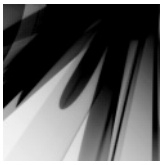

ARTICLE

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# Promoting morphological awareness in Hebrew-speaking grade-schoolers: An intervention study using linguistic humor

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**ABSTRACT**
Research indicates that morphological awareness contributes to success in literacy acquisition and consolidation, since morphology links together phonological and semantic facets of language. The role of morphology is especially important in Hebrew, a highly synthetic Semitic language. The current study aimed to investigate the impact of an intervention program on knowledge and awareness of morphology in Hebrew-speaking grade-schoolers. Two three-month intervention programs were conducted in two groups of 4th-grade children: a metalinguistic morphological intervention program using linguistic humor, and a parallel intervention program using nonverbal humor. A morphological awareness test was administered to the two groups prior to and following the intervention period. The results demonstrate consistent advantages to the morphological intervention group, including tasks related both directly and indirectly to content taught.

**KEYWORDS**
Hebrew; intervention; language awareness; linguistic humor; literacy; morphology

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# INTRODUCTION: LITERACY, METALANGUAGE AND THE LITERATE LEXICON

One of the main goals of educational systems is to promote students' literacy abilities and, specifically, linguistic literacy, a constituent of language knowledge characterized by the availability of multiple linguistic resources and by the ability to consciously access one's own linguistic knowledge and to view language from various perspectives (Olson, 1994; Ravid & Tolchinsky, 2002). The acquisition of written language in school is a major component of linguistic literacy. Literacy and schooling are tightly linked with language awareness or metalanguage (Hulme & Joshi, 1998), the ability to think about language as an external object, to consciously access, discuss and verbalize linguistic knowledge (Gombert, 1992; Karmiloff-Smith, 1986, 1992). Metalinguistic thought treats language as a formal problem space, analyzing linguistic components as cognitive goals. It requires the ability to introspect on the linguistic components that blend together naturally in language usage – phonemes, morphemes, words, syntactic structures and discourse types (Astington & Olson, 1990). Thus, it involves an analytical perception of units of language, the ability to represent on each unit separately, disassociating form from semantic content, and conscious monitoring of one's own linguistic knowledge (Doherty, 2000, 2004).

There is ample evidence that specific aspects of language awareness, especially phonological and morphological awareness, both promote and are promoted by learning to read and write through the establishment of links between linguistic units and their written representations (Fowler & Liberman, 1995; Gillis & Ravid, 2006; Levin, Ravid & Rappaport, 2001). Written language, in particular, enhances the ability to focus on specific linguistic components (Homer & Olson, 1999; Purcell-Gates, 2001). Written text conventions scaffold metalinguistic thinking in various linguistic domains such as sound/letter correspondence, word and sentence boundaries, and appropriate grammatical constructions (Olson, 1994).

Areas requiring more integrated knowledge such as reading comprehension also benefit from metalinguistic skills (Demont & Gombert, 1996; Yuill, 1998). Sensitivity to derivational morphology plays a role in reading ability in higher school grades and among college students (Henry, 1993; Mahony, 1994). Schoolchildren with poor comprehension skills perform poorly on oral language tasks despite matched age and decoding abilities (Nation, Clarke, Marshall & Durand, 2004). Metalinguistic development is thus clearly related to the acquisition of linguistic literacy, written language and school-based knowledge.

Linguistic literacy evolves in the school years through growing command of the literate lexicon. Vocabulary gains are obtained by exposure to expert texts, with use of textbooks, encyclopedias, reference books, dictionaries and the web providing experience with genre-specific constructions in their authentic contexts (Light & Littleton, 1999; Paltridge, 1997). The language of school texts is typically formal in register with complex syntactic constructions. Thus, higher-register lexical items and marked morphosyntactic structures are in general typical of texts encountered in the course of formal schooling (Nippold, 1998; Ravid & Shlesinger, 1995; Ravid & Zilberbuch, 2003). Since written language is better planned and more coherent

than spoken language, and the circumstances of its production encourage editing and revision (Ochs, 1979), schoolchildren have the opportunity to reflect on and retrieve appropriate lexical items and morphosyntactic structures in the course of reading and writing (Landauer & Dumais, 1997).

The literate lexicon contains high-register words from various knowledge domains, infrequent in everyday conversation and requiring specialized, school-type world knowledge (Anglin, 1993; Baayen & Renouf, 1996; Biber, 1995). Its words tend to be longer, whether measured in letters, syllables or morphemes (Ravid, 2006; Strömqvist, Johansson, Kriz, Ragnarsdóttir & Ravid, 2002), with multiple affixation expressing deverbal and de-adjectival attributes and states, e.g., English 'ungentlemanliness'. Lexical knowledge thus depends on analytical insight into how morphemes network in content words, and also requires an understanding of when to abandon morphological analysis for lexical retrieval to accommodate idiosyncratic elements (Baayen, 1991, 1994; Carlisle, 2000). In Hebrew, this analytic task is compounded by a rich morphology that encodes diverse semantic notions (Berman, 1987; Bolozky, 1999; Ravid, 1990).

## Morphological knowledge and awareness

Morphological awareness contributes to success in the beginning phases of literacy instruction since morphology links together phonological and semantic facets of language (Carlisle and Nomanbhoy, 1993). Morphological skills in kindergarten are predictive of reading achievement at the second grade (Carlisle, 1995, 2000). This is especially evident in studies comparing learning- and reading-disabled children with normally achieving readers (Webster, 1994). Recent studies on spelling development in English demonstrate how orthographic knowledge promotes morphological awareness, with possible two-sided causal links (Kemp, 2006; Nunes, Bryant & Bindman, 2006). Anglin (1993) provides evidence that vocabulary growth in grade-school years increases together with children's ability to perform morphological problem-solving. The ability to segment, extract and discuss stems and affixes underlie becoming an efficient reader in English (Derwing & Baker, 1986; Lewis & Windsor, 1996; Nagy & Scott, 1990). Nippold (1998) shows that understanding and use of various word classes, the ability to define words and awareness of the lexical network which facilitates the acquisition of new words all increase in English-speaking children and adolescents.

Morphological awareness is particularly important for Hebrew literacy development, given its highly synthetic Semitic morphology (Berman, 1987; Ravid, 1990). The bulk of content words in Hebrew are at least bi-morphemic, constructed of a consonantal root interdigitated by a vocalic pattern, or a concatenated stem and suffix. Hebrew nouns and adjectives are obligatorily inflected for gender and number. In addition, Hebrew has optional bound inflectional forms signifying genitive nouns and accusative verbs. Hebrew derivational morphology is rich and varied, with a large array of derivational affixes of various structures and with complex root, stem and affix allomorphy (Schwarzwald, 2002). This wealth of morphological structures in Hebrew is reflected in its written form, which consequently promotes morphological perception and strategies in its users (Olson, 1994; Ravid, 2005).

Studies indicate the strong relationship between morphological development and awareness and reading and writing acquisition in Hebrew (Levin et al., 2001; Ravid & Bar-On, 2005; Ravid & Schiff, 2006), which challenges Hebrew-speaking children and adolescents with language, reading and learning disabilities (Ravid, Avivi-Ben Zvi & Levie, 1999).

Hebrew linguistic development continues well into the school years, in two well-documented directions (Berman, 2004): One is linguistic usage, where later-emerging constructions, such as optional inflectional morphology, denominal adjectives, derived nominals or passive morphosyntax, are learned between the ages of 5 and 20 (Berman, 1997; Ravid, 2004; Ravid & Avidor, 1998; Seroussi, 2004). Another direction of development is the heightening and enhancement of morphological awareness in Hebrew speakers' perception, which become more robust and central with age and schooling (Berman, 1997; Ravid, 1995, 2002; Ravid & Kubi, 2003; Ravid & Malenky, 2001). Against this background, we expected morphological intervention to have an impact on morphological usage and awareness in grade-school children, with morphological usage benefiting more than explicit verbalization.

## Intervention in language and literacy

Educational projects have sought to enhance students' literacy abilities through metalinguistic intervention (Yaden, Rowe & MacGillivray, 2000). Intervention is an accepted tool for investigating the impact of language programs on variety in educational and clinical contexts (Barnett, 1995; Mendelsohn et al., 2001; Wasik, Ramey, Bryant & Sparling, 1990). Its main advantage as a research paradigm is the ability to control independent variables and to infer a causal link between variables. From a clinical point of view, intervention has been used extensively to assess the impact of treatment on naming, morphology and literacy in children with reading and language disabilities (Elbro & Arnbak, 1996; Menyuk & Chesnick, 1997; Wolf & Segal, 1999), and on children with speech impairments, phonological, lexical and syntactic difficulties (Law, 2004). Children with SLI benefit from intervention in phonology and morphosyntax beyond the specific treatment program (Gillon, 2000; Tyler, Lewis, Haskill & Tolbert, 2002).

Intervention studies are often designed to promote and remediate language and literacy skills in education. Thus, there are many reports of training phonological and alphabetical skills in preschoolers with different abilities (Blackman, 1991; Purcell-Gates & Dahl, 1991; Warrick, Rubin, Rowe-Walsh, 1993). For example, Aram & Biron (2004) conducted intervention programs using story reading, phonological and orthographic awareness, and writing in preschoolers from low socioeconomic background. Not only did study participants improve on these skills (in contrast to the nonverbal intervention group), they also gained in general world knowledge and listening comprehension. Morphological intervention has been shown to affect spelling and reading efficacy (Apel & Masterton, 2001; Nunes, Bryant & Olsson, 2003). Intervention studies have also focused directly on reading and writing processes in order to improve reading comprehension in grade-school children and adults (Bristor, Romance & Vitale, 1994; Ezell, Justice & Parsons, 2001; Gombert, 1994; Nicaise & Gettinger, 1995).

*Humor in language intervention*

Language play characterizes children's interlocution and might be a precursor of linguistic awareness (Ely & McCabe, 1994). The appreciation of linguistic humor, a facet of language play, is related to social, cognitive and linguistic development, and its comprehension requires metalinguistic abilities (Spector, 1990, 1992). While preschoolers simply enjoy humorous incongruity (McGhee, 1979), children aged 7–9 already understand jokes based on phonological ambiguity, 9–12 year olds understand lexical ambiguity, and adolescents understand jokes based on syntactic ambiguities (Shultz & Horibe, 1974). In order to resolve incongruities in riddles, narratives and jokes involving lexical and syntactic ambiguity, irony, absurd and figurative language, children must recognize that language is an arbitrary system where structure is dissociated from meaning (Bernstein, 1986; Kümmerling-Meibauer, 1999). The ability to appreciate and understand linguistic humor develops across childhood and adolescence, side by side with phonological, lexical and syntactic awareness, an increasing ability to analyze orthographic constructs, and more explicit metalinguistic expression (Ashkenazi & Ravid, 1998). Linguistic humor is considered an excellent tool for the examination of the relationship between morphological awareness and reading comprehension (Yuill, 1996, 1998).

Language intervention programs using linguistic humor serve a number of purposes: Enhancing humor perception is regarded as worthwhile in and by itself, since it contributes to more efficient communication, improves social skills in children and may even lead to changed behavioral patterns (Carlson & Peterson, 1996; McGhee, 1979; Spector, 1992). As language play is integral to any linguistic behavior, work on linguistic humor can bridge the home environment and the clinic or the classroom (Crystal, 1996) – leading, in its turn, to improving metalinguistic skills (van Kleeck, 1984) in a particularly enjoyable context.

Several researchers have used linguistic humor in language intervention. Ezell & Jarzynka (1996) promoted comprehension of riddles and jokes in typically developing and language disabled grade-schoolers through training, while Bryant, MacLean & Bradley (1990) showed how rhyming games improved phonological awareness in young children. Yuill (1996) succeeded in improving reading comprehension in grade-schoolers through an intervention program focusing on lexical and syntactic ambiguity in the context of jokes and riddles. Against this background, and given the immense importance of morphology in Hebrew literacy, the current study aimed to investigate the impact of an intervention program on knowledge and awareness of morphology in grade-school children, using humor as a pedagogical tool.

## METHOD

One possible problem in educational intervention programs is the so-called Hawthorne Effect – the claim that the effect of intervention might be an artifact of the treatment program itself. Meta-analysis suggests that it might result from the special attention received by participants, their awareness of being studied and the interest and novelty in the activities offered in the treatment program (Adair, Sharpe & Huynh, 1989). To neutralize this possible effect we conducted *two* concurrent

intervention programs of the same duration and frequency on same-age children attending the same school, both using humor as a tool: one program, administered to the metalinguistic intervention (henceforth MI) group, used linguistic humor; the second program, administered to the nonverbal intervention (henceforth NI) group, was based on nonverbal humor.[1] The question was whether intervention using any type of humor will promote morphological awareness, in which case both groups will improve after intervention; or will it be only treatment in *linguistic* humor that will affect morphological awareness positively, in which case only the MI group will improve after intervention. We opted for the second prediction.

## Participants

We selected 4th graders (aged 9–10) as our target population. One reason is that the research described above suggests that linguistic humor is especially effective as an instructional method in this age group. More importantly, a large body of evidence indicates that fourth grade constitutes a literacy 'watershed' in many respects, making it plausible to expect Hebrew morphological intervention to be especially effective in this age/schooling group.

Fourth graders have already mastered the fundamentals of Hebrew reading and writing (Levin, Share & Shatil, 1996). By this time, most typically-developing children have abandoned reading with diacritic vowel marks ('pointed reading'), the hallmark of novice Hebrew readers (Geva, Wade-Woolley & Shany, 1993; Navon & Shimron, 1984; Shatil, Share & Levin, 2000), and are relying more and more on morphological and syntactic clues (Ravid, 1996; Ravid & Shlesinger, 2001). They are well on their way to gaining mastery over non-pointed reading, which leans heavily on contextual discourse clues (Koriat, 1985; Ravid & Schiff, 2004; Shimron, 1999). Fourth graders spell function letters with a fair degree of accuracy, and their root spelling is improving rapidly (Ravid, 2001; Ravid & Bar-On, 2005). They have some sensitivity to morphological structure and semantics, and are able to identify roots in words, though patterns still challenge them (Ravid & Kubi, 2003; Ravid & Malenky, 2001; Ravid & Schiff, 2006). In a broader perspective, 4th-grade children are aware of discourse genre distinctions, as evidenced by their well-formed narratives in both speech and writing (Berman & Nir-Sagiv, 2004). Their explicit metalinguistic skills are still very different from those of highschoolers and adults, yet undergoing rapid development (Ashkenazi & Ravid, 1998; Hora, Avivi-Ben Zvi, Levie & Ravid, 2006; Ravid & Malenky, 2001). Thus, 4th graders have adequate language and literacy skills to ensure they can read and understand school-type instructions and perform language tasks, and can make the most of targeted child-friendly linguistic instruction.

The study population consisted of two 4th-grade classes from the same school in the center of Israel: One class of 30 children (16 boys and 14 girls), aged 9;1–10;0 ($M$ = 9;4) constituted the MI group, which received a treatment program in linguistic humor. A second class of 26 children (13 boys and 13 girls), aged 9;0–10;0 ($M$ = 9;5) constituted the NI group, which received a treatment program in nonverbal humor. To maintain comparability, we made sure that all study participants in both groups lived in the same neighborhood and received the same school instruction in Hebrew Language. They were all monolingual, native speakers of Hebrew from

middle-high socioeconomic background, with no diagnosed learning, reading or language disabilities.[2]

## Procedure and materials

The study was conducted in three steps: (1) pre-test – the Morphological Awareness test, administered in writing in class in two parts (see below); (2) intervention programs, conducted twice a week for three months in the study and NI groups respectively by the same investigator, the second author; (3) post-test – the same Morphological Awareness Test, administered again in the same way after the completion of the Intervention Program. Since three months had passed between administrations of the test, we did not see any reason to change the order of presentation of the tasks.

*The Morphological Awareness Test*

The Morphological Awareness Test consisted of ten tasks, focusing on literacy-related morphological constructions and categories known to emerge later on in Hebrew child language (Berman, 2004; Ravid, 2004). Six of these tested linguistic usage (comprehension and production), while four required metalinguistic verbalization of language phenomena (Table 1).

**Table 1** Structure of the Morphological Awareness Test

| *Inflection* | *Derivation* | *Morpho-syntax* | *Linguistic Humor* |
|---|---|---|---|
| 1. Grammaticality Judgment (metalinguistic verbalization) | 4. Derivational Categories (metalinguistic verbalization) | 9. Passive Construction (linguistic usage) | 10. Linguistic Humor – Comprehension (metalinguistic verbalization) |
| 2. Optional Bound Morphology – Comprehension (linguistic usage) | 5. Pseudo Words (metalinguistic verbalization) | | |
| 3. Optional Bound Morphology – Production (linguistic usage) | 6. Analogies Task (linguistic usage) | | |
| | 7. Derived Nominals – Comprehension | | |
| | 8. Derived Nominals – Production (linguistic usage) | | |

*Inflection tasks* Inflection is acquired early on in Hebrew, as in other languages, due to its regular and predictable semantics, obligatory character and general applicability (Bybee, 1985). Hebrew-speaking children also demonstrate early awareness of inflectional structures (Ravid, 1995; Ravid & Malenky, 2001). The Morphological Awareness Test included three inflectional tasks suitable for grade-schoolers: (1) The Grammaticality Judgment task (8 items), which required participants to identify, repair and explain inflectional errors in gender, number, person and tense, e.g., '*I have two cat'. Based on previous studies (Ravid & Malenky, 2001), we predicted that identifying and explaining gender/number suffixes would precede person suffixes.

The next two tasks examined Optional Bound Morphology – inflectional constructions with syntactic counterparts, typical of high-register language. (2) The Optional Bound Morphology – Comprehension task (6 items) required participants to provide the analytic counterpart of optional genitive noun and accusative verb inflections, e.g., replace synthetic *maxbartam* by analytic *ha-maxbéret shelahem* 'their notebook'. (3) The Optional Bound Morphology – Production task (6 items) required participants to provide the inflected counterpart of analytic genitive noun and accusative verb constructions, e.g., replace analytic *ha-maxbéret shelahem* 'their notebook' by synthetic *maxbartam*. Based on the literature, we expected comprehension to be easier than production tasks (Ravid, 1995).

*Derivation tasks* Derivational morphology is a useful source for examining the linguistic abilities of older children and adolescents (Ravid, 2004). Since it is a richer and less obligatory domain than inflectional morphology, and depends directly on a rich vocabulary, it offers considerable potential for linguistic evaluation of older children who have already mastered obligatory inflections. The major part of the Morphological Awareness Test thus consisted of derivational tasks, as follows: (4) The Derivational Categories task (15 items) presented participants with three types of morphologically complex words (stem and suffix, root and pattern, and blending), which they had to analyze and explain. For example, a correct response to 'why is *itonay* [journalist] called this?' Would be 'because he [based on agent suffix *-ay*] works in a newspaper [based on stem *iton* 'newspaper']'.

The two next tasks focused on the non-linear association of the Semitic root and pattern. (5) The Pseudo Word task (4 items) required participants to relate a pseudo word (presented in sentential context) to three related, real words, and motivate this relationship in terms of rhyming, root and pattern relationships. For example, the pseudo word *hidrig* shares root *d-r-g* with the real word *madrega* 'stair'. (6) The Analogies task (8 items) required participants to provide two words related to a given test word by root and pattern respectively. For example, two possible responses to *midraxa* 'sidewalk' could be *dorex* 'steps' (related through root *d-r-x* 'step') and *mizraka* 'fountain' (related through pattern *miCCaCa* signifying locations). In all derivational tasks, we expected root awareness to precede pattern awareness (Ravid, 2004; Ravid & Malenky, 2001; Ravid & Schiff, 2006).

Two more derivational tasks focused on deriving abstract nouns from verbs (Ravid & Avidor, 1998): (7) The Derived Nominals – Comprehension task (6 items) tested children's ability to relate deverbal (nominalized) nouns (presented in sentential context) to the verbs they are derived from. For example, noun *isuf* 'collecting' is

related to verb *le-esof* 'to-collect'. (8) The Derived Nominals – Production task (6 items) tested children's ability to relate verbs (presented in a sentential context) to deverbal nouns derived from them. For example, verb *kibes* 'launder' is related to noun *kvisa* 'laundry'. Again, we expected comprehension to be easier than production.

*Morphosyntax* Hebrew passives are formed in the verbal *binyan* system by the classical Semitic pattern affixation, e.g., *tiken* 'fixed' / *tukan* 'was fixed'. Like all verb-formation processes in Hebrew, passive involves both structural and lexical knowledge, although its regularity, transparency and predictability together with the syntactic context in which it occurs characterize it as a meeting-point for morphology, syntax and the lexicon. Passive voice is thus another late acquisition in Hebrew, which typically develops through the school years (Berman, 1997, 2004). (9) The Passive Construction task (6 items, in three different *banyan* verb patterns: *Nif'al, Pu'al, Huf'al*) required participants to change a sentence from active into passive voice. Based on previous findings, we expected more success on passive verbs in *Nif'al* than on other verb patterns (Ravid, 2004; Ravid, Landau & Lovetski, 2003; Ravid & Saban, 2008.

*Linguistic Humor* (10) The Linguistic Humor – Comprehension task (2 items) was adopted from Ashkenazi & Ravid (1998), and presented participants with riddles and jokes based on morphological, lexical and syntactic language play, which they had to explain. For example, 'a little girl said "they eat a lot of *marak* (soup) in Morocco." Can you explain why this is funny?' This required participants to identify the root-like consonantal skeleton *m-r-k* of (unrelated) *marak* and Morocco. Based on the same study, we expected linguistic humor based on morphology to be more easily explained than humor based on syntax, given the strong typological bias of Hebrew.

*Procedure*

The Morphological Awareness Test was administered to both groups as a pre-test one week before the start of the intervention programs, and one week after its completion, as a post-test. In both cases, the procedure was as follows: on the first day, the Grammaticality Judgment, Pseudo Words, Derivational Categories and Analogies tasks; and on the second day, the Passive Construction, Derived Nominals, Optional Morphology and Linguistic Humor tasks.

## Scoring

Scoring scales were constructed for the tasks, ranging between 0 and 3 or 0 and 4 points for each task. The construction of each scale derived from the nature of the task at hand. For example, the scale for grammaticality judgment took into account the degree of well-formedness and explicitness of response, in addition to its correctness. The responses were scored separately by the second author, 80% were also scored separately by the first author, and 20% were checked by a third judge with linguistic and educational experience. Agreement among judges was very high (95%), and the few cases of disagreement were resolved by discussion. See Appendix 1 for details.

*The intervention programs*

The intervention programs started one week after the administration of the pretest, and were both carried out by the same investigator, the second author, in the presence of the class teachers. Each program lasted for three months and consisted of 16 45-minute lessons twice a week. New material was introduced, taught and rehearsed in class with the active participation of students. Instruction in both groups included presentation, discussion, rehearsal, games and classwork in small groups, with a wide array of activities in which children participated enthusiastically. Children prepared and assembled portfolios with jokes, scripts, instructional materials and student assignments in the MI group, and similar nonverbal materials such as pictures and paintings in the NI group. At the end of the intervention programs, students in each group were asked to prepare a final assignment and to fill out feedback forms. All lessons were videotaped and transcribed to follow students' participation and progress and to enable a qualitative analysis of the study materials.

*Linguistic humor intervention in the MI group* The treatment program in the MI group discussed and explained Hebrew morphological phenomena in a child-friendly manner, using jokes and riddles carefully selected so as not to detract from children's enjoyment. Appendix 2 delineates the linguistic and humoristic topics and categories taught in the intervention program.

*Nonverbal humor intervention in the NI group* The treatment program in the NI group was equivalent in duration, frequency and intensiveness of class activation, interaction and consequent familiarity with the teacher/investigator. Appendix 3 delineates the topics and categories of nonverbal humor taught in the intervention program.

## RESULTS

This section reports findings on the Grammaticality Judgment, Optional Bound Morphology, Derivational Categories, Pseudo Words, Analogies, Passive Construction, Derived Nominals and Linguistic Humor tasks prior to and following intervention, with an additional analysis of direct and indirect effects of intervention.

### Grammaticality Judgment task

This task required the children to identify, repair and explain inflection errors. Analysis here focuses on explanation alone, since identification and repair proved easy even for 5-year-olds (Ravid & Malenky, 2001). Table 2 presents correct performance (in mean percentages) on explanation in each of the inflectional categories before and after intervention.

A three-way ANOVA found an effect of Time ($F(1, 54) = 18.74$, $p < 0.001$), and an effect of Group ($F(1, 54) = 13.16$, $p < 0.001$), with an interaction of Time and Group ($F(1, 54) = 16.93$, $p < 0.001$) (Fig. 1), showing that the MI group gained significantly from the intervention, while the NI group made no such gains.

**Table 2** The Grammaticality Judgment task (explanation): mean percentages and standard deviations of correct performance in the MI and NI groups before and after intervention, by inflection type

| *Inflection* | *Group* | *Before intervention* | *After intervention* |
|---|---|---|---|
| Gender | MI | 25.56 | 66.67 |
| | | (43.5) | (43.11) |
| | NI | 18.60 | 19.23 |
| | | (37.9) | (37.62) |
| Number | MI | 18.33 | 67.22 |
| | | (35.92) | (41.63) |
| | NI | 14.74 | 19.23 |
| | | (30.3) | (37.62) |
| Person | MI | 16.11 | 55.00 |
| | | (28.9) | (38.44) |
| | NI | 11.54 | 10.26 |
| | | (21.9) | (22.15) |
| Tense | MI | 21.67 | 69.44 |
| | | (37.7) | (42.45) |
| | NI | 15.38 | 14.90 |
| | | (33.97) | (29.23) |

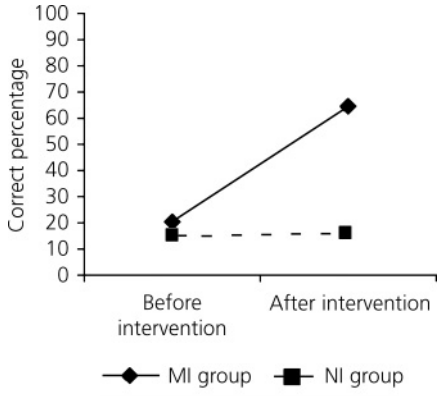


**Figure 1** Grammaticality Judgment: interaction of time and group

Inflection type had an effect ($F(1, 54) = 8.02$, $p < 0.01$), which derived from differences *before* intervention. To determine these differences, we compared gender and number with person inflection (excluding tense, which is an inherent category of verbs) in the pre-test. A two-way ANOVA revealed an effect of inflection type ($F(1, 54) = 8.11$, $p < 0.006$), showing that gender and number ($M = 19.49\%$)

scored higher than person ($M$ = 13.98%). There was no effect for Group and no interaction.

## Optional Bound Morphology task – Comprehension and Production tasks

The Optional Bound Morphology tasks included genitive nouns (e.g., *maxbartam* 'their-notebook') and accusative verbs (*re'itixa* 'I-saw-you') which children had to replace by analytic constructions (comprehension), or create, based on analytic constructions (production). Table 3 presents correct performance (in mean percentages) on the Optional Bound Morphology categories before and after intervention.

Two three-way ANOVAs on comprehension and production (respectively) revealed the following: effects for Time (Comprehension: $F(1, 54) = 45.7$, $p < 0.001$; Production: $F(1, 54) = 47.54$, $p < 0.001$); no effect for Group in either comprehension or production, but interactions of Time and Group (Comprehension: $F(1, 54) = 20.45$, $p < 0.001$; Production: $F(1, 54) = 17.76$, $p < 0.001$). Both tasks revealed effects for Category (Comprehension: $F(1, 54) = 18.35$, $p < 0.001$; Production: $F(1, 54) = 33.89$, $p < 0.001$). An interaction of Time and Category emerged in the production task ($F(1, 54) = 26.92$, $p < 0.001$). Most importantly, a three-way interaction of Time, Group and Category emerged for each task (Comprehension: $F(1, 54) = 4.4$, $p < 0.04$; Production: $F(1, 54) = 5.22$, $p < 0.02$).

The post-hoc Bonferroni analyses on the two interactions revealed the following. (a) Comprehension: before intervention, genitive nouns had higher correct scores than accusative verbs in both groups; however, only the MI group improved significantly on both categories post intervention. Finally, accusative verbs improved significantly more than genitive nouns. (b) Production: before intervention, genitive nouns had higher correct scores than accusative verbs in both groups. *Both* MI and NI groups improved significantly on accusative verbs post intervention, but only the MI group improved on genitive nouns. Finally, accusative verbs improved significantly more than genitive nouns in the MI group.

**Table 3** Optional Bound Morphology – Comprehension and Production tasks: mean percentages and standard deviations of correct performance in the MI and NI groups before and after intervention, by task and optional inflection category

| *Inflection* | *Group* | *Before intervention* | | *After Intervention* | |
|---|---|---|---|---|---|
| | | *Comprehension* | *Production* | *Comprehension* | *Production* |
| Genitive nouns | MI | 69.33 (31.64) | 69.11 (31.68) | 93.33 (18.45) | 90.22 (19.00) |
| | NI | 83.33 (19.16) | 77.18 (26.61) | 90.51 (16.99) | 80.00 (26.67) |
| Accusative verbs | MI | 50.86 (34.72) | 33.33 (34.63) | 89.63 (41.63) | 85.30 (18.29) |
| | NI | 69.52 (24.29) | 55.27 (35.88) | 74.80 (28.05) | 70.09 (30.29) |

We proceeded to perform in-depth analyses on the data in Table 3. First, a three-way ANOVA on comprehension and production of genitive nouns, resulting in an effect for Time ($F(1, 54) = 29.99$, $p < 0.001$), an interaction of Time and Group ($F(1, 54) = 12.17$, $p < 0.001$), and an effect for Task ($F(1, 54) = 5.03$, $p < 0.02$), but no further interactions. Second, a three-way ANOVA on comprehension and production of accusative verbs, resulting in an effect for Time ($F(1, 54) = 65.22$, $p < 0.001$), an interaction of Time and Group ($F(1, 54) = 26.5$, $p < 0.001$), an effect for Task ($F(1, 54) = 12.38$, $p < 0.001$), and an interaction of Time and Task ($F(1, 54) = 6.02$, $p < 0.02$). This interaction showed that comprehension was higher than production in the pre-test, but reached the same scores on the post-test.

## Derivational Categories task

This task consisted of nouns constructed in three different ways: linear structure (stem and suffix), non-linear structure (root and pattern), and blended forms (Berman, 1987; Ravid, 1990). Table 4 presents correct performance (in mean percentages) on the three structural categories before and after intervention.

A three-way ANOVA revealed the following: an effect for Time ($F(1, 54) = 95.06$, $p < 0.001$), an effect for Group ($F(1, 54) = 6.05$, $p < 0.001$), and an interaction of Time and Group ($F(1, 54) = 62.01$, $p < 0.001$). There was also an effect for derivational structure ($F(2, 108) = 13.76$, $p < 0.001$), and an interaction of Time and derivational structure ($F(2, 108) = 11.17$, $p < 0.001$). Most informatively, there emerged a three-way interaction of Time, Group and derivational structure ($F(2, 108) = 5.67$, $p < 0.05$).

The post-hoc Bonferroni tests indicated that before intervention, linear scores were lower than nonlinear and blending scores. After intervention, the NI group did not make any significant gains, while the MI group improved in all categories, especially in blending.

## Pseudo Words task

The Pseudo Words task tested the ability to find and explain structural relations between pseudo and real words. Table 5 presents correct scores (in mean percentages)

**Table 4** The Derivational Categories task: mean percentages and standard deviations of correct performance in the MI and NI groups before and after intervention, by structural category

| *Inflection* | *Group* | *Before intervention* | *After intervention* |
|---|---|---|---|
| Stem and suffix | MI | 30.50 (14.04) | 65.33 (21.90) |
| | NI | 36.35 (19.06) | 36.92 (16.56) |
| Root and pattern | MI | 41.33 (18.38) | 64.83 (19.00) |
| | NI | 41.73 (19.50) | 45.00 (14.00) |
| Blending | MI | 35.50 (22.57) | 82.00 (26.40) |
| | NI | 45.20 (33.19) | 52.50 (25.54) |

**Table 5** Structural relationships in the Pseudo Words task: mean percentages and standard deviations of correct identification and motivation of relationship types in the MI and NI groups before and after intervention

| *Inflection* | *Group* | *Identification* | | *Motivation* | |
|---|---|---|---|---|---|
| | | *Before* | *After* | *Before* | *After* |
| Rhyme | MI | 20.00 (24.03) | 76.67 (37.11) | 7.78 (10.01) | 56.11 (32.89) |
| | NI | 16.35 (23.14) | 9.62 (14.28) | 10.57 (16.76) | 4.48 (7.54) |
| Root | MI | 85.83 (22.45) | 97.50 (10.06) | 33.06 (25.47) | 80.56 (30.27) |
| | NI | 85.58 (23.64) | 88.46 (16.17) | 43.59 (29.18) | 43.91 (28.44) |
| Pattern | MI | 7.50 (16.29) | 73.33 (39.36) | 6.94 (11.80) | 69.72 (38.93) |
| | NI | 5.77 (10.74) | 3.84 (9.20) | 6.73 (18.26) | 1.60 (3.35) |

of identification and motivation of three types of structural relationships, before and after intervention

Three-way ANOVAs on the data in Table 5 revealed the following: effects for Time (identification: $F(1, 54) = 51.45$, $p < 0.001$; motivation: $F(1, 54) = 65.27$, $p < 0.001$); effects for Group (identification: $F(1, 54) = 66.55$, $p < 0.001$; motivation: ($F(1, 54) = 30.47$, $p < 0.001$); and interactions of Time and Group (identification: $F(1, 54) = 61.12$, $p < 0.001$; motivation: $F(1, 54) = 85.96$, $p < 0.001$). No effects for structural relationship were found, but three interactions emerged: Group and structural relationship (identification: $F(2, 108) = 20.65$, $p < 0.001$; motivation: $F(2, 108) = 10.11$, $p < 0.001$); Time and structural relationship (identification: $F(2, 108) = 12.42$, $p < 0.001$; motivation: $F(2,108) = 1.72$, $p < 0.001$); and most informatively, two three-way interactions of Time, Group and structural relationship (identification: $F(2, 108) = 20.73$, $p < 0.001$; motivation: $F(2, 108) = 3.12$, $p < 0.05$). The Bonferroni post-hoc on the identification interaction found that before intervention both groups succeeded most on identifying root relation, followed by rhyme relation and then pattern relation. After intervention, the NI group did not make any significant gains, while the MI group improved in pattern and rhyme identification, but not on root identification. The post-hoc on the motivation interaction found that before intervention, both groups succeeded most on motivating root relation, followed by rhyme and pattern relations. After intervention, the NI group did not make any significant gains, whereas the MI group improved in all structural categories, with most gains made in pattern explanation.

## Analogies task

The Analogies task tested the ability to produce words related by root and pattern to a given item. Table 6 presents correct scores (in mean percentages) of root and pattern responses, before and after intervention.

A three-way ANOVA revealed the following: an effect for Time ($F(1, 54) = 28.85$, $p < 0.001$); an effect for Group ($F(1, 54) = 19.93$, $p < 0.001$); and an interaction of Time and Group $F(1, 54) = 43.96$, $p < 0.001$). There was also an effect for relationship type ($F(1, 54) = 469.25$, $p < 0.001$), and the following interactions: Time and relationship type ($F(1, 54) = 5.5$, $p < 0.02$), Group and relationship type ($F(1, 54) = 5.1$, $p < 0.03$), and a three-way interaction of Time, Group and relationship type ($F(1, 54) = 9.49$, $p < 0.003$). The Bonferroni post-hoc found that before intervention both groups produced significantly more words related by root and fewer related by pattern. After intervention, the NI group did not make any significant gains, whereas the MI group improved in producing same-pattern words, and slightly less so in same-root words.

## Passive Construction task

This task consisted of active sentences with verbs in three different *binyan* patterns: *Qal, Pi'el* and *Hif'il*, which participants were supposed to change into passive sentences in the three corresponding passive *binyan* patterns: *Nif'al, Pu'al* and *Huf'al*. Table 7 presents correct scores (in mean percentages) by *binyan*, before and after intervention.

**Table 6** Root and pattern responses in the Analogies task: mean percentages and standard deviations of correct performance in the MI and NI groups before and after intervention, by root and pattern

| *Inflection* | *Group* | *Before intervention* | *After intervention* |
|---|---|---|---|
| Root | MI | 70.48 (21.61) | 85.00 (15.62) |
| | NI | 71.43 (21.39) | 69.78 (20.23) |
| Pattern | MI | 6.43 (8.47) | 44.29 (29.50) |
| | NI | 7.97 (13.30) | 4.12 (7.90) |

**Table 7** The Passive Construction task: mean percentages and standard deviations of correct performance in the MI and NI groups before and after intervention, by *binyan*

| *Inflection* | *Group* | *Before intervention* | *After intervention* |
|---|---|---|---|
| *Nif'al* | MI | 83.75 (29.75) | 98.33 (7.14) |
| | NI | 83.65 (29.96) | 88.46 (22.90) |
| *Pu'al* | MI | 67.92 (35.31) | 93.75 (13.43) |
| | NI | 75.00 (30.21) | 78.37 (25.87) |
| *Huf'al* | MI | 53.75 (22.78) | 84.17 (22.49) |
| | NI | 69.23 (24.55) | 66.35 (26.64) |

A three-way ANOVA revealed the following: an effect for Time ($F(1, 54) = 22.84$, $p < 0.001$), no effect for Group, but an interaction of Time and Group ($F(1, 54) = 16.94$, $p < 0.001$). An effect for *banyan* emerged ($F(2, 108) = 441.64$, $p < 0.001$), and a three-way interaction of Time, Group and *binyan* ($F(2, 108) = 4.12$, $p < 0.02$). The Bonferroni post-hoc found that before intervention *Nif'al* was easier than the other *binyanim.* After intervention, the NI group did not make any significant gains, whereas the MI group improved in all three *binyanim*.

## Derived Nominals tasks – Comprehension and Production

Two tasks tested comprehension and production of derived nominals. Table 8 presents correct scores (in mean percentages) by task, before and after intervention.

A three-way ANOVA revealed the following: an effect for Time ($F(1, 54) = 15.07$, $p < 0.001$), no effect for Group, but an interaction of Time and Group ($F(1, 54) = 21.54$, $p < 0.001$), showing that the MI group improved significantly after intervention, while the NI group did not. No other effects or interactions emerged.

## Comprehension of Linguistic Humor

This task consisted of four subsets of tasks using jokes and riddles (Ashkenazi & Ravid, 1998), based on (1) lexical ambiguity, (2) syntactic ambiguity, (3) reanalysis (morphological structure). Table 9 presents correct scores (in mean percentages) by category, before and after intervention.

A three-way ANOVA revealed the following: an effect for Time ($F(1, 54) = 33.72$, $p < 0.001$), an effect for Group ($F(1, 54) = 7.03$, $p < 0.001$); and an interaction of Time and Group ($F(1, 54) = 41.27$, $p < 0.001$). An effect for Linguistic Humor category also emerged ($F(3, 162) = 16.2$, $p < 0.001$), with interactions of Time and Linguistic Humor category ($F(3, 162) = 4.97$, $p < 0.001$), Group and Linguistic Humor category ($F(3, 162) = 2.27$, $p < 0.001$), and a three-way interaction of Time, Group and Linguistic Humor category ($F(3, 162) = 13.58$, $p < 0.001$). The Bonferroni post-hoc found that syntactic ambiguity was significantly lower than the other humor categories before intervention. While the NI group did not make any significant gains after intervention, the MI group improved in all four linguistic humor types, with the smallest gain in syntactic ambiguity.

**Table 8** Derived Nominals – Comprehension and Production: mean percentages and standard deviations of correct performance in the MI and NI groups before and after intervention, by task

| *Task* | *Group* | *Before intervention* | *After intervention* |
|---|---|---|---|
| Comprehension | MI | 66.11 (18.18) | 80.37 (10.80) |
| | NI | 75.64 (12.58) | 69.87 (14.07) |
| Production | MI | 66.80 (25.83) | 82.22 (18.25) |
| | NI | 73.72 (24.07) | 77.14 (18.75) |

## Direct and indirect effects of intervention

The Morphological Awareness Test contained five tasks based on material taught directly and explicitly during the linguistic humor intervention program – inflectional and derivational constructions appearing in the Grammaticality Judgment, Pseudo Words, Derivational Categories, Analogies, and Linguistic Humor tasks. There were also five tasks containing material which was not taught directly during intervention – the Passive, Derived Nominals and Optional Bound Morphology tasks. We hypothesized that the knowledge gained in the direct intervention program will indirectly affect those tasks which were not based on direct teaching. To test this hypothesis, we pooled together all tasks based on direct teaching versus all tasks based on indirect teaching (Table 10).

A three-way ANOVA revealed the following: an effect for Time ($F(1, 54) = 192.07$, $p < 0.001$); an effect for Group ($F(1, 54) = 7.14$, $p < 0.001$); an interaction of Time and Group $F(1, 54) = 156.88$, $p < 0.001$); and an interaction of Group and Teaching Type ($F(3, 162) = 35.142$, $p < 0.001$). Finally, there was a three-way

**Table 9** The Linguistic Humor task: mean percentages and standard deviations of correct performance in the MI and NI groups before and after intervention, by category

| *Inflection* | *Group* | *Before intervention* | *After intervention* |
|---|---|---|---|
| Lexical ambiguity | MI | 13.61 (17.71) | 54.72 (33.09) |
| | NI | 21.79 (21.35) | 18.59 (21.77) |
| Syntactic ambiguity | MI | 8.61 (15.39) | 22.50 (26.64) |
| | NI | 7.05 (13.27) | 13.46 (24.73) |
| Re-analysis | MI | 8.89 (16.66) | 52.50 (28.55) |
| | NI | 15.06 (16.50) | 15.38 (22.69) |
| Morphological structures | MI | 11.94 (19.04) | 46.67 (33.45) |
| | NI | 21.47 (26.79) | 11.22 (21.72) |

**Table 10** Mean percentages and standard deviations of correct performance in the MI and NI groups before and after intervention on tasks based on direct versus indirect teaching

| *Inflection* | *Group* | *Before intervention* | *After intervention* |
|---|---|---|---|
| Direct teaching | MI | 26.52 (10.62) | 65.90 (20.23) |
| | NI | 28.04 (10.04) | 27.18 (10.21) |
| Indirect teaching | MI | 60.58 (22.09) | 87.60 (12.52) |
| | NI | 72.95 (15.43) | 77.16 (15.54) |

interaction of Time, Group and Teaching Type ($F(3, 162) = 10.87$, $p < 0.02$). The Bonferroni analysis indicates that the MI group made significant gains in both directly and indirectly taught material, while the NI group did not make any such gains.

## DISCUSSION

The most striking finding of this study confirms our main hypothesis: the Morphological Intervention (MI) group improved significantly on every single task – in some cases dramatically, while the Nonverbal Intervention (NI) group did not make any significant gains.[3] Thus, this study did not exhibit the Hawthorne Effect: Two variegated, intensive, interesting and enjoyable programs based on humor were carried out with the same duration, frequency and intensity in both 4th-grade groups, but only the program using *linguistic* humor resulted in substantial increase of morphological knowledge and meta-morphological awareness. Thus, it is not the attention and interest involved in the intervention program that brought about this change, but rather its contents.

This three-month intervention program consisted of classroom instruction, classwork and homework using jokes and riddles based on Hebrew morphological constructs. It focused children's attention on the internal structure of words, and in addition provided them with the verbal apparatus necessary to explain their knowledge, making their responses more explicit, correct and detailed, relating morphological constructs to their written forms. Children learned to identify roots and patterns, stems and suffixes, to analyze the components of blends, and to relate different words sharing these morphemes. Instruction focused not only on structure, but also elaborated on meaning, with numerous examples and analyses of lexical and syntactic ambiguity and homonymy. Special attention was paid to the semantics of grammatical morphemes (number, gender, person and tense), and derivational morphemes such as diminutive, agent and place suffixes. The program required children to work intensively and extensively on word structure and meaning – to retrieve words, make up new words, analyze words into their components to discuss jokes and riddles, to find different meanings for the same word, detect erroneous forms and produce deliberate errors.

As a result, MI children moved from implicit, concrete, pragmatic and holistic perception of lexical items, prior to intervention, to more linguistically explicit, abstract, morphologically oriented responses focusing on word-internal components. For example, in the pre-test, Yishai explained his repair of *kélev ktana* 'dog,Masc small,Fm' by saying 'because they say in the sentence it's a dog and not a bitch', while in the post-test he said 'error in masculine and feminine'. Uri explained *safran* 'librarian' before intervention as 'it's one who writes stories' – indicating his implicit perception of root *s-p-r* 'tell' relating the two words; after intervention he said 'it's *séfer* [book] with the suffix *-an*, which means it's a person with a profession' – a fairly explicit demonstration of noun agency and appropriate suffixation. Before intervention, explanations were vague and associative, e.g., 'the [pseudo] word *le-hadrig* [to-grade] resembles *le-hasbir* [to-explain]', while after intervention they became linguistically precise, e.g., 'it's the same pattern'.

The classroom interaction indicated children's increasing interest in language and linguistic awareness. At the beginning, children merely demonstrated their enjoyment of the phatic function of language[4] (Jakobsón, 1987) by laughing at examples of language play, but were not able to provide any linguistic motivation for their delight. As the program progressed, they were also able to appreciate the linguistic aspect of language play and react to it in spontaneous ways that indicated their increasing morphological awareness. For example, the discussion of lexical ambiguity gave rise to the idea that children's own names (e.g., *Stav Lev*) often had general meanings – in this case, 'autumn' and 'heart', respectively. Once the group learned about the *CaCéCet* noun pattern[5] signifying diseases, they used it to make up funny names for fictitious diseases such as *dabéret* 'talkativeness' (from *diber* 'talk', root *d-b-r*). Eventually, children used explicit linguistic terminology even when it was not introduced in formal instruction, e.g., Eran reacted to a joke based on pattern similarity by saying 'this is a verb and not a profession'. These examples indicate that the intervention program succeeded in bringing our participants to the realization that language is an arbitrary system – an insight underlying schoolchildren's metalinguistic ability (Bernstein, 2002).

## The effect of intervention on morphological knowledge

The Morphological Awareness test consisted of two main task types, cutting across the linguistic domains specified above: (i) tasks testing linguistic knowledge; and (ii) tasks requiring explicit metalinguistic verbalization. While correct responses on both task types increased considerably in the MI group after intervention, they had different start-off points and were affected differently by the intervention program.

Six of the tasks (e.g., Optional Bound Morphology) required participants to conduct morphological operations: analyzing words into their components and producing words upon demand (e.g., the response to 'what does a person do who is engaged in *xaluka* [distribution]?' should be *mexalek* 'distributes'). While these tasks did not require explicit verbalization of linguistic phenomena, they did necessitate certain metalinguistic skills in paying attention to word structure and morpheme semantics. Of the six tasks involving linguistic knowledge, five had initial scores of 60–70% in both groups, while only the Analogies task scored around 40%. This shows that the implicit and epilinguistic knowledge of 'advanced' categories of the literate lexicon in Hebrew is already well on its way by age 9 in typically developing children (Ravid, 2004). The intervention program thus had a broad and solid platform of already extant knowledge from which to extend morphological skills. Three morphological domains benefited from it: optional bound morphology, derivational morphology and morphosyntax.

### *Optional Bound Morphology*

Hebrew genitive nouns and accusative verbs may take either morphological or syntactic form. The perceptually salient and semantically transparent analytic option is typical of spoken, everyday usage, and emerges early on in child language. The morphological option with the same semantics is denser and more opaque morphophonologically, typical of written, school-type texts and high-register usage, and a

later, school-age acquisition (Berman, 1997; Levin et al., 2001). Noun genitives (comprehension and production) in the MI group scored rather high on the pre-test (about 70%), indicating that this knowledge is already well established in 4th grade. In contrast, comprehension of accusative verbs (e.g., *re'itiv* 'I-saw-him') was lower (about 50%), and their production did not exceed one-third correct responses before intervention. This indicates the more fragile nature of accusative verbs, which occur less frequently in written Hebrew texts and have more complex structures not shared by any other Hebrew category (Schwarzwald, 2002). Consequently, even educated adults are familiar with only few, restricted declensions of accusative verbs (Cahana-Amitay & Ravid, 2000).

Optional morphology was one of the tasks which had not been taught formally in the intervention study. Nevertheless, the MI group improved by over 20% in genitive comprehension and production, by 30% in accusative comprehension, and by over 50% in accusative production, reaching between 85–90% correct scores in all domains after intervention. Genitive nouns improved mainly in semantic and morpho-phonological accuracy of stem and suffix. For example, erroneous *morathem* 'their-teacher,Fm' prior to intervention was replaced by grammatical *moratam*. Accusative verbs improved in a more fundamental way in the very ability to alternate inflection and analytical form. These results indicate 9-year-olds' ability to apply skills taught in one morphological domain to another. Accusative production is the only category where the NI group made a significant improvement from pre-test to post-test: Three months in 4th grade might be an adequate period of time for making some natural progress on a challenging linguistic domain highly dependent on literacy development.

*Derivational morphology*

This domain was tested by three tasks: First, Analogies – where children were expected to produce two words, related to the test word by root and pattern respectively. For example, *dira* 'apartment' (root relationship) and *balash* 'detective' (pattern relationship) in response to *dayar* 'resident'. Second, two Derived Nominals tasks where children were required to produce the verb related to the nominalized form, e.g., *dag* 'to fish' for *dáyig* 'fishing'; and the nominalized form in response to the verb, e.g., *révax* 'profit' for *hirviax* 'to profit'. In general, prior to intervention, success on derived nominals (70%) was much higher than on analogies (40%). However, a closer examination of Table 6 and the statistical analysis of the initial Analogies scores indicates that root-related words had the same scores as derived nominals, while pattern responses were extremely low (6%). This finding reinforces the early and robust sensitivity to consonantal Semitic roots, in contrast to the later-emerging perception of the vocalic and categorical pattern (Ravid, 2002, 2004; Ravid & Kubi, 2003; Ravid & Malenky, 2001; Ravid & Schiff, 2006). Most responses in the pre-test consisted of one word related by root and another, by phonology or association.

The Analogies task sustained direct intervention on the topics of root and pattern, with intensive, direct and explicit work using linguistic humor. Post intervention, MI children improved by 15% in their root responses, but pattern responses soared from 6% to 44%. For example, they now produced noun pattern responses

such as *miklat* 'shelter', *migdal* 'tower', *mixtav* 'letter' to test item *misxak* 'game' (pattern *miCCaC*); and adjective patterns such as *mexunax* 'educated', *mesupar* 'told', *meshuman* 'oiled' in response to *melumad* 'scholar' (pattern *meCuCaC*).

Derived Nominals – one of the latest categories in Hebrew acquisition – were among those topics which were not taught in the intervention program, but nevertheless improved by about 15% in the MI group. Only two words in comprehension – *te'ura* 'lighting' and *taxanunim* 'begging' – in fact improved post intervention. Before intervention, misled by word structure and spelling considerations, many children erroneously attributed *te'ura* to *te'er* 'describe' and *taxanunim* to *tixnen* 'plan'. After intervention, most MI children were able to correctly relate *te'ura* 'lighting' to verb *he'ir* 'shed light', and *taxanunim* 'begging' to *hitxanen* 'beg'. In production, MI children's responses changed after intervention from mostly concrete and ungrammatical to abstract, e.g., from *késef* 'money' to erroneous action nominal *harvaxa* 'profiting' (for correct *révax* 'profit'). Such responses were found among older children in previous studies (Ravid & Avidor, 1998; Ravid & Cahana-Amitay, 2005; Seroussi, 2004). Despite the absence of direct and formal teaching, classwork on lexical ambiguity and morphological analysis enhanced children's ability to perceive words as arbitrary representations conveying multiple meanings, and drew their attention to the role of roots and patterns in word formation.

*Morphosyntax*

Although the intervention program did not include any mention of passive formation, the MI group improved by nearly 25% on the Passive Construction task. Before intervention, *Nif'al* verbs had the highest scores, followed by *Pu'al* and then *Huf'al*. Errors consisted of active instead of passive responses, ill-formed passives and erroneous passives, mostly in *Nif'al*. After intervention, *Nif'al* and *Pu'al* had almost ceiling scores, and even *Huf'al* verbs scored close to 85%. These findings support the pattern reported in Ravid et al. (2003) and Ravid (2004), but the scores after intervention are higher relative to the age of the participants. This again testifies to the indirect impact of verbal treatment program on linguistic domains not explicitly taught in class.

To summarize this part, our assumption about the efficacy of morphological intervention in 4th grade was borne out by the results of the tasks testing morphological knowledge. All domains tested, whether taught directly or not, responded significantly to intervention, including pattern manipulation, the most challenging morphological task in grade-school. NI students, in contrast, did not make any such progress.

## The effect of intervention on metalinguistic verbalization

The four remaining tasks required participants to respond to test items by the use of metalinguistic verbalization. Three of them (Grammaticality Judgment, Pseudo Words, Linguistic Humor) did not exceed 20% correct responses before intervention, while Derivational Categories scored under 40%. In contrast to the high initial success on morphological knowledge, metalinguistic verbalization of morphological phenomena was mostly still emergent in grade-schoolers.

The emergence of metalinguistic verbalization constituted the main difference between pre-test responses and post-test responses of the MI group. One dramatic improvement was the number of children who were willing to provide explanations for linguistic phenomena. For example, prior to intervention, 22 of the 30 MI children did not try to motivate their identification and repair of erroneous Grammaticality Judgment items, while only seven failed to do so in the post-test. Another difference was in degree of linguistic elaboration: Most Linguistic Humor responses before intervention either ignored the request to explain the joke/riddle, or else consisted of either 'funny' or 'not funny'. While the NI group continued to give the same responses on the post-test, responses by MI group participants became elaborated and contained linguistic terminology, e.g., Nufar's reaction to the word *kinúax* 'dessert/wiping' in the post-test was 'ambiguity – it's the same word for food and for blowing your nose'.

Side by side with these qualitative changes, every category showed significant quantitative improvement.

*Grammaticality Judgment*

Identifying and repairing inflectional errors was easy for our participants. All children in both MI and NI groups succeeded in repairing all eight items before intervention; however, 2/3 of them did not even try to explain and motivate their repairs. As found in Ravid & Malenky (2001), motivating person inflection was more difficult for children than gender and number, most probably because the latter are much more widespread in Hebrew inflection, are closely packaged together phonologically and are much less abstract. The few responses regarding person were vague, e.g., 'because you can't say I went,2nd to the supermarket yesterday, it should be the opposite'. There were also vague and/or erroneous responses regarding number such as 'you should say two cats and not a cat or because cat is masculine'. However, some gender/number responses were already linguistically explicit even before intervention, e.g., 'it can't be three doll because three is already a number'. After intervention, there were no longer any differences among inflection types in the MI group: number, gender and tense all scored about 2/3 correct responses, and person scored 55%.

*Derivational Categories*

Inflection usually precedes derivation in natural acquisition due to its predictable and regular semantics and obligatory and highly frequent applicability. However, its abstract, grammatical character seems to make inflection less metalinguistically accessible than derivation. Before intervention, the Derivational Categories task already scored close to 40%, double the score of the Grammaticality Judgment task. Derivational morphemes – especially roots and stems, which carry lexical meaning – are less abstract and less categorical in nature than inflectional morphemes, and are thus easier to conceptualize and explain. After intervention, awareness of all derivational categories increased significantly, especially the explicit verbalization of blends, which are less transparent and less typical of Hebrew morphological structure (Berman, 1987; Ravid, 1990). A frequent strategy after intervention was the use of root-related words to explain test items, e.g., *metukan* 'is fixed', *tiken* 'fixed' in response to *tikun* 'fixing'.

Interestingly, non-linear structures (root and pattern) had higher initial scores than linear constructions (stem and suffix) and blends both before and after intervention. This is in line with abundant independent evidence of the centrality of root-based morphology in Hebrew from early on (Deutsch, Frost, Pollatsek & Rayner, 2000; Ravid, 2002; Ravid & Bar-On, 2005; Ravid & Kubi, 2003; Velan, Frost, Deutsch & Plaut, 2005), and the relative complexity of Hebrew linear morphology (Ravid, 2006). Words with linear and blended structure were more difficult to process in the absence of a root-related morphological family, and necessitated a more analytical approach separating word components – which explains the higher scores of non-linear words after intervention.

*Pseudo Words*

This task required children to identify and state explicitly the nature of a structural relationship between a pseudo word and real words. This was much harder to do than trying to motivate why a concept has a certain name, as required in the Derivational Categories task. Words related by root were easily identified by both groups, and did not improve significantly in either, though it reached almost 100% in the MI group. Words related by rhyme were more difficult to identify, while pattern relationships were hardly identified at all. The motivation task showed the same configuration of response types, albeit with a much lower score on motivating root relationship. After intervention, pattern awareness emerged in the MI group, where both identification and motivation multiplied ten-fold, with children often using morphological terminology explicitly. This was the result of direct instruction on roots and patterns in linguistic jokes and riddles, which entailed class discussion by children. For example, Nufar explained that the childish innovation *matpela* (meant to denote a place for prayer), is derived from *mitpalelim* 'they pray' (root *p-l-l* 'pray'), and Assaf said that the word resembled *maspera* 'hairdressing salon', obviously relating them by pattern *maCCeCa* which often denotes locations. Though the intervention program did not include phonological instruction, rhyme identification and motivation improved as well, probably because of the focus on word endings. Seventeen children in the MI group used the term *rhyme* in its correct context after intervention, although it had never been formally introduced in class.

*Linguistic humor categories*

The ability to comprehend linguistic humor is indicative of children's metalinguistic abilities (Ashkenazi & Ravid, 1998; Yuill, 1996, 1998). Before intervention, the categories of lexical ambiguity, reanalysis and morphology scored higher than syntactic ambiguity. This finding testifies to the central role of morphology in Hebrew and the challenge posed by the requirement to conceptualize and verbalize sentence structure – which emerges very late in Hebrew (Ravid & Saban, 2008). All three morphological categories improved exponentially in the MI group; and despite the fact that intervention was morphological, syntactic ambiguity improved significantly as well. This illustrates again the ability to transfer metalinguistic insight from one domain to the other as a result of intervention.

The difference in the responses of MI group children after intervention demonstrates to what extent the intervention program facilitated the expression of their

implicit knowledge. Many of those who had failed to respond in any way to jokes and riddles in the pre-test came up with linguistically relevant responses in the post-test. Others advanced from partial and vague responses ('these words are similar') to making use of linguistic terminology ('it has to do with the root'; 'there are two meanings here – it has to do with ambiguity'). Several children shifted attention from concrete to abstract properties denoted by test items. For example, before intervention 'the man thought the book was heavy', and after intervention, 'the man thought the book was light in its weight but the seller meant that the book was light in its words'.

## CONCLUSIONS AND IMPLICATIONS

From an educational perspective, we have shown that it is possible to promote metamorphological thinking in Hebrew-speaking grade-school children aged 9–10 with the use of linguistic humor, and that learning can be overextended to categories not directly taught in class. The implication is that grade-schoolers acquiring a Semitic language with rich morphology are able to represent morphemes of various types and to use them to relate lexical items with the proper intervention (Ben-Dror, Bentin & Frost, 1995; Ravid, 2004; Ravid & Malenky, 2001). Moreover, given that all tasks were administered in writing, this also means that it is possible to promote awareness of written language constructs and, consequently, linguistic literacy in grade-schoolers by child-friendly yet direct and explicit instruction (Ravid, 2002; Ravid & Bar-On, 2005). After intervention, motivation and willingness of children in the MI group to engage in linguistic manipulation increased a great deal, as evidenced by their responses on the morphology test, their feedback and their final assignments. Children reported that learning was 'fun' and that they continued thinking about verbal jokes at home and in their free time. They also demonstrated the ability to examine linguistic constructs from multiple perspectives – the hallmark of linguistic flexibility. Children's enjoyment and delight with linguistic humor was evident in the fact that some of them preferred to continue a metalinguistic discussion in class to playing outside.

From a psycholinguistic perspective, this study provides independent support for previous findings, such as the central role of morphology in the mental lexicon of Hebrew-speaking children, especially root-based relationship among words. It also demonstrated once again the fragile nature of Semitic patterns in contrast to the robust character of roots. The study showed that this difference can be reduced through metalinguistic intervention as early as in 4th grade. Finally, our study shed some new light on the way linguistic knowledge is processed under different conditions. Inflection is generally much easier and consequently learned earlier than derivation in natural usage, but for the purposes of metalinguistic analysis, derivational constructs were easier to explain than inflectional morphemes.

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## NOTES

1. Under perfect conditions, we would have had a multi-condition study, including, for example, metalinguistic intervention without humor and a control group with no intervention at all. Under such conditions we could also have used a number of different teachers. Because of resource limitations and practical difficulties in respect of arranging access to the two classes for the 3-month treatment program, we opted for the two groups described in the study.
2. Three children with diagnosed learning disabilities had been screened out of the program.
3. Except for a single category in the production of optional bound morphology.
4. Focusing on language's maintenance of itself as a working system.
5. Semitic patterns consist of a vocalic template into which root radicals are inserted (marked by C), often prefixed and/or suffixed by consonants (McCarthy, 1981).

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# APPENDIX 1

### Examples of the scoring scales

**Grammaticality Judgment task**

- 0 points No response.
- 1 point Correcting error without giving an explanation, e.g., 'I don't have a small, Masc Dog, Fm, I have a small, Fm Dog, Fm'; erroneous explanation, e.g., gender for person.
- 2 points Implicit response, with some focus on target word, e.g., '*halaxta* [you walked] is for you and it says here "I"'.
- 3 points Correct response including explicit linguistic terminology, e.g., 'the person is wrong'.

**Optional Bound Morphology – Production task: genitive nouns**

*Stem scale*

- 0 points No response; no combination of stem and suffix; different stem.
- 1 point Erroneous stem, e.g., plural instead of singular stem; morphophonological error, e.g., *morahem* for *moratam* (relevant part in bold).
- 2 points Correct stem.

*Suffix scale*

- 0 points See stem scale.
- 1 point Erroneous gender, number of person, e.g., *moratxem* 'your,Pl teacher' for *moratam* 'your,Sg teacher'.
- 2 points Correct grammar, incorrect allomorph, e.g., *axo* for *axiv* 'his brother'.
- 3 points Correct grammar, correct allomorph.

# APPENDIX 2

### Structure of the intervention program based on linguistic humor (MI group)

| *Lesson no.* | *Humor category* | *Linguistic category* | *Linguistic terminology taught* |
|---|---|---|---|
| 1 | Linguistic and nonverbal humor | Linguistic and nonverbal humor | Language |
| 2–4 | Ambiguous words | Root identification | Roots, morphological families |
| | | Homophones and homonyms | Ambiguity |

*(Continued)*

## APPENDIX 2 (*Continued*)

| | | | |
|---|---|---|---|
| 5–7 | Word reanalysis | Derivational morphology: Linear structure Blends | Blends |
| 8–9 | Children's productions | Derivational morphology: Linear structure Stem and suffix | Suffix |
| 10–12 | Children's productions | Derivational morphology: Non-linear structure | Root and pattern |
| 13 | Review | Review | |
| 14 | Children's and non-native productions | Inflectional morphology | Singular/plural, masculine/feminine, person, tense |
| 15–16 | Summary and conclusions | Preparing final assignment on linguistic humor | |

## APPENDIX 3

**Structure of the intervention program based on nonverbal humor (NI group)**

| *Lesson no.* | *Humor category* | *Humoristic activities* |
|---|---|---|
| 1 | Nonverbal humor | Watching comic movies, identifying comic activities |
| 2–4 | Absurd look | Preparation of masks Painting and cutting funny figures |
| 5–7 | Unexpected events | Pantomine Watching comic tv shows |
| 8–9 | Funny situations | Funny games |
| 10–12 | Gestures and facial expressions | Contests relating to facial gestures Carrying our assignments involving gestures and facial expressions |
| 13–14 | Noises and sounds | Juxtaposing natural sounds Vocal exaggeration |
| 14–15 | Review | Carrying our humoristic assignments |
| 16 | Summary and conclusions | Preparing final assignment on nonverbal humor |

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