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What can errors tell us about specific language impairment deficits? Semantic and morphological cuing in a sentence completion task

RAMA NOVOGRODSKY[1,2] & VARDA KREISER[3,4]

[1]*Department of Communication Sciences and Disorders, University of Haifa, Haifa, Israel,* [2]*The Center for the Study of Communication and the Deaf, Boston University, Boston, MA, USA,* [3]*Department of Special Education, Gordon College of Education, Haifa, Israel, and* [4]*Department of Special Education, Kibbutzim College of Education, Tel Aviv, Israel*

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Abstract
The lexical retrieval ability of children with specific language impairment (SLI) and children with typical language development was compared. Fifty Hebrew-speaking children participated: 15 school-age with SLI, 20 typically developing, matched on age to the SLI group and 15 younger, typically developing matched on naming performance to the SLI group. Participants were tested in a sentence completion task with semantic cuing and with morphological cuing. SLI children performed poorer than the chronological-age group and similarly to the naming-matched group. Error patterns showed a qualitative difference between the SLI and naming-matched groups. The results suggest that lexical retrieval of children with SLI is delayed and qualitatively different from that of typically developing children.

Keywords: Derivation, lexical-retrieval, morphological-cueing, semantic-cueing, sentence-completion, SLI

Introduction

Children with Specific Language Impairment (SLI) represent a heterogeneous group with diverse language difficulties (Conti-Ramsden, Crutchley, & Botting, 1997; Friedmann & Novogrodsky, 2011; Leonard, 1998; Van Daal, Verhoeven, & van Balkom, 2004, among others). One-quarter of children with SLI have naming difficulties during spontaneous speech and structured tasks (Messer & Dockrell, 2006; Radford, 2009). This deficit is described using different terms such as: Word Finding Difficulty (WFD) (Best, 2005; Dockrell, Messer, George, & Wilson, 1998; German & Simon, 1991; Messer & Dockrell, 2006); Lexical-SLI (Friedmann & Novogrodsky, 2011); Naming difficulties (Faust, Dimitrovsky, & Davidi, 1997). However, regardless of the terminology, the characteristics of the difficulty are similar across studies and languages. These characteristics include inaccuracy in naming (Dockrell, Messer, & George, 2001; Lahey &

Correspondence: Rama Novogrodsky, PhD, Department of Communication Sciences and Disorders, University of Haifa, 199 Abba Khoushy Ave, Haifa 3498838, Israel. E-mail: ramanovo@gmail.com; rnovogr1@univ.haifa.ac.il

Edwards, 1999), long latency before response (Bragard, Pillon, & Schelstraete, 2012; Dockrell, et al., 2001), long pauses within phrases, frequent use of place holders (such as: ''*uh''*, ''*um''*) or general words (such as: ''*that*'', ''*like this*'') and use of circumlocutions, for example: *''the long one that you use when you write''* (Dockrell, et al., 1998). Another important characteristic of WFDs is variability across occasions: the same target word is successfully retrieved on one occasion but not on another (McGregor & Appel, 2002). It is agreed that the naming difficulty is related to the retrieval process of words that the child knows and are stored in his/her lexicon (Bragard & Schelstraete, 2007; Friedmann, Biran, & Dotan, 2013; German, 2002). The current study explored the effectiveness of semantic cues versus morphological cues in the lexical retrieval process for children with SLI and WFDs[1] relative to two control groups of typically developing (TD) children, one matched on age and one matched on naming.

The morphological relationship between words in Hebrew

In many languages, knowledge of word roots helps children understand the relationship between words and their meanings (Gonnerman, Seidenberg, & Andersen, 2007; Levin, Ravid, & Rapaport, 2001). In Hebrew, as in other Semitic languages (such as Arabic), many nouns and verbs share the same root. For example the verb ''*le-exol*'' (to eat) and the noun *''oxel''* (food) share the same three consonantal root letters *a.x.l* (or are derived from the same root). While many inflections in Hebrew are linear[2], like the plural in English: ''*balon*'' (balloon) + the plural morpheme: ''*im''* = ''*balonim''* (balloons), the basic derivational means is nonlinear. The nonlinear derivation is an interweaving of a consonantal root into a vocalic pattern. In the current study, we selected nonlinear Hebrew morphemes. This form combines two discontinuous tiers: a consonantal tri- or quadrilateral root (e.g. ''*s.r.k.*'') mapped onto a template, e.g.: the verb ''*meXaXeX*[3] - *mesarek''* meaning to comb, the noun ''*maXXeX – masrek''* meaning a comb, or the adjective *''meXoXaX – mesorak''* meaning being combed. Each combination of root and template yields a lexical item (Levin, et al., 2001). Many lexical families share a root and basic semantic components, as can be seen in the example above.

Knowledge of words and their roots is an essential linguistic ability with a semantic function in Hebrew, a language whose lexicon consists primarily of 1800 roots and 50 templates (Choueka, 1996, see Nir, 1993 for a higher number of templates). Three-year-old Hebrew speakers with typical language development can extract the root from verbs (Clark & Berman, 1984) and can understand new verbs based on known nouns and adjectives (Berman, 2000). This knowledge gradually evolves during pre-school and school years (Ravid, Levie, & Avivi-Ben Zvi, 2003; Ravid & Malenky, 2001).

Morphological and phonological knowledge as mediators of search for meaning

Hebrew roots play an important role in mediating the search for meaning (Avivi-Ben Zvi, 2011). Morphological cuing is inherent in Hebrew, allowing the examination of this unique aspect of a language. In noun elicitation tasks, Avivi-Ben Zvi (2011) found that elementary-school children successfully extracted the correct root from the prompt, even when they chose the incorrect template. This finding is important for the current study as in one condition, we used a derivational task, asking children to complete a sentence based on the relationship between a verb and a target noun sharing the same root.

[1]The current study tested a specific group of children that confirm the diagnosis of both SLI and WFDs as described in the Method section. The terms SLI or children with WFDs are used along the paper depending on the terms that are used in the original study discussed.
[2]The English system is what morphologists refer to as linear.
[3]The notation of ''*X''* in *meXaXeX* intend to highlight the morphological modification of the root (in this case *''s.r.k.*'') and the role of the template (in lowercase).

Phonology also has an important role regarding the relationship between the words sharing the same root. In Hebrew, most verbs and nouns derived from the same root, share the root's phonemes. Gonnerman et al. (2007) argued that the phonological similarity between words showed a priming effect when the words were semantically related, as occurs in most cases of morphologically-related words in Hebrew. They suggested that morphology is a gradient system that is a by-product of repeated sound and meaning co-occurrence. Hebrew has a unique integration of morphological and semantic information of verbs and nouns derived from the same root (Friedmann et al., 2013). This integration makes Hebrew a useful language tool for exploring the relative strength of morphological knowledge in children with SLI. In linear morphology (e.g. English), the basic pattern of the phonemes does not change, as in *''love'', ''loved'' and ''lovable''*; thus, it is hard to distinguish between phonological and morphological knowledge. However, in nonlinear morphology, the relationship between words requires knowledge beyond the sequence of phonemes. To identify the relationship between ''*mesarek*'' (meaning comb) and ''*mesorak*'' (meaning being combed), or the relationship between ''*mexabes*'' (meaning do the laundry) and ''*kvisa*'' (meaning laundry) one has to use a morphological operation, as the phonemes are not sequential. This entangled characteristic of Hebrew morphology allows exploring the sensitivity of children with SLI to morphological similarities between words and studying how this knowledge contributes to their performance in lexical retrieval tasks. In order to use morphological knowledge, the child must have preserved phonological knowledge, as the morphological similarities are presented in shared roots, which in most cases are shared phonemes. Some children with SLI do not have preserved phonology, as will be discussed in the next section.

Phonological deficits of children with SLI

Children with SLI exhibit phonological difficulties in various tasks (Constable, Stackhouse, & Wells, 1997; Dockrell et al., 2001; Easton, Sheach, & Easton, 1997; McGregor, 1994). In picture naming tasks, although most errors are semantic (e.g. ''*shirt*'' for ''*coat*'') (Dockrell et al., 2001), phonological errors also occur (e.g. ''*toon*'' for ''*moon*''). Whereas the ratio of semantic errors is similar in TD and SLI groups, the ratio of phonological errors is higher in children with SLI compared to TD (Dockrell et al., 2001; Faust et al., 1997). This effect is so robust that it serves as an important clinical marker for SLI. Support for phonological deficit also comes from better performance on naming tasks when phonological cues are provided (McGregor, 1994). It is thus suggested that the phonological and morphological components are separate. Phonological impairment in children with SLI is also represented by low scores on non-word repetition (Dockrell & Messer, 2007, among others). This task requires phonological knowledge without semantic support, thus supporting the phonological deficit and its isolation.

Theories have assumed different relationships between the semantic and phonological components of the lexical retrieval process. Levelt, Roelofs, and Meyer (1999) and German and Newman (2004) argue for a serial relationship between these two components, whereas Dell, Burger, and Svec (2002) argue for an interactive relationship. Recent studies showed that children with SLI can be impaired in either or both components (Bragard & Schelstraete, 2007). The current study is not designed to distinguish between the models, but rather to explore the unique effect of the morphological component, of which phonology is a part, in the process of lexical retrieval among children with SLI.

Morpho-phonological deficits of children with SLI

In typical language development, morphological knowledge facilitates words comprehension and production (Ravid et al., 2003). Based on the assumption that word retrieval includes a

morphological component (Friedmann et al., 2013; Levelt et al., 1999) and morphologically-related words share semantic and phonological information (Gonnerman et al., 2007), children's performance can be facilitated by morphology cues[4]. Ravid et al. (2003) tested the ability of school-age, Hebrew-speaking children with SLI, to derive novel nouns from novel verbs. Their findings showed no difference between the SLI and age-matched control groups in comprehension tasks. However, in production tasks the SLI group performed significantly lower than the age-matched and language-matched control groups. In the same study, in an adjective derivation task, the SLI group performed lower than the control groups in comprehension and production tasks. These results agree with previous studies that presented morphological deficits of children with SLI (Leonard, 1998). Contrary to these results, when children with WFDs are tested on inflectional tasks of regular past tense, which represent linear morphology, their performance is not different than that of the control group (Murphy, Dockrell, Messer, & Farr, 2008). Thus, the question of whether morphological knowledge facilitates word retrieval of children with SLI is still open and seems to depend on the morphology of the language.

The current study

The current study aimed to compare the lexical retrieval ability of children with SLI and children with typical language development. Lexical retrieval ability was tested in a sentence completion task under two conditions: semantic relationships between verbs and target nouns (e.g. ''to bake'' and ''an oven''), and morphological relations between verbs and target nouns (e.g. *''mekadrer''* – *''kadur''*, ''dribble'' – ''ball'' *(shared root: k.d.r.*). The morphological cuing is inherent in Hebrew, allowing examination of this unique aspect of the language and its influence on lexical retrieval of children with SLI (see also examples ''a'' and ''b'' in the Method section below). Comparing these two conditions allowed us to explore semantic and morphological cuing during the lexical retrieval process, as it can be seen in Table 1. As verbs that relate to nouns morphologically allow both semantic and morphological cuing, we predicted that if children with SLI use morphological knowledge, they would perform better on the morphological condition than on the semantic condition.

Method

Participants

SLI group

The participants in the SLI group were 15 Hebrew-speaking children (11 boys, 4 girls) from middle-to-high socioeconomic status (SES) ages 8:6 to 14:4 years (mean = 10:8, SD = 1:10). They were recruited from a clinic in Israel and parental permission was obtained for study participation. All were diagnosed prior to the study by Speech and Language Pathologists.

Table 1. Comparison of morphological and semantic conditions.

Item	Semantic relations	Morphological relations	Prediction
''Ani ofe be'' ''tanur'' I bake in – an oven	+	–	<
Ani mekadrer''kadur'' I dribble – a ball	+	+	>

[4]The facilitating role of morphology is relatively strong for Semitic languages (i.e. Hebrew) (Ravid & Malenky, 2001).

The assessment included the standardized Ma'ase test (Rom & Morag, 1999) and non-standardized tests used in clinics. They met the exclusion criteria for SLI (Leonard, 1998): no hearing impairment and no recent episodes of otitis media; no abnormalities of oral structure or problems in oral function; no evidence of obvious neurological impairment or impaired neurological development; no symptoms of impaired reciprocal social interaction or restriction of activities that are typical of autism or PDD. All 15 participants scored within the norm (range 85–120) on the Wechsler Intelligence Scale for Children (WISC-R95, Hebrew adaptation, Cahan, 1998). In addition to exclusion criteria, a naming test was used as inclusion criteria for WFDs. This subject selection procedure was used to identify children with SLI and WFDs (Dockrell et al., 2001; Novogrodsky, 2015). Each participant showed WFDs based on performance in the Shemesh Naming Test (Biran & Friedmann, 2005), which includes 100 colored pictures of objects. The performance of each participant was compared to average score of 60 TD children, ages 9–12 years and was at least 1 SD below this average. The participants attended regular classes in regular schools and participated in an individual intervention program with a Speech and Language Pathologist, weekly.

Control group

The control group included 35 typically-developing, Hebrew-speaking children from middle-high SES, recruited from two schools in Israel. Parental permission was obtained for study participation.

The *Chronological Age-Matched group (CA)* included 20 children (12 boys, 8 girls) ages 9–10:3 years (mean 9:9, SD = 0:4). These children were fourth graders matched in age to the younger children in the SLI group, aiming to present the performance of TD children on the task.

The *Language Age-Matched (LA)* group included 15 children (10 boys, 5 girls) ages 4-4:7 years (mean 4:5, SD = 2 months). This group was matched to the SLI children based on their performance on the Shemesh Naming Test (Biran & Friedmann, 2005). The average performance of the children in the LA group was 80%, which is not significantly different from the 75% performance of the SLI group (Mann–Whitney test: $z = 1.29$, $p = 0.19$), suggesting that the two groups matched on their lexical retrieval performance. Thus, no significant difference was expected in any naming task of a different set of words (as was the case in the current study task).

All the children were born in Israel and Hebrew was their primary language. In the SLI group, six children were bilingual (L2 English for 5 children, L2 Russian for one child), and in the control group four children were bilingual (L2 English for 3 children, L2 Russian for one child). The bilingual children were all simultaneous and were exposed to Hebrew for 6 years or more. They all studied in Hebrew speaking schools starting from preschool, and Hebrew was their dominant language.

Materials

The naming of 55 different nouns was tested in the sentence completion task under two conditions. In the semantic cue condition, 28 sentences included verbs which semantically constrained the complement noun (see example a). In the morphological cue condition, 27 sentences included verbs that constrained the complement noun both semantically and morphologically, i.e. the verb and the noun shared the same root (see example b).

(a) *Semantic cuing: ''Ani gozer be . . .''-''mispara'im'' (verb's root: g.z.r., noun's root: s.p.r).* ''I cut with . . .'' – ''scissors''.
(b) *Morphological cuing ''Ani tsone'ax be . . .'' – ''mitsnax'' (shared root: ts.n.x.).* ''I parachute with . . .'' – ''a parachute''.

The sentence completion task was developed in two stages. First, an earlier version of the task was administered to 96 Hebrew-speaking adults. Only nouns with performance higher than 89% were selected. Therefore, each sentence was restricted to one target noun, rather than multiple responses. Additionally, word frequency was estimated using a Hebrew corpus encompassing 12,242,587 written words (Linzen, 2009). No significant frequency effect was found for the target nouns in the semantic condition compared to the target nouns in the morphological condition (t (53) = 1.77, p = 0.09). This result suggests that if a difference is found between the two conditions, it cannot be explained by frequency effects (Vitevitch & Sommers, 2003 for TD children and German, 1982; German & Newman, 2004 for children with SLI).

Procedure and error analysis

Each participant was tested in a quiet room. No time limit was imposed and no response-contingent feedback was given by the examiner. The sentences in the sentence completion task were randomly ordered. The responses of all participants were transcribed. All correct responses were counted and calculated as percentage of correct scores on both tasks. Errors were classified as morphological (1), semantic (2), descriptions (3), phonological (4), hesitations (5), meta-linguistic phrases (6) or other (7). In the analysis of error types, all responses for each target noun were analysed. For example, for the target word ''*sabon*'' (soap), one of the participants responded sequentially: *"shampoo*" – a semantic error (2), *"masben"* - a morphological error (1), and ''*I use it in the bath*'' – a description (3). Few errors were categorized by more than one error type. In these cases, we counted the error twice, for example the response ''*igulim''* (circles) for the target word ''*agilim*'' (earrings) was counted as one semantic error and one phonological error. Errors were calculated as total error types out of the total errors. The scoring was done by the two authors, reliability exceeded 95%, and the few disagreements were resolved by consensus.

(1) Morphological errors: A correct root of a morpho-phonologically-restricting verb was mapped onto an incorrect template, resulting in a non-word (e.g.: ''*mashrek''* = a non-word for ''*mashrokit''* = whistle) or a real, but incorrect word (e.g.: ''*mashkof''* = doorpost for ''*mishkefet''* = binocular). The root of a verb that is related to the target noun only semantically was mapped onto a noun template, resulting in a non-word (e.g.: the root ''*x.v.sh''* from the verb ''*xavash''* = wear a hat, mapped onto an instrumental template ''maXXeXa'' resulted with a non-word: ''*maxvesha''* for ''*kova''* = a hat).
(2) Semantic errors: Substitution of the target word with another word from the same category (e.g. ''shoelace'' for ''zipper''; ''nail'' for ''screwdriver'').
(3) Descriptions: a description of the target word (e.g. ''the hat of a pot'' for ''pot lid'').
(4) Phonological errors: a word including at least half of the target word's phonemes (e.g.: ''rashreshan'' = a non-word, for ''raashan'' = a drill; *''af''* = a nose, for *''kaf''* = a spoon); Reliable searching, production of consonants included in the target word (e.g.: *''ze . . . ze . . .*'' for *''zra'im*'' = seeds); Unreliable searching: production of consonants not included in the target word (e.g.: *''mach . . .*'' for *''tanur*'' = an oven). In this example none of the produced consonants (*m, ch)* are included in the target word *''tanur*''.
(5) Hesitations: more than 5 seconds of hesitations including speech sounds (e.g.: ''um, um . . . .'').
(6) Meta-linguistic phrases such as ''I don't know'' or ''I don't remember''.
(7) Other errors: Gestures (e.g. a gesture of a tie); naming in another language (e.g. ''*tapor*'' in Russian for ''ax''); visual errors (e.g. ''a surface'' for ''an oven''); negation (e.g. ''it's not a trumpet'' for a ''shofar''- [''ram's horn'']); association (e.g. ''an orange'' for a juice-extractor).

Statistical analysis

As we could not assume that the SLI group data were normally distributed, conservative nonparametric tests were used. For planned orthogonal comparisons, we used Dunn's procedure, which is a nonparametric procedure equivalent to ANOVA. In this procedure, the level of significance is divided by the number of comparisons performed (Kirk, 2009, p. 497). For each Dunn's procedure, p was divided by the number of comparisons as described in the Results section. For comparisons between groups, we used the Mann–Whitney Test and for comparisons within groups, we used the Wilcoxon Test.

Results

Correct performance

Group differences

As can be seen in Table 2, the CA group performed at ceiling in the sentence completion task, whereas the SLI and the LA groups performed poorer. To examine whether the three groups differed in their performance in the two conditions, we used Dunn's procedure (Kirk, 2009). Three comparisons were performed. Thus, for a significant difference of $p \leq 0.05$, p was expected to be $\leq 0.05/3 = p \leq 0.017$ (Dunn's procedure, Kirk, 2009, p. 497). The CA group performed significantly better than the SLI ($z = 4.95$, $p < 0.0001$) and the LA group ($z = 4.98$, $p < 0.0001$), with no significant difference in performance between the LA group and the SLI group ($z = 0.04$, $p = 0.97$). The LA group was matched to the SLI group in the Shemesh naming task (as described in Method section). Thus, the no difference between the two groups was not surprising as it was expected that the groups would show similar performances on any set of words.

Effects of two verb conditions

To explore the effect of the two verb conditions, the semantic and morphological conditions for the SLI and the LA groups were compared. The effect was not explored in the CA group because of their high ceiling performance on the two conditions and because there was a significant difference between their overall performance and the performance of the other two groups (see Table 2 and Statistical Results above). The comparison between the SLI group and LA group is shown in Table 3. In both conditions, no significant difference was found between the groups. In addition, no significant difference was found between the semantic versus morphological conditions in the SLI group ($z = 0.1$, $p = 0.92$), and in the LA group ($z = 0.75$, $p = 0.45$). Thus, contrary to our prediction no facilitation effect was found in the morphological condition and superficially, both groups performed similarly. Summarizing the correct performance results, the SLI group performed significantly worse than the CA group in the two conditions, yet similarly to the LA group.

Table 2. Sentence completion task results of each group, mean percentage correct (SD).

Group	*n*	Sentence completion % (SD)
Chronological age (CA)	20	94 (5)
SLI	15	64 (11)
Language age (LA)	15	63 (10)

Table 3. Results of the semantic and morphological conditions (mean percentage correct of each condition).

Condition	SLI % (SD)	Language-age (LA) % (SD)	Mann–Whitney
Semantic cue	65 (9)	65 (8)	$z = 0.22$, $p = 0.83$
Morphological cue	64 (15)	63 (15)	$z = 0.46$, $p = 0.65$

Error analysis

The number of trials in which the children erred was equal across the SLI and LA groups as shown in similar low performance on the task of the two groups (Tables 2 and 3). However, the number of words produced in effort to retrieve these target words was larger in the SLI group compared to the LA group. The children in the SLI group showed more word searching for each target word, they did not succeed to retrieve. For example, one child completed the sentence ''I cover the pot with __'' (a pot lid) with a meta-linguistic phrase ''How do you call it? I forgot the name'' continuing with a description: ''The hat of the pot''. Another child completed the sentence ''I knead the __'' (dough) with two semantic errors: ''a Hallah-bread'', ''a bun''. In the SLI group, the total produced words was 345 (M = 23, SD = 6.46) and in the LA group only 257 words (M = 17, SD = 5.04). Searching for the target word in the SLI group included significantly more words per target word (t (28) = 2.77, $p < 0.01$).

The first comparison was of morphological errors between the two conditions. In the semantic condition, the verb and the target word did not share the same root. Thus, it was not expected to result in morphological errors (e.g.: *''gozer''* (cut), *verb root: g.z.r.,* and *''mispara'im''* (scissors), *noun root: s.p.r.*). However, in the morphological condition, the verb and the target word shared the same root (example b) and it was expected to result in more morphological errors, as evidence of the relationship between the verb and the target noun and of children's awareness of this morphological relationship. The SLI group produced a total of 66 morphological errors (17% of the total errors). Of these errors, 68% were in the morphological condition, significantly more than the errors in the semantic condition ($z = 2.57$, $p < 0.01$) (Figure 1). In contrast, the LA group had a total of 38 morphological errors (15% of the total errors), with no significant difference between the two verb conditions ($z = 0.89$, $p = 0.37$) (Figure 1). The children with SLI had more morphological errors on nouns preceded by morphologically related verbs than on nouns that were not. This pattern of morphological errors across the target types was not observed in the LA group.

The second comparison explored error types of the two groups across the two conditions. As can be seen in Table 4, the children with SLI had significantly more phonological errors and more

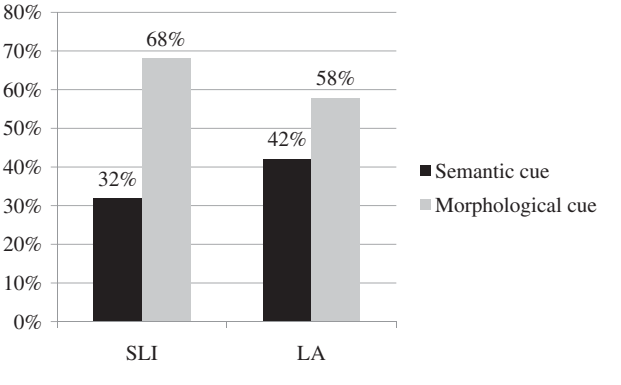

Figure 1. Rate of morphological errors in the sentence completion task.

Table 4. Ratio of error types (%) of the SLI and LA groups across the conditions.

Type of responses	SLI	Language age (LA)	Mann–Whitney
Morphological error	17	15	$z = 0.23$, $p = 0.81$
Semantic error	28	22	$z = 0.95$, $p = 0.34$
Descriptions	3	1	$z = 0.87$, $p = 0.38$
Phonological error	9	2	$z = 2.47$, $p = 0.01$
Hesitation	24	6	$z = 2.76$, $p < 0.01$
Meta-linguistic phrases	13	35	$z = 2.78$, $p < 0.01$
Other errors	6	19	$z = 3.11$, $p < 0.01$

hesitations, while the LA group showed significantly more meta-linguistic phrases and other errors (e.g. gestures and visual errors).

Summarizing the error analysis, the results show a different pattern of errors for the two groups. In addition, whereas the SLI group presented more morphological errors in the morphological condition than in the semantic condition, the LA group did not show a significant difference between these two conditions.

Discussion

The current study showed that school-aged children with SLI performed significantly lower on a sentence completion task compared to CA control group and similarly to younger TD children (the LA control). In addition, the performance of the groups on the semantic and morphological conditions was equal. The difference between the SLI and the LA control is concealed in the comparison of correct performance and is revealed only in the pattern of errors.

Poor performance of the SLI group

The current study showed that children with SLI perform significantly poorer than CA matched controls in sentence completion tasks with semantic and with morphological cueing. These results agree with previous findings (Best, 2005; Constable et al., 1997; Dockrell et al., 2001; Dockrell et al., 1998; Faust et al., 1997; Friedmann & Novogrodsky, 2011; German & Simon, 1991; McGregor, 1994; McGregor & Appel, 2002, among others), suggesting that WFD is a characteristic of SLI and manifests itself in various tasks, such as picture naming, sentence completion and story-telling. The current results show quantitatively that children with SLI have impaired performance compared to TD children of the same age, but similar to that of younger children. This result by itself suggests delayed lexical retrieval abilities of children with SLI. However, as discussed below, the SLI morphological error patterns support more developed morphological knowledge compared with younger TD children and the other error patterns suggest a distinct deficit in their lexical retrieval process.

Incomplete morphological knowledge of the SLI group

The current study compared semantic and morphological cues in a sentence completion task. The former was intended to facilitate retrieval of the target nouns semantically, and the latter was aimed at facilitating the target nouns semantically and morphologically. Although the SLI group performed similarly to the LA group in each of the two conditions, when comparing the error patterns of the two groups, it appeared that the children with SLI performed qualitatively different than the children in the LA group.

Contrary to our prediction, no facilitation naming effect was shown in the morphological condition. The performance of the SLI group in both conditions was similar. Studies that showed semantic priming effect in children with SLI suggested that semantic cues facilitate the selection threshold of the target words (Bragard, et al., 2012; Wright, Gorrie, Haynes, & Shipman, 1993). The current results show that verbs relating to the target noun only semantically, did not facilitate lexical retrieval. For example, the verb ''bake'' did not facilitate ''oven'', suggesting that the children with SLI did not have the lexical association built up in their years of language use. One explanation could be that the semantic relationship between words, specifically between verbs and nouns (as shown in the current results) is impaired for children with SLI (Bragard & Schelstraete, 2007). Future research is needed to further understand what types of semantic relations are needed for a semantic cue to facilitate word retrieval in children with SLI.

Due to the morphological relationship between the verbs and related nouns in the morphological condition (*''Ani mexalel be . . .''* – *''xalil'', shared root: x.l.l.* – ''I play the''. . . – ''flute''), there is more room for partial knowledge. Thus, the children with SLI could potentially use their knowledge about the relation between verbs and nouns to prompt their performance in the morphological condition, better than in the semantic condition. However, their performance was not better than on semantic condition, due to their lexical retrieval deficit. The partial morphological knowledge is shown in the type of errors produced: more morphological errors in the morphological condition compared with morphological errors in the semantic condition. This suggests that the children with SLI were aware (probably implicitly) of the verbs that were morphologically related to the target nouns, and in many cases retrieved a word morphologically related to the target word; however, not the correct one (example (1)). The results agree with Ravid et al. (2003), who tested Hebrew speaking children with SLI taking into account the mismatch between good comprehension and poor production of the children with SLI. In both Ravid et al. (2003) and the current study, children with SLI performed significantly poorer than TD age-matched controls on production tasks that represented morphological knowledge.

The children with SLI presented incomplete morphological knowledge. In Ravid et al. (2003) study, this partial knowledge is shown in the gap between good comprehensions versus poor production. In the current study, this is shown in large number of morphological errors, demonstrating incomplete knowledge of the relationship between verbs and nouns in the morphological condition. In contrast to the SLI group, LA group did not distinguish between the two types of verbs, those related only semantically to the nouns and those related both semantically and morphologically to the nouns. Thus, they produced similar numbers of errors in both semantic and morphological conditions.

Morphological knowledge of the LA group

The LA group showed similar numbers of morphological errors across the two verb conditions. We suggest that they were too young to use morphological knowledge of verb-noun relations. They produced half the number of morphological errors compared with the SLI group. In addition, they had similar rates of morphological errors in the morphological and semantic conditions. This result agrees with studies that found a dramatic development of morphological knowledge, specifically the derivational ability that is relevant for the current discussion, in TD Hebrew speaking children during kindergarten and primary school (Avivi-Ben Zvi, 2011; Ravid et al., 2003). While listening to the verbs in the prompting sentences, the LA group could not figure out which verbs were root-related to the target noun and which were semantically related. For example, the verb ''*mexalel*'' (play the flute) and the noun ''*xalil*'' (flute) are related semantically and morphologically (sharing the same root), while the verb ''*lash*'' (knead) and the noun *''batsek''* (dough) are only semantically related. The children's undeveloped morphological knowledge caused some of them to produce

non-words like ''*lashlashot''* (a non-word related morphologically to the verb, compare the three similar phonemes, ''*l-a-sh'',* across the verb *''lash''* and the noun ''*lashlashot''*) rather than the correct target word ''*batsek''* (dough). The children in the LA group, all four years old, derived nouns from verbs in the two conditions similarly, showing productive derivational knowledge which, in some cases, interrupted them from getting to the correct target word, due to undeveloped knowledge about the relationship between the verb and the noun.

Difference in error patterns between the SLI and LA groups

The analysis of errors revealed that both SLI and LA groups had similar average percentage of morphological semantic and description errors. The morphological errors suggest that the sentence completion task prompted this type of error and affected both groups similarly. The similarity in average percentage of the semantic errors agrees with previous studies (Dockrell et al., 2001; German, 1982; Nettelbladt & Hansson, 1999). One has to recall that the children in the LA group were younger than those in the SLI group by at least four years. Semantic errors are apparent in young TD children. For example, Dapretto and Bjork (2000) showed that toddlers aged 14–24 months produced more semantic errors (75%) than phonological errors (9%) in a retrieval task of familiar objects that were part of their productive vocabulary. The current findings suggest that semantic errors are frequent for TD and SLI children and cannot qualitatively differentiate between typical and atypical retrieval.

The children in the LA group had more metalinguistic phrases such as ''I don't know'' and ''I don't remember'' responses than the SLI group. In contrast, the children with SLI had more phonological errors and hesitations. These two types of errors represent distinctive differences between the SLI and the LA group.

Phonological errors

The SLI group produced more phonological errors than the LA group, in agreement with previous studies that examined children with WFDs and children with SLI (Constable et al., 1997; Dockrell et al., 2001; German, 2002; German & Newman, 2004; Faust et al., 1997). The results suggest that during word finding, the phonological component of children with SLI is impaired and does not always allow them to retrieve the target word, even when they have partial phonological knowledge of it, as demonstrated by their phonological errors. In addition, the results support the idea that phonological errors can serve as a clinical marker for children with WFDs (Dockrell & Messer, 2007) and children with SLI (Kraizer & Novogrodsky, 2012; Novogrodsky, 2015). Further research is needed to determine whether all children with SLI and WFDs have a phonological deficit. We assume that some have phonological deficits, whereas others have deficits in the semantic component (Bragard & Schelstraete, 2007; Friedmann et al., 2013; German, 2002; Messer & Dockrell, 2006; Novogrodsky, 2015).

Hesitations

Hesitations were rare in the LA group, but were a prominent phenomenon in the SLI group. This result agrees with findings showing that hesitations were more frequent in a group of pre-school children with SLI than in an MLU control group (Nettelbladt & Hansson 1999). This can be explained by an ineffective retrieval process. According to Dockrell and Messer (2007), the latency measure reflects a processing deficit that is unrelated to naming accuracy, but rather represents a slower processing system of children with SLI. The current results support this assumption, as most of the hesitations[5] in the SLI group (84% of 70 hesitations) were followed by

[5]The hesitations were counted as hesitation errors when the target word was produced. When an additional error was produced, it counted separately. See an example in the procedure and error analysis section.

correct responses. The other 16% of hesitations were usually followed by a semantic or phonological error. Similar to the phonological errors, the hesitations are a unique response of the SLI group and can serve as a clinical marker (Nettelbladt & Hansson, 1999).

Clinical implications

The last point to be addressed regarding the current study is the clinical implications of the results. Morphological knowledge is an important component during the process of lexical retrieval. It contains both meaning and phoneme information of the target word. The current results show incomplete morphological knowledge in the SLI group. If this knowledge was more accessible and accurate, it might have facilitated the lexical retrieval of the children with SLI. In all languages, children with SLI present difficulties with verbs. The poor performance on both semantic and morphological conditions highlights this general observation. The specific characteristics of morphological errors, presented in this study, address language specific features. It is essential for clinicians to recognise these general deficits, as well as the specific characteristics of each language, in order to develop efficient intervention strategies for children with SLI. It is thus suggested that any intervention program for children with SLI and WFDs should include explicit strategies concerning meta-morphological knowledge, especially in Semitic languages, where the knowledge of roots and word patterns is crucial. Explicit strategies might help these children use morphological knowledge more productively and efficiently during their attempts to retrieve words from the lexicon. Semantic knowledge is also essential for the lexical retrieval process. If a child with SLI makes semantic substitutions, the clinician may help him develop a strategy of descriptions in order to retrieve more semantic knowledge. If the child already produces descriptions, the clinician can elaborate them by a strategy of definitions, which includes essential specific semantic information such as category and function. Both descriptions and definitions include the verb that relate to the target word, which can facilitate the retrieval of this noun. The poor performance in semantic cuing emphasized the lack of semantic relationship knowledge between verbs and nouns in the SLI group. It is suggested that any intervention program should include explicit strategies concerning semantic and meta-semantic knowledge of verbs and nouns (Radford, 2009) in order to improve lexical retrieval and to allow precise descriptive strategies when the child cannot retrieve the target word.

To conclude, the current study revealed that morphological knowledge is likely not the core deficit in WFD of children with SLI. While evidence of morphological knowledge was revealed in children with SLI, it was not sufficient for a successful lexical retrieval process. The significant difference in error patterns between the children with SLI and the TD younger children, suggests that word finding in children with SLI is not simply delayed. Rather, these error patterns suggest that this population takes a different route in the development of its lexical retrieval abilities.

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Declaration of interest

The authors report no conflicts of interest.

References

Avivi-Ben Zvi, G. (2011). Later morpho-lexical development in Hebrew. *The Israeli Journal of Language, Speech & Hearing Disorders*, *30*, 25–46. (In Hebrew).

Berman, R. A. (2000). Children's innovative verbs vs. nouns: Structured elicitations and spontaneous coinages. In L. Menn & N. Bernstein-Ratner, (Eds.), *Methods for studying language production* (pp. 69–93). Mahwah, NJ: Erlbaum.

Best, W. (2005). Investigation of a new intervention for children with word finding problems. *International Journal of Language & Communication Disorders*, *40*, 279–318.

Biran, M., & Friedmann, N. (2005). From phonological paraphasias to the structure of the phonological output lexicon. *Language and Cognitive Processes*, *20*, 589–616.

Bragard, A., & Schelstraete, M. A. (2007). Word-finding difficulties in French-speaking children with SLI: A case STUDY. *Clinical Linguistics & Phonetics*, *21*, 927–934.

Bragard, A, Pillon, A., & Schelstraete, M. A. (2012). The source of word-finding difficulties in SLI children. A poster presented at the 33st annual Symposium on Research in Child Language Disorders (SRCLD), June 2012, Madison, Wisconsin.

Cahan, S. (1998). Manual for WISC-R 95. Jerusalem: The Israeli Ministry of education-The psychological and Counseling Service and the Henrietta Szold Institute for Research in Behavioural Sciences. (In Hebrew).

Choueka, Y. (1996). *Rav milim: A dictionary of contemporary Hebrew.* Tel Aviv: Center for Educational Technology. (In Hebrew).

Clark, E. V., & Berman, R. (1984). Structure and use in the acquisition of word formation. *Language*, *60*, 542–590.

Constable, A., Stackhouse, J., & Wells, B. (1997). Developmental word-finding difficulties and phonological processing: The case of the missing handcuffs. *Applied Psycholinguistics*, *18*, 507–536.

Conti-Ramsden, G., Crutchley, A., & Botting, N. (1997). The extent to which psychometric tests differentiate subgroups of children with SLI. *Journal of Speech, Language, and Hearing Research*, *40*, 765–777.

Dapretto, M., & Bjork, E. L. (2000). The development of word retrieval abilities in the second year and its relation to early vocabulary growth. *Child Development*, *71*, 543–821.

Dell, G., Burger, L., & Svec, W. R. (2002). Language production and serial order: A functional analysis and a model. In T. A. Polk (Ed.), *Cognitive modalities* (pp. 749–794). Cambridge, MA: MIT Press.

Dockrell, J. E., & Messer, D. (2007). Language profiles and naming in children with word finding difficulties. *Folia Phoniatrica et Logopaedica*, *59*, 318–323.

Dockrell, J. E., Messer, D., George, R., & Wilson G. (1998). Children with word-finding difficulties-prevalence, presentation and naming problems. *International Journal of Language and Communication Disorders*, *33*, 445–454.

Dockrell, J. E., Messer, D., & George, R. (2001). Patterns of naming objects and actions in children with word finding difficulties. *Language and Cognitive Process*, *16*, 261–286.

Easton, C., Sheach, S., & Easton, S. (1997). Teaching vocabulary to children with word-finding difficulties using a combined semantic and phonological approach: An efficacy study. *Child Language Teaching and Therapy*, *13*, 33–50.

Faust, M., Dimitrovsky, L., & Davidi, S. (1997). Naming difficulties in language disabled children: Preliminary findings with the application of the Tip-of-the-Tongue paradigm. *Journal of Speech, Language and Hearing Research*, *40*, 1026–1036.

Friedmann, N., & Novogrodsky, R. (2011). Which questions are most difficult to understand? The comprehension of Wh questions in three subtypes of SLI. *Lingua*, *121*, 367–382.

Friedmann, N., Biran, M., & Dotan, D. (2013). Lexical retrieval and breakdown in aphasia and developmental language impairment. In C. Boeckx & K. K. Grohmann (Eds.), *The Cambridge handbook of biolinguistics* (pp. 350–374). Cambridge, UK: Cambridge University Press.

German, D. J., & Newman, R. S. (2004). The impact of lexical factors on children's word-finding errors. *Journal of Speech Language and Hearing Research*, *47*, 624–636.

German, D. J., & Simon, E. (1991). Analysis of children's word-finding skills in discourse. *Journal of Speech and Hearing Research*, *34*, 309–316.

German, D. J. (1982). Word-finding substitutions in children with learning disabilities. *Language, Speech and Hearing Services in Schools*, *13*, 223–230.

German, D. J. (2002). A phonologically based strategy to improve word-finding abilities in children. *Communication Disorders Quarterly*, *23*, 179–192.

Gonnerman, L. M., Seidenberg, S. S., & Andersen, E. A. (2007). Graded semantic and phonological similarity effect in priming: Evidence for a distributed connectionist approach to morphology. *Journal of Experimental Psychology*, *136*, 323–345.

Kirk, R. E. (2009). Nonparametric analysis of multigroup experiments. In R. E. Kirk (Ed.)., *Experimental design* (4th Ed.) (pp. 497–498), Belmont, CA: Wadsworth.

Kraizer, V., & Novogrodsky, R. (2012). The effect of morpho-phonological cues on words retrieval of children with lexical-SLI. *DASH: The Israeli Journal of Language, Speech and Hearing Disorders*, *31*, 21–36. (In Hebrew).

Lahey, M., & Edwards, J. (1999). Naming errors of children with specific language impairment. *Journal of Speech, Language and Hearing Research*, *42*, 195.

Leonard, L. B. (1998). *Children with SLI*. Cambridge, MA: The MIT Press.

Levelt, W. J. M., Roelofs, A., & Meyer, A. S. (1999). A theory of lexical access in speech production. *Behavioral and Brain Sciences*, *22*, 1–38.

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

Linzen, T. (2009). Corpus of blog postings collected from the Israblog website. Tel Aviv University. Retrieved from http://tallinzen.net/frequency/.

McGregor, K. K., & Appel, A. (2002). On the relation between mental representations and naming in a child with specific language impairment. *Clinical Linguistics and Phonetics*, *16*, 1–20.

McGregor, K. (1994). Use of phonological information in a word-finding treatment for children. *Journal of Speech Language and Hearing Research*, *37*, 1381–1393.

Messer, D., & Dockrell, J. E. (2006). Children's naming and word-finding difficulties: Descriptions and explanations. *Journal of Speech Language and Hearing Research*, *49*, 309–324.

Murphy, V., Dockrell, J., Messer, D., & Farr, H. (2008). Morphosyntax in children with word finding difficulties. *Journal of Child Language*, *35*, 703–720.

Nettelbladt, U., & Hansson, K. (1999). Mazes in Swedish pre-school children with specific language impairment. *Clinical Linguistics & Phonetics*, *13*, 483–497.

Nir, R. (1993). *Lexical devices in modern Hebrew* (pp. 113–124). Tel Aviv: The Open University of Israel. (In Hebrew).

Novogrodsky, R. (2015). Specific language impairment (SLI) is not specific enough: Sub-types of SLI and their implications for the theory of the disorder. In Stavrakaki, S. (Ed.), *Language acquisition and language disorders*. John Benjamins.

Radford, J. (2009). Word searches: On the use of verbal and non-verbal resources during classroom talk. *Clinical Linguistics & Phonetics*, *23*, 598–610.

Ravid, D., & Malenky, D. (2001). Awareness of linear and nonlinear morphology in Hebrew: A developmental study. *First Language*, *21*, 25–56.

Ravid, D., Levie, R., & Avivi-Ben Zvi, G. (2003). Morphological disorders. In L. Verhoeven & H. van Balkom (Eds.), *Classification of developmental language disorders: Theoretical issues and clinical implications* (pp. 235–260), Mahwah, NJ: Erlbaum.

Rom, A., Morag, L. (1999). Maase – A test for spoken language processing. Israel: Michlalon. (In Hebrew).

van Daal, J., Verhoeven, L., & van Balkom, H. (2004). Subtypes of severe speech and language impairments: Psychometric evidence from 4-year-old children in the Netherlands. *Journal of Speech Language and Hearing Research*, *47*, 1411–1423.

Vitevitch, M. S., & Sommers, M. S. (2003). The facilitative influence of phonological similarity and neighborhood frequency in speech production. *Memory & Cognition*, *31*, 491–504.

Wright, S. H., Gorrie, B., Haynes, C., & Shipman, A. (1993). What's in a name? Comparative therapy for word-finding difficulties using semantic and phonological approaches. *Child Language Teaching and Therapy*, *9*, 214–229.