learning activities would probably be better spent on improving decoding skills and not assigning reading of texts with the intention of incidental learning of novel vocabulary items.

Before concluding, we would like to offer several thoughts on issues that remain open and should be addressed in future research. The current study did not examine the importance of other aspects of L2 proficiency in predicting lexical inferencing from text. For example, morpho-syntactic abilities might also play a significant role in supporting reading comprehension and lexical inferencing beyond vocabulary and word level reading. It is also possible that the characteristics of vocabulary acquisition in L2 change over time. Whereas early vocabulary (e.g., the first several hundred lexical items) might be learned more directly, later acquisition can rely to a greater extent on developing relevant morpho-syntactic and orthographic strategies in the L2. Similarly, as the existing vocabulary knowledge in L2 grows, learners may be able to rely on a broader store of knowledge when inferring the meanings of novel words (Pulido, 2007). Thus, the contribution of lexical inferencing ability to vocabulary acquisition most likely increases over the course of developing proficiency in L2. Along similar lines, the predictive role of word level decoding might diminish with growing proficiency in the L2, as is the case for the role of reading efficiency for predicting reading comprehension in the L1 (Kirby & Savage, 2008; Landi, 2010; Tilstra et al., 2009). Finally, in our own current work we are pursuing direct comparisons between the predictive roles of reading comprehension, vocabulary and word level reading efficiency for lexical inferencing in the L1 and in the L2 for young and older readers acquiring the same language.

To conclude, the current results reaffirm the important role of reading comprehension in understating the variability in the ability of L2 learners to extract higher-order information from written texts. However, we also demonstrate that at least when considering the ability to infer the meaning of new words in a second, less proficient language, existing decoding accuracy and vocabulary knowledge make independent contributions, beyond their role of supporting reading comprehension itself. The importance of these skills most likely lies in their contribution to creating higher quality lexical representations of the novel lexical items, enabling more efficient and precise inference of their meaning, and ultimately enabling further comprehension of texts.

Appendix: Sample story

Everyone says that 13-year-old Alon is a "born actor." His parents say that even when he was 2 years old, he would stand at the table at family events and entertain the audience. When a theater department was opened at the performing arts school, it was clear that Alon would be the first to sign up for it. The theater class puts on shows twice a year. In preparation for the show, many rehearsals are held in the afternoons as well, and students spend a lot of time working on the sets and the characters' costumes. For the first role he played, Alon had to find a ***shofter***. Alon asked friends and neighbors if any of them had a ***shofter*** and explained that he needed a ***shofter*** because he was playing the role of an old man who has trouble keeping stable while walking. When he did not find what he was looking for, Alon had an idea—he went to the retirement home near his house and asked if they could help him out. The retirement home staff was happy to help him and promised to come see the play.

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