

# Morphophonological salience as a compensatory means for deficits in the acquisition of past tense in SLI

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## Abstract

The aim of this study is threefold: *Firstly*, to describe the acquisition patterns of Greek past tense by children with specific language impairment (SLI); *secondly*, to investigate the relationship between the phonological salience of past tense in Greek and its acquisition by children of typical and atypical language development; *thirdly*, to establish an account on the nature of specific language impairment by comparing the acquisition patterns exhibited by children with SLI to those presented by typically developing children.

The performance of 10 children with SLI in elicited past tense production is compared to that of chronological age matched (CA) and language matched (LM) controls. Based on the claim that morphophonological salience aids acquisition (or learning), it is predicted that children with SLI will perform better in the production of past forms of higher salience than less salient forms. The results confirm this prediction, providing support for the claim that salience differences do account for better performances in tense marking in Greek SLI.

**Learning outcomes:** By reading this article, the reader will be able to: (1) describe the problems children with SLI face in Greek tense marking, (2) explain the reasons why SLI performances differ from one language to the next based on the Interpretability Hypothesis, (3) discuss whether children with SLI differ qualitatively from TD controls in past tense marking and explain how.

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## 1. Introduction

The general purpose of this paper is to investigate the status of past tense in the typical acquisition of Modern Greek and determine the extent to which its acquisition is impeded by specific language impairment (SLI). Specifically, this study seeks to identify acquisition patterns exhibited by children with SLI, who are considered to face considerable difficulties with elements that lack semantic content under the *Interpretability Hypothesis* (Tsimplici & Stavrakaki, 1999), which is adopted in this study. According to research supporting this framework, Greek children with specific language impairment tend to exhibit problematic or strenuous acquisition of definite articles and 3rd person accusative clitics, while at the same time indefinite articles and genitive (possessive) clitics do not seem to pose any difficulties. This discrepancy has been attributed to the lack of semantic import characterising elements like object clitics and definite articles in Modern Greek, which are claimed to be less accessible (or inaccessible) to children with specific language impairment. In the absence of semantic content, these children seem to employ means accessible to them

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(like phonology) in order to compensate for their inability to analyse purely grammatical input (e.g. Paradis & Gopnik, 1997). In fact, the compensatory role of phonology has been often acknowledged in studies on specific language impairment, either as a means to counterweigh grammatical deficits (e.g. Goad, 1998; Tsimpli & Stavrakaki, 1999), or as a variable determining the acquisition patterns exhibited by SLI children in a given language (as stated in the *Surface Hypothesis* stated in Leonard, Sabbadini, Volterra, & Leonard, 1988 and Leonard, 1989, among others).

Taking these claims into account, it is suggested that SLI children depend on morphophonological cues for the acquisition of semantically deficient elements. On the assumption that crosslinguistic variation in SLI performance is determined to a large extent by the realisation of grammatical features across languages, this paper aims to provide an explanation for the acquisition patterns exhibited by Greek children with SLI and attempts to attribute discrepancies from SLI performance in English to morphophonological variation between the two languages. For that purpose, an insight into the two interface levels postulated by Chomsky's *Minimalist Program* (1995) – namely Phonetic Form or PF and Logical Form or LF – in SLI grammar is the major goal of this study. It is therefore claimed that SLI children face greater difficulties with less semantically relevant grammatical features and are greatly affected by phonological cues, at least compared to typically developing children.

### 1.1. The feature of [ $\pm$ past] in the minimalist framework

According to Chomsky's postulation (1995, 1998), a verb carries a feature of [tense], which is *interpretable*. At the same time, [tense] is an *optional* rather than an *intrinsic* feature, as the [ $\pm$ past] value is not an inherent property of the verb in the sense of being stored in the lexicon. However, [tense] is considered semantically interpretable to the extent that it overlaps with the semantic feature of [time], which is not always the case, though.<sup>1</sup> In fact, according to a number of authors, tense inflection is semantically 'empty' and licensed by agreement (e.g. von Stechow, 2005).

Specifically, it has been suggested that the morphology of tense is dissociated from its semantic counterpart and that the two features are hosted by two different nodes in the syntactic tree (namely the finite verb () and Tns nodes, respectively). In that sense, *morphological tense* is claimed to be uninterpretable and unvalued in the sense that it only obtains a past/non-past value through agreement with the *semantic* (and hence interpretable) *tense* feature (Pesetsky & Torrego, 2004; for similar analyses, see also Adger, 2003; Hawkins & Liszka, 2003; von Stechow, 2005). Furthermore, as Pesetsky and Torrego state, in many languages it is the finite verb that bears the morphology that marks tense distinctions rather than Tns itself, a statement that clearly suggests a distinction between semantic and morphological tense. Adopting this view, we can then assume that tense is semantically interpretable *only* to the extent that it overlaps with the [time] feature, and that morphological tense is, in fact, *uninterpretable*.

### 1.2. Past formation in Greek

Modern Greek (MG) verbal morphology formally distinguishes between *past* and *nonpast* tenses. Although according to Clairis and Babiniotis (2005) the distinction involves three grammatical tenses, *past*, *present* and *future*, the future is admitted to involve an inherent characteristic of modality. The past-nonpast distinction has therefore been more widely accepted as a clear grammatical tense distinction.

MG verbs are inflected to reflect person and number along with tense, but tense (past–nonpast) and aspect (perfective–imperfective) constitute the main morphological distinctions of the MG verb (Holton, Mackridge, & Philippaki-Warburton, 1999; Joseph & Philippaki-Warburton, 1987; Stephany, 1995). Aspect is realised on the verb stem, so that each verb employs two stems, the *perfective* and *imperfective*, expressing aspectual distinction. Tense, on

<sup>1</sup> The distinction between instances of overlap and deviance between the [tense] and [time] features is demonstrated in root and subordinate clauses, respectively. Observe the following examples:

[Helen	<b>said</b>	[she	<b>lived</b>	away from the centre]]
[tense]:	<i>past</i>		<i>past</i>	
[time]:	<i>past</i>		<i>present</i>	

the other hand, is marked through suffixation (*morphologically*) and stress shift (*phonologically*). The patterns of past formation are described below.

### 1.2.1. The morpho-phonological rule of past tense formation in MG

The inflectional system of MG verbs has been a troubling issue for Greek linguists for the past few years, leading to various analyses attempting to explain the morphological processes involved in forming the past. Most descriptions of the past tense formation in Greek have focused on alterations in the stem, related either to the presence of the aspectual marker /s/ (used to distinguish between simple and habitual or progressive past) or to systematic and non-systematic stem allomorphy, descriptions which, however, do not adequately distinguish between tense and aspect. Although this issue is to be discussed in detail in the following section, it should be noted at this point that stem-related changes are not characteristic of tense but rather of aspect. If that is the case, what is it then that distinguishes past from nonpast in Greek?

Apart from morphological variation (i.e. suffixation: nonpast 1st sg: *-o*, past 1st sg: *-a*), the MG past involves a high degree of phonological variation, which has been rather neglected in the recent literature. Most MG verbs form the past by shifting the main stress to the antepenultimate syllable. This rule will be henceforth referred to as the *stress shift rule* and applies to the majority of Greek verbs.

- (1) χ<sup>o</sup>rév-o – χ<sup>o</sup>réps-a (=dance) [rule: stress shift]

Verbs with a monosyllabic stem are forced by the stress shift rule to add a prefixed, syllabic augment, which will carry the stress<sup>2</sup>:

- (2) váf-o – é-vaps-a (=paint) [rule: stress shift +augment]

As it is shown in the above examples, past tense formation involves two versions of this phonological rule in combination with the morphological rule (i.e. suffixation), which are given in (3) below.

- (3) *Past tense formation rule*
- |    |              |                         |  |
|----|--------------|-------------------------|--|
| a. | stress shift | +augment:               | verbs with monosyllabic stems            |
|    |              | –augment:               | verbs with disyllabic/polysyllabic stems |
| b. | suffixation: | –a/–es/–el–amel–atel–an |  |

It is crucial to note that the stress shift rule encodes the past in general, as it applies to both past perfective (simple past) and past imperfective (past progressive or habitual past):

- (4)
- a. χ<sup>o</sup>révo (=dance) – χ<sup>o</sup>réva (=was dancing/used to dance) – χ<sup>o</sup>répsa (=danced)
- b. váfo (=paint) – é-vafa (=was painting/used to paint) – é-vapsa (=painted)

According to Ralli (2005), the stress-shift is a property of the past suffix *-a*, stored along its entry in the lexicon. Therefore, it is plausible to argue that the stress shift – and the addition of the syllabic augment where necessary – is closely related to and actually expresses the *past* as a notion in Modern Greek, and it is this feature that mainly distinguishes the past from the nonpast in MG verbs, along with the past tense suffix *-a*.

### 1.2.2. Verb classification and (ir)regularity of past tense formation

Due to the high variability within Greek verbal paradigms, there is no clear-cut distinction between regular and irregular past tense formation. Most approaches to verbal inflection have focused on the morphological changes that verbs undergo in the formulation of their paradigms, which mainly occur in the verb stem and involve either allomorphic variations of the stem-internal vowel, or the presence or not of the aspectual marker /s/. In this sense, the

<sup>2</sup> The syllabic augment is normally the prefix *é-*, although few verbs employ the suffix *í-*, depending on the initial phoneme of the base form.

existence of an allomorphic variation and the addition of the /s/ in the past have been claimed to determine regularity, so that verbs that involve morphological and phonological alterations in the stem have been characterised as *regular* (5a), as opposed to the absence of the /s/ and stem-vowel variations, which are seen as *irregular* (5b) (Stavrakaki & Clahsen, 2008; Tsapkini, Jarema, & Kehayia, 2002)<sup>3</sup>:

(5)	a.	lín-o	→	élis-a	(=solve-solved)
		γράφ-o	→	έγραψ-a	(=write-wrote)
		τρέχ-o	→	έτρεξ-a	(=run-ran)
	b.	mén-o	→	émín-a	(=stay-stayed)
		δίν-o	→	έδω-s-a	(=give-gave)

It should, however, be noted that the morphological processes described in (5) cannot be regarded as expressing past tense for the following reasons: *first*, they are only active in the past perfective, as no verbs employ these alterations in the past imperfective, and *secondly*, they are also active in the nonpast perfective. This applies even to verbs that do not involve addition of the aspectual marker –s and those that make use of a stem allomorph, as it is shown in (6) below:

(6)	nonpast imperfective:	mén-o	δίν-o
	nonpast perfective:	mín-o	δώ-s-o

This means that no Greek verbs deviate from the rule described in (3) above (see previous section) in forming the imperfective past, which therefore always involves regular formation. However, it is essential that a distinction be made between irregularity of stem formation to express *only* aspectual distinctions and irregularity in forming the past in general. Although these two are closely related, they cannot be claimed to involve the same processes with respect to representation or acquisition.

Taking into consideration the past tense formation rule described in (3), only forms that do not involve application of that rule in the past perfective (i.e. fully irregular stems, suppletives) are considered irregular – not rule-based – under the scope of this paper. It is worth noting that even verbs with stem allomorphy (e.g. **πονάο-πόνεσα** = *ached*) do involve application of the morphophonological rule, namely the stress shift (+/–augment) and the past suffix –a. The same goes for certain verbs that employ non-systematic allomorphy (Ralli, 2005), as the example below indicates:

(7)	mén-o	–	é-mín-a	(=stay – stayed)
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Therefore, these verbs do not actually form an *irregular past*, as all past tense rules are applied. Yet, a number of verbs involve a greater degree of irregularity in forming the (perfective) past tense in the sense that they do not make use of the phonological past tense rule (see (8a) below) or employ a different stem (as in (8b)) rather than a change of the stem-internal vowel or stem-final consonant.

(8)	a.	bén-o	→	bík-a	(=enter-entered)
	b.	lé-o	→	íp-a	(=say-said)

This verb category is distinct in the sense that the (perfective) past tense is not *formed* but rather expressed through a distinct lexical stem and can be characterised as *fully irregular past* or *suppletive*. This claim is based on the fact that the formation of the (perfective) past in these verbs is not predictable based on any rule or morphological process. In that sense, verbs that involve use of the stress shift rule but employ a stem-internal change in the perfective can only be characterised as *partly irregular*, since the formation of the past is predictable to a certain degree based on the

<sup>3</sup> In addition to the accounts on regularity of past formation mentioned above, Ralli (2005) distinguishes four categories of verbs, ranging from no allomorphy to stem substitution.

morphophonological rule of past tense formation. In fact, these verbs involve an *allomorphic* or *irregular stem* in the perfective, but do not involve irregular formation of the past. So, in order to investigate the (perfective) past tense formation in Modern Greek, the following classification is proposed, presented in order by increasing irregularity (or decreasing predictability) of past formation<sup>4,5</sup>:

(9) *Past (perfective) tense formation and irregularity*

**Regular**

a. +stress shift (phonological) e.g. γράφ-*o* → έ-γράφ-*a*  
 +aspectual marker (morphological)  
 +stem allomorphy

b. +stress shift (phonological) e.g. δίν-*o* → έ-δός-*a*  
 +aspectual marker (morphological)  
 +stem allomorphy

c. +stress shift (phonological) e.g. μέν-*o* → έ-μήν-*a*  
 –aspectual marker (morphological)  
 +stem allomorphy

**Irregular**

d. + stress shift (phonological) e.g. τρώ-*o* → έ-φάγ-*a*  
 –aspectual marker (morphological)  
 +stem substitution (suppletion)

e. –stress shift (phonological) e.g. βέν-*o* → βίκ-*a*  
 –aspectual marker (morphological)  
 +stem or suffix allomorphy

Finally, it should be noted that even suppletive verbs undergo the same morphophonological rule (stress shift and/or syllabic augment) in the formation of the past imperfective, so it is only in the formation of the perfective that the effect of regularity can be investigated.

1.3. *Notes on the typical and atypical acquisition of past tense*

The acquisition of past tense morphology has drawn considerable attention in the past two decades. Starting with English, at the first stage of verb use, children tend to use finite and non-finite verbs variably, that is, they seem to use verb inflections for tense (i.e. *-s*, *-ed*) optionally and interchangeably with bare stems. This stage has been described by Wexler (1994) as the *Optional Infinitive* (OI) stage, during which children tend to omit the tense (TNS) and agreement (AGR) features of T, producing uninflected verb forms (Schütze and Wexler, 1996a, 1996b). The *TNS/AGR Omission Model* (ATOM) was based on evidence that involved errors in subject (nominative) case. Initially it was argued that if TNS is omitted, then a default case (accusative in English) is assigned on the subject (the *Tense Deficit* account, Rice & Wexler, 1996b). This suggestion would mean that, since TNS is supposed to be omitted at the OI stage, then mainly non-nominative subjects should appear during that stage. The frequent occurrence, however, of nominative subjects indicated that another case assigning factor was present in the OI stage, namely AGR. Consequently, it was proposed that if TNS or AGR or both are absent, then default (non-nominative) case is assigned (Wexler, 1998; Wexler, Schütze, & Rice, 1998).

<sup>4</sup> Verbs with disyllabic and trisyllabic stems also fall into these categories: e.g. χτενίζ-*o* – χτένις-*a* (=comb-combed), ζωγραφίζ-*o* – ζωγράφις-*a* (=draw-drew), etc.

<sup>5</sup> Verbs with monosyllabic, regular stems that do not employ the stress-shift rule also belong in this category: e.g. θεί-*o* – θεί-*is-a*.

Relevant work on the acquisition of Greek also points towards the existence of an OI stage. However, because Greek is a highly inflectional language and does not allow use of bare infinitives, overgeneralisation of the 3rd singular nonpast perfective form (e.g. *péksi* = play) in nonpast as well in past contexts has been taken as indication of this form functioning as a non-finite, *infinitival* form (Varlokosta, 1995; Varlokosta, Vainikka, & Rohrbacher, 1998). Additionally, the observation that this form was extensively used by the children studied in non-3rd-sg contexts lead the authors to assume that this bare perfective corresponds to the participial form used in participle constructions (e.g. *éxo péksi* = *I have played*), a form that does not inflect for person (e.g. *éxis péksi* = *you have played*). Consequently, the fact that this form was used in contexts where infinitives are used in other languages (e.g. *théli na péksi* = (*he/she*) *wants to play*; *tha péksi* = (*he/she*) *will play*) as well as the children's tendency to overuse it at the age when children from other languages tend to use infinitives led Varlokosta et al. to assume that Greek children also go through an OI stage at that point. However, this account has been challenged by other researchers, who have claimed that instances of inappropriate use of the 3rdsg perfective in child language do not correspond to the participle but rather involve omissions of the modal particles *na* (=to) or *tha* (=will), thus entailing modality, and cannot be considered bare infinitives (Hyams, 2002; Tsimpli, 2005).

Moving to the next reported stage of development, namely the over-regularisation of irregular past forms, the fact that children tend to over-apply regular inflections as well as the fact that regular past formation seems to be acquired earlier than irregular has led researchers to investigate the existence of possible dissociations between the two categories. This issue has caused a great deal of dispute among researchers, who have been producing contrasting evidence or interpreting existing ones accordingly with the purpose of resolving the great *Past Tense Debate*. Two main theoretical trends were formed with respect to the acquisition of regular and irregular past tense, namely the *single-route* and the *dual-route* models.

Advocates of the *single-route* models attain that both regular and irregular past forms are processed – and thereby acquired – in the same way, without necessitating the application – or learning – of explicit morphological rules. Single-route models posit that both rules and lexemes are processed by a single mechanism, while stems and inflected forms are all stored in the lexicon (Bates & Goodman, 1997; Bates & McWhinney, 1989). *Dual-route*<sup>6</sup> models, on the other hand, posit the existence of two distinct mechanisms responsible for the processing and learning of regular and irregular past forms. Specifically, it is proposed that phonological and semantic information of lexical items is stored in an associative memory and processed differently from grammatical rules and principles (Fodor, 1983; Frazier, 1987). Under this account, irregular past forms are stored in the lexicon and retrieved from memory, while regular past forms are composed by applying *-ed* suffixation to the stored verb stem. It is also suggested that the rule applies by default unless an irregular match is retrieved from memory (Pinker & Prince, 1988; Pinker, 1991).

Studies on the acquisition of past tense in other languages report similar patterns to those of English. Specifically, French-speaking children also tend to over-regularise irregular past forms, while the developmental pattern observed in French resembles the U-shaped curve of the English past (Legendre, Hagstrom, Todorova, & Vainikka, 2000). The same pattern has been observed in Spanish; Clahsen, Avelado, and Roca (2002) report children's tendency to overuse regular stems where irregular ones were required and regular suffixes with irregular verbs, while frequency effects were revealed with irregular verbs but not with regulars. These claims were supported by a more recent study, in which *stem* allomorphs of Spanish verbs were claimed to be lexically represented, contrary to regularly inflected stems, which did not (Linares, Rodriguez-Fornells, & Clahsen, 2006). These findings were taken to support the dual-mechanism account on acquisition of regular and irregular past.

Turning to children with SLI, past tense has been claimed by various researchers to be problematic for in English and German, as well as in a number of languages (e.g. Leonard, 1992, 1996; Rice & Wexler, 1996a, 1996b; Rice, Ruff Noll, & Grimm, 1997; van der Lely, 1994). Greek research, however, has not provided similar results, as Greek children with SLI have not appeared to face difficulties in past tense marking (Clahsen & Dalalakis, 1999; Stavrakaki, 1996; Tsimpli, 2001; Varlokosta, 2002). Although two case studies have presented problems with the expression of the past in SLI speech (Diamanti, 2000; Stamouli, 2000), both studies present findings from spontaneous speech, revealing difficulties that are very different from those mentioned in the literature for other languages. Specifically, the two children that participated in these studies mainly exhibited an avoidance strategy for using past forms, resulting in either verb omission or use of the non-past. This comprises a quite intriguing fact, as children with the same language

<sup>6</sup> The terms *dual-mechanism* and *dual-system* as opposed to *single-mechanism* and *single-system* accounts are also used in the literature.

disorder perform very differently in the production of the same feature in different languages. It is, however, necessary to consider language-specific features before interpreting these language behaviour differences between English and Greek SLI children.

#### 1.4. Rationale

As stated earlier, tense is an optional grammatical feature realised on the verb, closely related to the notion of time. According to the view adopted in this study, there is a distinction between semantic and syntactic tense, the former referring to the semantic properties of time and the latter being the LF uninterpretable counterpart of tense, related to its morphological realisation (e.g. Hawkins & Liszka, 2003; Pesetsky & Torrego, 2004). Therefore, tense enters the derivation unvalued and obtains its [+/-past] value through agreement with the semantic interpretation of tense, namely the [finiteness] feature hosted by *C<sub>fin</sub>* (Rizzi, 1997). Under the *feature checking* operation, semantically interpretable features are visible to the LF interface, contrary to uninterpretable features, which are deleted and thus not sent to the LF interface. Therefore, as an uninterpretable feature, grammatical tense feature is deleted and thus not visible to semantic interpretation (Legate, 2002).

Following that tense is a syntactic, optional and LF uninterpretable feature, its status in developing grammars highly depends on the way tense is visible (i.e. interpretable) in the PF interface. PF interpretability is associated with the morphological and phonological characteristics of grammatical features and is language-specific. In the minimalist framework, the PF interface is where formal features result in after spell-out, which means that morphological, phonological and phonetic characteristics are involved at that stage. Following this assumption, morphology and phonetic form are interrelated, with morphology preceding the phonetic realisation of formal features. Therefore, the way tense is interpreted at PF entails the means by which it is both morphophonologically and phonetically expressed in a given language. This clearly leads to the assumption that, being a feature with limited semantic content, grammatical tense holds a different status in different languages, depending on the way it is expressed and interpretable at PF.

Since PF interpretability involves morphological and phonological/phonetic characteristics, it is closely related to the way formal features are perceived by speakers of a language, a relation limited however to the phonological and phonetic properties of a given feature. In other words, perceptual salience is sensitive to phonological and phonetic means of expression but does not refer to the PF interface, since it does not entail morphological characteristics as PF interpretability does. For instance, a PF interpretable feature is expressed through morphology in the sense that it makes use of distinct morphemes, which appear in speech in a distinct phonetic form. Their perceptual salience is thus directly affected by the degree these morphemes are phonetically visible and can vary accordingly, but is only indirectly – if at all – influenced by their morphological status. Additionally, a PF interpretable feature can also be expressed through phonology in the sense that it can activate certain phonological processes, which are directly mapped onto phonetic representations and are perceptually salient.

As far as grammatical tense is concerned, its PF interpretability is highly language-specific, as different languages tend to make use of different means of expression: morphological, phonological or both. For instance, regular past formation in English involves suffixation of the *-ed* morpheme at the end of the verb stem, which is a rather clear-cut rule to learn and use. Nevertheless, this *-ed* suffix used in English past is characterised by quite low perceptual salience as its phonetic realisation is typically limited to a word-final phoneme, namely /t/ or /d/. The same morpheme, however, can bear higher perceptual salience in certain contexts, when its phonetic form turns to /ɪd/ (as in *hunted*: /hʌntɪd/). It is therefore evident that the way a single morpheme is perceived can vary depending on the way it is phonetically expressed:

(10)	<i>PF-representation of English regular past</i>				
	morphology	→	phonetic realisation	→	perceptual salience
	-ed/-ied/-d		/d/, /t/ /ɪd/		Ø <sup>7</sup> /+ ++

<sup>7</sup> The /t/ and /d/ allophones of the English past morpheme *-ed* can be completely absent in connected speech.

This has led various researchers to assume that it is this lack of perceptual salience of the English past that causes greater difficulties to SLI children, leading to the formation of a (*phonological*) *processing* or *perceptual account* to the disorder (Leonard, 1989). Although this account has not gained great empirical support, perceptual salience should play an important role affecting the learnability of grammatical features. In fact, certain research on second language acquisition (SLA) reports such an effect played by salience variations that characterise the allophones of the English past morpheme *-ed*, i.e. /t/ or /d/ as in *stopped* and *robbed*, as opposed to the syllabic allophone /ɪd/ as in *wanted* (Solt et al., 2004). This pattern reveals the rather significant role that perceptual salience of grammatical features plays in the way these features emerge in developing grammars.

Contrary to English, Greek regular past is expressed through a more complicated set of morphological and phonological processes. The fact that Greek past is both morphologically and phonologically expressed renders tense interpretable at PF, as (11) below clearly illustrates.

(11) *PF-representation (morphophonological salience) of Greek regular past:*

a.	morphology	→	phonetic realisation	→	salience
	-a		/a/		+
	phonology	→	phonetic realisation	→	salience
	stress shift		↙		++
OR					
b.	morphology	→	phonetic realisation	→	salience
	-a		/a/		+
	phonology	→	phonetic realisation	→	salience
	stress shift		↙		++
	augment		/e/-		+++

(11a) and (11b) represent the two versions of the past formation rule in Greek, namely the +/– augment distinction. As this presentation suggests, Greek past involves two versions of a rule, one employing a combination of morphological and mainly suprasegmental means (stress shift), the second being morphophonological in nature (addition of an extra, stressed syllable, the augment). It is quite clear that this process is of considerably higher perceptual salience in Greek than English, which possibly explains the discrepancy between Greek and English SLI performance.

Apart from the above differences between English and Greek past tense, the two languages differ in the way (ir)regularity of formation is realised morphologically. English verbs involve a distinction into two clear-cut categories, either clearly regulars or irregulars. Regulars make use of an explicit inflectional rule of past tense formation, namely the addition of the *-ed* suffix, which includes two allophonic distinctions (only one of which are salient: /d//t/ – /ɪd/). Irregular verbs are distinctively formed, and although predictable patterns of formation have been noted (e.g. *blow/blew* – *throw/threw*; *bring/brought* – *think/thought*), no clear degrees of irregularity are observed. In Greek on the other hand, there is no clear-cut distinction between regular and irregular past formation. As stated earlier, various morphological changes have been put forward as determinants of irregularity (i.e. stem allomorphs or aspectual /s/), but no consensus has been reached on the issue. This fact constitutes a rather complicated picture of Greek tense morphology with respect to (ir)regularity of past formation, so that clearly defined terms are more than crucial.

According to claims based on Romance languages like Spanish and Italian (Linares et al., 2006; Say & Clahsen, 2002), stem allomorphs are listed in the lexicon in different nodes under the citation form of each verb stem. Under this view, verbs that involve allomorphic variations in the past are dissociated from rule-based forms. Applying this claim to Greek, however, is not simple. The question whether verbs that employ stem allomorphs can count as *irregulars*, implying different representation and acquisition processes, is crucial. Considering the fact that past tense formation with such verbs is partly rule-based – the stress-shift and past suffixation still apply to them – it rather seems more plausible that verbs that make use of different stems in the formation of past perfective will be acquired as irregulars,



thus requiring memorisation of the perfective stem. On the other hand, stem-vowel alterations should involve a much lower degree of lexical listing, while the use of a morphophonological rule is more critical. In that sense, verbs that belong to the *Irregular* category in (9) above will require memorisation during acquisition as well as lexical activation and retrieval during processing to a higher degree than verbs that fall into the *Regular* category, which mainly produce rule-based forms online.

Following the above points, this paper aims to investigate the effect of morphophonological salience on the acquisition of Greek past tense in normal and impaired language development. Under this scope, salience variations of past verb forms in MG are exploited in such a way that, lower performance in the production of less salient forms would actually suggest such an effect. What is more, the study aims to look into the way children – with or without language impairment – handle the morphology of tense, in the absence of any lexical or semantic effects such as that of frequency. Thus, the use of nonsense words (pseudo verbs) was considered essential. That way, the children would have to process *unknown* verbs morphologically, just as they would do with any novel verb they come across in the language input. Under the assumption that the children are required to perform a morphophonological analysis on the novel verb without any kind of lexical information available, it is predicted that morphophonological salience will have a stronger effect in the pseudo verbs condition than in the real verbs. In fact, if SLI impedes the acquisition of grammatical features and children compensate through phonology, the salience effect should be profound in the SLI data. Finally, the children's performance in regular and irregular past forms is also tested in order to investigate whether children differentiate between forms that employ the morpho-phonological past tense rule and those that do not. It is predicted that children with SLI will have fewer problems producing suppletive past forms than regular ones, although the size of the difference could also be affected by the highly complex patterns of morphological formation of the past in Greek. Yet, the performance of children with SLI in less salient past forms as well as in regular forms as opposed to irregulars is of great significance, as it will provide a clear insight into the locus of the problem and lead to assumptions on a critical question: is the feature of [Tense] impaired for Greek SLI children as it is for English, or not?

## 2. Methods

### 2.1. Subjects/participants of the study

Three groups of children participated in the study: the experimental group, which included children with specific language impairment (SLI), the *chronological age matched* controls (CA) and the *language development matched* controls (LD). A language-matched group was considered necessary as any differences in performance on specific language tasks will constitute strong indications that SLI development qualitatively deviates from typical language acquisition (Leonard, 2003).

#### 2.1.1. Experimental group – SLI

The experimental group of the study consists of ten (10) children aged 4;2 to 5;9, all formally diagnosed with specific language impairment by special units in Speech and Language Therapy centres in Athens, Greece. All the children selected fulfilled the diagnostic criteria of SLI, as they have been reported in the literature (Leonard, 1998). More specifically, the children's IQ scores fell within the range of normal intelligence ( $>85$ )<sup>8</sup> and they all presented serious difficulties in the acquisition of morphosyntax. They lacked any history of neurological or psychosocial disorders or otitis media and they all came from middle-class families. They had a speech therapy background of between 0 and 9 months. Moreover, it was ensured that, if any speech therapy had been provided to the children, it focused on articulation/phonology, whereas their morphosyntactic skills were 'untouched' as yet. The exclusion criteria used were very severe phonological disorders causing unintelligible speech, co-occurring severe semantic-pragmatic disorders, IQ scores below 85 and speech intervention background of 10 months or longer.

All the children of the study were evaluated with the Diagnostic Verbal IQ test (Stavrakaki & Tsimpli, 2000) so that a detailed picture of their language abilities and developmental stage was obtained. The DVIQ test is useful tool, partially

<sup>8</sup> With the exception of one child who scored 84 in the non-verbal intelligence assessment, which, however, was not considered low enough for exclusion.

standardised on Greek population,<sup>9</sup> which measures language development in different levels (vocabulary, morphosyntax, metalinguistic concepts, sentence repetition) both in production and comprehension. It was designed to engage children in simple activities, such as sentence completion based on pictures (black-white drawings), word-picture matching, naming and sentence recall. The children were tested on three sections of the test: comprehension and production of morphosyntax and sentence recall (see [Supplementary Appendix A](#) for sample items and pictures of the sections used).

The scores that the children of the SLI group achieved in the DVIQ test were used as matching criteria with the children of the language-matched controls (LM group). Each child of the SLI group was matched with two control participants: one matched in chronological age and one matched on language age (DVIQ scores). Detailed information on the participants of the experimental group is available in [Supplementary Appendix B](#).

### 2.1.2. Control group I – chronological age matched controls (CA group)

The first control group (CA) consists of ten (10) typically developing children, matched in chronological age with the children of the SLI group. The age of the children of the CA group is between 4;2 and 6;0.

The children of the CA group were obtained through a private kindergarten (PK) in Piraeus, Greece and they did not present any language delay, learning disabilities or attention deficit disorder (ADD) or hyperactivity (HADD) syndromes. Furthermore, none of these children exhibited any signs of psychosocial or neurological disorders and they all presented normal language development, which was further established by the DVIQ test for the purposes of this study (see [Supplementary Appendix B](#) for detailed information).

### 2.1.3. Control group II – language development matched controls (LM group)

The second control group of the study – which is also the one of greatest interest – consists of ten (10) typically developing children, matched with the children of the SLI group based on their language development. Their developmental stage was determined through their DVIQ scores. Specifically, the children's performance in the *morphosyntactic* sections of the test were used as matching criteria with the children of the experimental group. The children's performance in this part of the test constitutes evidence of their morphosyntactic development at the time of investigation, and was therefore considered a reliable matching criterion for the language-matched controls. In fact, it is considered more useful a criterion than MLU, since it has been observed that MLU does not correspond to actual language development in the case of children with SLI (Lahey, 1994).

The children of the LM group were aged between 3 and 3;7 and they all fulfilled all the inclusion criteria for the control groups: no evident language delay, learning difficulties or hyperactivity and/or attention deficit disorder (HADD, ADD). Detailed information is available in [Supplementary Appendix B](#).

## 2.2. Materials

Forty-four (44) activity-sentences (four trial and forty test sentences), including a nonpast verb form were created following Ullman and Gopnik's past tense elicitation method (1994). Each sentence was followed by the time adverbial 'xθes' (=yesterday) aiming to elicit the past form. The experiment contained two conditions (henceforth referred to as *sections*), one with real verbs and one with pseudo verbs, which were presented at random order. The verbs that were used in the first section (real verbs) were selected based on criteria of imageability and frequency: they were all drawn from commonly used vocabulary and corresponded to easily picturable everyday activities. Formal frequency counts (both token and lemma frequency) were obtained from the Hellenic National Corpus (HNC) created by the Institute for Language and Speech Processing (ILSP), (available in <http://hnc.ilsp.gr/>)<sup>10</sup> and are provided in [Supplementary Appendix C](#). Verbs of three categories were selected, all in 3rd singular forms: 2-syllable verbs like *váfi* – *évapse* (e.g. 2), which require a syllabic augment to carry the stress in the past (+Aug condition), 3- and 4-syllable verbs like *χórevi* – *χόrepse* (e.g. 1), which only require stress shift and no augment (–Aug condition), and suppletives

<sup>9</sup> The DVIQ test has been administered to 291 children in Northern Greece and is under the process of full standardisation on populations across all geographical districts in Greece.

<sup>10</sup> The corpus consists of more than 47,000,000 words and contains a large variety of texts, including biographies, newspaper articles, private letters and diaries, transcribed conversations and interviews, literature, school textbooks and others. Although this corpus consists of written texts, it constitutes the only source of formal frequency measurements for Modern Greek. In fact, due to the large variety of text styles included in the corpus, the measurements can be used as an indication of usage patterns in Greek language, both written and spoken.

like *béni* – *bíke* (e.g. 8), which employ different stems in the past and do not make use of the stress shift/augment rule. The structure of the experiment is the following:

### Section a – real verbs (22 items)

	✕	Training condition:	Two (2) items
	✕	1st condition, Regulars +Aug:	Four (4) items <i>Mean token frequency of present form: .0087%<sub>0</sub>,</i> <i>Mean token frequency of past form: .0146%<sub>0</sub>,</i> <i>Mean lemma frequency: .0942%<sub>0</sub>.</i> <i>Mean number of syllables: 2.</i>
e.g.		I Sofia γράφι éνα γράμα. =Sofia is writing a letter.	Xθes i Sofia. . . ? – <b>éγραπε</b> <sup>11</sup> éνα γράμα. Yesterday Sofia. . . ? – wrote a letter.
	✕	2nd condition, Regulars –Aug:	Eight (8) items <i>Mean token frequency of present form: .0050%<sub>0</sub>,</i> <i>Mean token frequency of past form: .0077%<sub>0</sub>,</i> <i>Mean lemma frequency: .0783%<sub>0</sub>.</i> <i>Mean number of syllables: 3.5.</i>
e.g.		O Janis ζωγράφι. =Janis is drawing	Xθes o Janis. . . ? – <b>ζωγράφι</b> Yesterday Janis. . . ? – drew.
	✕	3rd condition, Irregulars:	Eight (8) items <sup>12</sup> <i>Mean token frequency of present form: .0806%<sub>0</sub>,</i> <i>Mean token frequency of past form: .1350%<sub>0</sub>,</i> <i>Mean lemma frequency: .8717%<sub>0</sub>.</i> <i>Mean number of syllables: 2.13.</i>
e.g.		O Nikos πίνι γάλα. =Nikos is drinking milk.	Xθes o Nikos. . . ? – <b>ίπε</b> γάλα. Yesterday Nikos. . . ? – drank milk.

The verb forms of the two regular categories (+Aug and –Aug) were of equal token (in the present and the past) frequency levels ( $p = .933$ )<sup>13</sup> and lemma frequency levels ( $p = .570$ ), while the verb forms of the IRR category were of higher token (present forms:  $p = .001$ , past forms:  $p = .010$ ) and lemma frequency than the –Aug category ( $p = .010$ ). However, the IRR category differed from the +Aug category only in the token frequency of the present forms ( $p = .028$ ) but not of the past forms ( $p = .73$ ), while their lemma frequency was significantly higher than that of the +Aug verbs ( $p = .028$ ).

The second section of the experiment included 22 novel verbs that were created for the purposes of the study, combining novel verb stems with the 3rd person singular suffix. All stems were created following the phonotactic patterns of the Greek language but avoiding rhyming to existing verbs, so that lexical associations and frequency effects could be avoided. The test items included in this section were of the two categories of *regular* formation mentioned above, namely +Aug (2-syllable verbs like *váfi* – *évapse* (e.g. 2)) and –Aug (3- or 4-syllable verbs like *χórévi* – *χóρεψε* (e.g. 1)), so they were matched to real verbs in the number of syllables, so that word length effects could also be avoided. No pseudo verbs corresponding to the *Irregular* condition were created for two reasons: firstly,

<sup>11</sup> All the examples given in the Materials and Results sections include the 3rd person singular form of the verbs used. So, present forms end in *-i* and past forms in *-e*. In general, the verbs used in examples illustrating test items of children's responses will be in the 3rd singular as determined by the methodology used, as opposed to those used to illustrate features of the Greek inflectional system, where the citation form must be used, namely the 1st singular (*-o* in the present and *-a* in the past).

<sup>12</sup> As pointed out by an anonymous reviewer, the unequal numbers of items per condition constitute a limitation of the methodology. This was due to a number of reasons: one reason was that +Aug verbs are fewer than –Aug ones, a ratio that was maintained in the experiment: 2, 3 and 4-syllable verbs are equally represented in the items, which resulted in the –Aug category being of double size as the +Aug one. Yet, more verbs were included in the IRR category due to the idiosyncratic character of their past equivalent. As for the pseudo verbs condition, an attempt to maintain the same total number of real and novel verbs (22) resulted in more verbs included in both +Aug and –Aug. However, the authors acknowledge this limitation and recognise it as a confound in the generaliseability of the findings.

<sup>13</sup> Between-categories differences with respect to frequency counts were tested statistically through the Mann–Whitney non-parametric test.

the irregular verbs included in section a all involved cases of suppletion in the sense that very low or no phonological or morphological similarity can be identified between present and past forms. This means that no patterns of irregular formation can be identified in this category, which could be used to devise pseudo verbs of this kind. The second reason is that rhyming effects between novel and real verbs was avoided in the creation of the novel verbs for reasons that have already been explained. Examples of the items used in this section are given below.

### Section b – pseudo verbs (22 items)

	✘	Training condition:	Two (2) items
	✘	1st condition, Regulars –Aug:	Twelve (12) items
			<i>Mean number of syllables: 3.25.</i>
e.g.		O Janis <b>trenúzi</b> . =Janis is X-ing.	Xθes o Janis. . .? – <b>trénise</b> . Yesterday Janis. . .? – V-ed.
	✘	2nd condition, Regulars +Aug:	Eight (8) items
			<i>Mean number of syllables: 2.</i>
e.g.		To koritsi <b>krávi</b> to krevati. =The girl is Xing the bed.	Xθes to koritsi. . .? – <b>ékrase/ékrapse</b> Yesterday the girl. . .? – V-ed the bed.

### 2.3. Procedure

The child was presented with the stimulus sentence, followed by the time adverbial ‘xθes’ (=yesterday) and was asked to complete the sentence, using the past form of the verb given. Training items with real verbs at the beginning of the task ensured understanding of the task and production of the target verb form (i.e. past perfective instead of imperfective or perfect). In the event of an imperfective response in the training condition, the researcher would encourage the participating children to produce perfective verb forms by repeating the stimulus sentence having added the phrase “once, not all the time”. In the testing condition, the researcher would only utter the phrase “once” after an imperfective response and provide no further feedback of any kind. This way the child was given the opportunity to revise his/her response and the second response was scored, regardless of whether it was successful or not. The real-verb training was followed by pseudo-verb training, where the children were warned that they were going to hear a ‘new word’ but they would have to do the same as what they did with the real words. The test items of the two tasks (real and pseudo verbs) were presented at random order, while no visual information (pictures) on the activities involved was provided to the children.

### 2.4. Analyses and measurements

The children’s responses were analysed with respect to the number of *target* (TRs) and *non-target* responses produced in each task (rather than correct and incorrect). It should be clarified that in the pseudo verbs task production of a verb form corresponding to the novel verb given was considered target when it reflected use of the appropriate version of the rule, i.e. augment and/or stress shift, even with minor phonological stem internal alterations. Past imperfective<sup>14</sup> forms were not counted as errors but as *inappropriate responses*, categorised along with errors as *non-target*. It should also be noted that the use of the suffix was not scored as there were no instances of incorrect or inappropriate suffixes used by any of the children. As for the real verbs task, past perfective responses were considered target, past imperfective responses were again considered *inappropriate*, while instances of using the present form of the verb (use of the non-past perfective or repetition of the non-past imperfective used in the prompts) were scored as *errors*.

The results were analysed to investigate two main independent variables: *group* (SLI, LM and CA) and *verb category*. The *verb category* variable was tested for two main effects: that of *saliency* (–Aug and +Aug categories) and that of *regularity* (REG and IRR categories). Main effects and interactions were tested for statistical significance through two-way mixed ANOVAs, while post hoc comparisons were applied for between-groups (Tukey HSD) and within-groups effects (paired-samples *t* tests).

<sup>14</sup> It is noted that the children were carefully guided into producing past perfective forms and avoiding the imperfective throughout the training condition but in the testing conditions as well (see Procedure section above). Since there was no visual information provided indicating a completed action, any imperfective forms produced were discouraged but could not be counted as errors.

Table 1  
Three groups' performance section a (real verbs) – descriptive values.

	Group	Sum	Mean	SD
–Aug	SLI	57/80	71.3%	28.83
	CA	77/80	96.3%	11.70
	LD	71/80	89%	9.19
+Aug	SLI	37/40	92.5%	12.08
	CA	40/40	100%	.00
	LD	39/40	97.5%	7.91
IRR	SLI	68/80	85.1%	18.39
	CA	80/80	100%	.00
	LD	79/80	98.8%	3.80

### 3. Results

All children had to produce the past form of a verb (or pseudo verb), which was given in a sentence, without any visual information provided. The two sections of the task – i.e. real and pseudo verbs – were analysed separately for each group.

#### 3.1. Section a: real verbs

Beginning with the real verbs section, it included three testing conditions, namely –Aug (*chorévi* – *chorépsē*), +Aug (*váfi* – *évapse*) and IRR (*béni* – *bíke*). As a first presentation of the findings, Table 1 includes the three groups' average success scores in the real verbs section.

The results were statistically tested through a two-way mixed ANOVA, which revealed a significant between-groups difference,  $F(2,27) = 7.227, p < .005$ , as well as significant within-groups effects,  $F(2,54) = 8.304, p < .001$ , whereas no significant interaction was found between *verb category* and *group*,  $F(4,54) = 1.702, p = .163$ . As it seems, the SLI group performed lower than both control groups, while –Aug success scores were lower than +Aug and IRR in all groups' results. In a closer look, SLI performance seems to deviate from LM scores but not in all conditions, whereas a notable rise of SLI success rates from –Aug to +Aug condition is revealed. What is even more interesting is that SLI mean score in the high-salience condition is even higher than their score in the irregular verbs category, which is not true for the two control groups. This could be an indication of the extent to which children with SLI depend on and are affected by the morphophonological salience of the Greek past. Although simple main effects are not usually investigated in cases of no significant interaction between variables, the significant between- and within-groups differences call for further analyses. Detailed descriptions of the three groups' performances are included in the following paragraphs, with within-group analyses presented first, followed by between-groups comparisons.

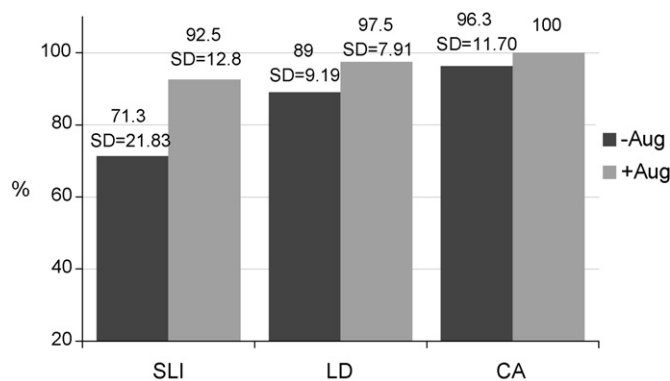


Fig. 1. Three groups' target responses in –Aug and +Aug categories – section a, real Vs.

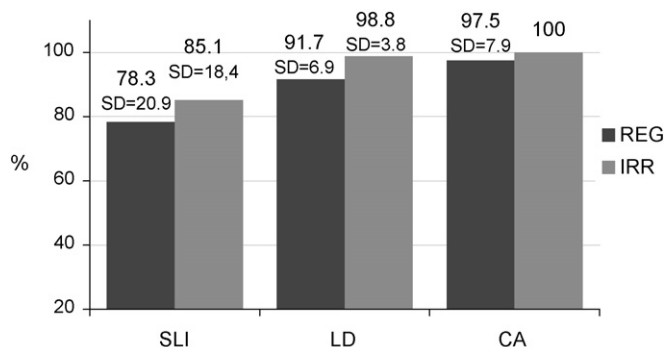


Fig. 2. Three groups' target responses in REG and IRR verbs – section a, real Vs.

Table 2

Non-target responses in –Aug and +Aug conditions (section a, real Vs).

	SLI		LD			CA			
	–Aug	+Aug	IRR	–Aug	+Aug	IRR	–Aug	+Aug	IRR
Errors ( <i>non-past imperfective</i> )	17 (73.9%)	3 (100%)	7 (58.3%)	7 (77.8%)	0 (0%)	0 (0%)	3 (100%)	0 (0%)	0 (0%)
Inappropriate ( <i>past imperfective</i> )	6 (26.1%)	0 (0%)	5 (41.7%)	2 (22.2%)	1 (100%)	1 (100%)	0 (0%)	0 (0%)	0 (0%)
T non-target/T items	23/80 (28.8%)	3/40 (7.5%)	12/80 (15%)	9/80 (11.3%)	1/40 (2.5%)	1/80 (1.3%)	3/80 (3.8%)	0/40 (0%)	0/80 (0%)

Beginning with the variable of salience, the SLI group appeared to face greater difficulties producing past forms by applying the stress shift rule alone than by adding a syllabic augment. Fig. 1 presents the salience effects on the children's correct responses (–Aug and +Aug categories).

This graph shows a clear difference between the two conditions in the SLI group, which was confirmed statistically ( $t = 2.430$ ,  $df = 9$ ,  $p < .05$ ). It is therefore clear that the low salience of the verbs in the –Aug condition affected these children's performance, leading to more non-target responses. As for the two control groups, they clearly faced fewer difficulties in the production of past forms than children with SLI did. To begin with, verbs of the low salience category (–Aug) caused no serious problems to the age-matched control children, whereas more difficulties were encountered by the language-matched controls. As the figure demonstrates, the CA group exhibited top performance in both verb categories, contrary to the language-matched children, who seemed to face greater difficulties in the low-salience condition (–Aug), with an average success score of 89%. Their performance rises considerably in the high-salience category with only one error produced, showing greater ease in producing past forms of verbs of this category, a difference that proved only marginally significant ( $t = 2.261$ ,  $df = 9$ ,  $p = .05$ ). Therefore, the ceiling performance of the CA children in both verb categories indicates that they were not affected by the salience variation,<sup>15</sup> an effect that was also found, though mild, in the LM performance.

Moving to an analysis of the regularity factor, the performance of the children of the three groups in the REG and IRR verb categories is given in Fig. 2.

It is interesting that, although the two regular categories proved to differ significantly for the SLI group, indicating a strong effect of phonological salience variations in children's production of past forms, the children of this group did *not* achieve as high performance with irregulars as they had been expected. It thus seems that children with SLI were

<sup>15</sup> An anonymous reviewer pointed out that the control children's ceiling performance renders the investigation of a salience effect in their results statistically impossible. Although this is true especially for the older controls, this was also an anticipated fact as these children were not expected to face any difficulties in forming the past. In that sense, the increased salience of the +Aug category could not have facilitated difficulties that did not exist in the first place. The fact that this effect is visible in the SLI group's performance is owed to the difficulties that were revealed in cases where perceptually salient means are minimised (–Aug category). This pattern was not visible in the control data, which constitutes a crucial difference between experimental and control groups.

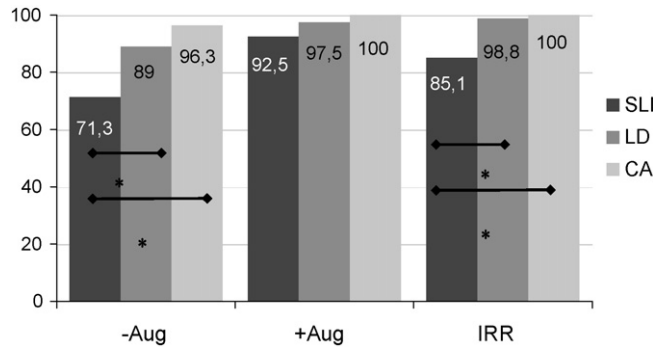


Fig. 3. Between-groups analysis – section a, real Vs. Note: Statistical significance is indicated with \*

not significantly affected by the verb regularity factor ( $t = 1.095$ ,  $df = 9$ ,  $p = .302$ ). However, this fact is likely attributable to the high variability within the children's responses in the REG verb category. Recall that this category includes both –Aug and +Aug verbs, hiding the strong effect of salience, which raised the children's mean success scores to 92.5% (Fig. 1), even higher than their performance with irregular verbs. Coming to the two control groups, the children performed at ceiling in the irregular verbs condition. Looking at the graph, one can notice that both groups performed at very high levels in both verb categories. As expected, the older children performed higher than the younger ones, while both groups' mean scores in the irregular past category are higher than in the regular. However, due to the very high rates of target responses, no statistical analyses were performed on the control groups' data, which were considered to exhibit no difference between the two verb categories.

Apart from the quantitative presentation of the children's performances in the verb categories tested, an error analysis of the non-target responses produced could reveal interesting patterns of performance. This analysis is provided in Table 2.

According to this table, only 26.1% of the non-target responses produced by the SLI group in the low salience condition (–Aug) involved production of the past imperfective form, whereas the majority of them constituted tense errors, namely repetition of the non-past imperfective. As for the high salience category (+Aug), very few non-target responses were produced, which involved repetition of the non-past (imperfective) form of the verb. In the irregular verbs category, 58.3% of the children's non-target responses constitute tense errors, whereas 41.7% involved production of the imperfective past form. Although the errors outnumber inappropriate responses, the frequency of imperfectives is higher than in the other two conditions. This could be due to the fact that the children were required to apply the stress shift/(+)augment rule in the majority of the test items (regulars), which could have functioned as a form of 'training', leading them to prefer the use of the +augment on the irregular test verbs as well, that is, produce their imperfective equivalent. Remember that these verbs employ suppletion in the past perfective but form a totally regular past imperfective, employing the most salient version of the rule, namely the syllabic augment (e.g. *tróo – étroya – éfaya = eat – was eating – ate*; *píno – épina – úpja = drink – was drinking – drank*; *vlépo – évlepa – íða = see – was seeing – saw*). Thus, the difference in the children's performance in the IRR category could be attributable to task effects rather than difficulties with the verb category as such.<sup>16</sup>

As far as the two control groups are concerned, the three non-target responses produced by the CA group in the –Aug category involved repetition of the non-past (imperfective) form instead of the past, while only two of the non-target responses produced by the LM group involved production of the imperfective instead of the perfective past form. The seven (7) errors probably indicate difficulties with producing the past form, which are quite insignificant though, as all LM children performed well in this condition of the task. As for the +Aug condition, only one non-target response was noted by a child of the LM group, who produced the past imperfective form instead of the past perfective. Apart from this, all young controls produced the target forms in all items of the task.

<sup>16</sup> An anonymous reviewer suggested that possible telicity differences between the two verb categories could also have caused more imperfective responses in the IRR category. Although such a possibility cannot be excluded, it is not considered very likely given the training given in order to avoid imperfective responses.

Table 3

Three groups' performance in section b (pseudo Vs) – descriptive values.

	Group	Mean	SD
–Aug	SLI	31.6%	33.91
	CA	95.8%	4.22
	LD	90.8%	6.32
+Aug	SLI	75%	22.70
	CA	100%	0.00
	LD	97.5%	5.06

Moving to between-group analyses, the salience effects found in the three groups of the study revealed some interesting information. The SLI group performed lower than both groups, as Fig. 3 depicts.

SLI performance is lower than the control groups' in all conditions. What is interesting, though, is that the difference between SLI and controls is reduced in the +Aug condition, as SLI mean success score rises up to 92.5%. Again, children with SLI were the most affected by salience variations across the two conditions, since their performance deviates from the controls in the low-salience verb category more than in the high-salience one. Between-groups differences were checked statistically with Tuckey post hoc tests, which revealed that the experimental group differed significantly from both control groups in the –Aug and IRR verb categories. Their scores approached those of language-matched children and even those of the age-matched children in +Aug past forms, revealing the strong facilitatory effect of the high morphophonological salience of the rule applied in this category. Their performance was still significantly lower in the low-salience condition, revealing once more the crucial role of perceptual salience of grammatical features like tense.

### 3.2. Section b: pseudo verbs

This section of the experiment tested the children's ability to handle nonsense verbs morphologically, forming their past equivalent. The pseudo verbs task is a crucial part of the study as the children's mere morphological knowledge and ability is tested, 'stripped' off any semantic/lexical factors affecting their performance. Because such tests lack any semantic value and usually pose difficulties to young children, this task was administered to the children of the study along with section a, with real and pseudo verbs presented at random order.

Beginning with a general overview of the results, Table 3 presents the three groups' average performance in section b.

According to this table, the SLI group performed considerably low in the low-salience category (*chorévi* – *chorépsē*), whereas their performance in the high-salience condition (*váfi* – *évapsē*) rises considerably, revealing a notable effect. Again, SLI scores exhibit very high variance in both conditions, which is an anticipated pattern given the heterogeneity of SLI population in general.

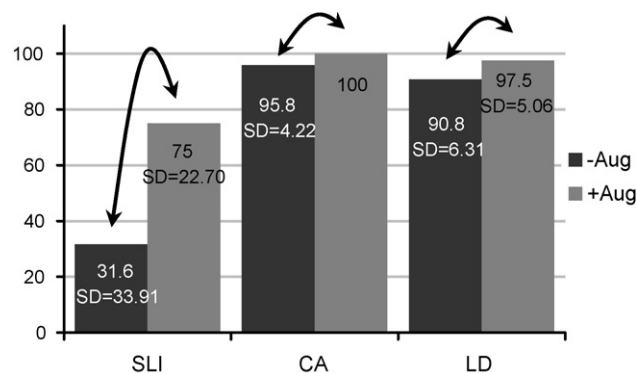


Fig. 4. Three groups' target responses in –Aug and +Aug categories – section b, pseudo Vs.



Fig. 4 presents the three groups' performance in the two testing conditions, so that a comparison of the salience effect across groups can be revealed.

A clear difference between SLI and control performance is shown in this figure, which is evident especially in the –Aug category. A two-way mixed ANOVA revealed significant differences, both between-groups,  $F(2,27) = 41.277$ ,  $p < .001$ , and within-groups,  $F(1,27) = 17.188$ ,  $p < .001$  and a significant interaction between the two independent variables, namely *group* and *verb category*,  $F(2,27) = 8.574$ ,  $p < .01$ . Given this significant variation found in the results, post hoc analyses were considered necessary for the investigation of main effects. The remaining part of this section will focus on within-subjects analyses, whereas between-groups comparisons and error analyses are also provided afterwards.

Beginning with the SLI group, the data in Fig. 4 suggest that the children have been affected by salience variations across the two testing conditions, an effect that was confirmed by statistical analysis ( $t = 3.395$ ,  $df = 9$ ,  $p < .01$ ). SLI performance in the –Aug category is very low (31.6% mean target scores) but with a very high range of scores. These results indicate serious difficulties in applying the past formation rule to nonsense verbs of the –Aug category for the children of the group, although task-related or item-related difficulties – arising from the fact that the test items lacked any semantic value or referent – cannot be excluded at this point. In contrast, the results in +Aug verbs indicate considerable improvement in success rates for these children. Their mean score of 75% indicates that they performed better than in the –Aug category, even though they still seem to face some difficulties. It is important to note that the improved performance the SLI group shows in this category also excludes any task-related explanations of their very low scores in the –Aug category, as it eliminates the possibility that the children could not handle empty items like pseudo verbs semantically or process pseudo words phonologically due to phonological working memory limitations. The difference in SLI performance between the two verb categories is therefore very clearly visible in this section, while a statistical analysis confirmed the significance of the salience effect on the children's performance.

Moving to the two control groups, the children's scores in the two conditions of the task suggest very high abilities in applying the morphological rule of past tense marking in its both versions. All age-matched children performed at ceiling in both conditions, with a 95.8% mean success score in the –Aug category and 100% success in +Aug verbs. This small difference between the two categories shows a mild effect of the salience variation between them, although it could not bear any statistical significance. However, it is notable that the children's performance was not affected by perceptual salience, in the sense that their scores did not drop in the low salience category (–Aug). Similarly, the language-matched children also performed really well in both conditions with a mean score of 90.8% in the –Aug category and a mean of 97.5% in the +Aug category. It should, therefore be noted at this point, that both control groups found both verb categories easy to handle, contrary to SLI performance, where a decrease of perceptual salience (–Aug verbs) revealed considerable difficulties in forming the past.

Analysing between-groups effects, the results present greater interest. The findings are replicated in the following graph, presented in a different layout to emphasise on the comparison of the salience effect that was found in the three groups performances (Fig. 5).

As this figure shows, there was significant variation across the three groups in both conditions. What is most interesting is that SLI performance differs significantly from *both* CA and LD, whereas the two control groups do not

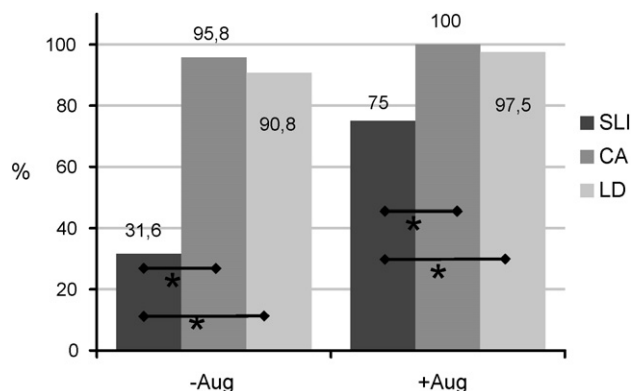


Fig. 5. Three groups' target responses in –Aug and +Aug categories – section b, pseudo Vs. Note: Statistical significance is indicated with \*

differ from each other. These results lead to the preliminary assumption that children with SLI face considerable difficulties with applying the less salient version of the past formation rule, namely the *stress shift*. This indicates that they actually *do* have problems with the morphological feature of tense as such, which is regulated by the realisation of this feature. Their significantly higher ability to produce past pseudo-forms by applying the more salient version of the rule, namely *stress shift* in combination with the *syllabic augment*, suggests that these children ‘use’ phonological cues as a means to compensate for a morphological deficit that affects tense. In other words, children with SLI seem to depend on phonological cues more than unaffected children do, a tendency that implies lack or a deficit at the level of morphology.

Apart from the quantitative differences between SLI and controls described here, qualitative analyses of the three groups’ performance proved quite revealing. The errors that the children made could be indicative of the acquisition process they go through as well as of any underlying deficits.

Three types of errors were produced by the children of the study in this task: repetition of the non-past (imperfective) form that was given in the prompt instead of production of the past (e.g. 12), application of the [+augment] rule on verbs of the –Aug category that would normally require stress shift only (e.g. 13) and formation of the non-past perfective (dependent) equivalent of the form provided (e.g. 14).

(12)	<b>Repetition of the non-past (imperfective) instead of past:</b>			
	(+Aug)	prompt:		<i>krávi</i>
		target:		<i>ékrapse</i>
		acceptable:		<i>ékrave</i>
		error:		<i>krávi</i>
(13)	<b>Wrong application of rule [+augment] in –Aug category (rule overuse)</b>			
	(–Aug)	prompt:	<i>stepáí</i>	
		target:	<i>stépace</i>	
		acceptable:	<i>stépatse, stépike, stépakse</i>	
		errors:	<i>éstekse, éstapse</i>	(CA)
			<i>étatse</i>	(SLI)
			<i>éstije</i>	(SLI, LM)
(14)	<b>Formation of the non-past perfective instead of past perfective:</b>			
	(–Aug)	prompt:	<i>trenúzi</i>	
		target:	<i>trénise</i>	
		acceptable:	<i>trínise, trénitse, trénikse.</i>	
		errors:	<i>tenútsi</i>	(SLI)
			<i>trenúsi</i>	(SLI, LM)

The distribution of these error types across the three groups is available in Table 4.

Table 4  
Error types produced by the three groups in the pseudo-verbs task.

		Non-past imperfective (repetition of prompt)			Rule overuse			Non-past perfective			Total	
		<i>n</i>	%/errors	%/ctxs	<i>n</i>	%/errors	%/ctxs	<i>n</i>	%/errors	%/ctxs	<i>n</i>	%/ctxs
SLI	–Aug	44	53%	36%	12	15%	10%	26	32%	22%	82/120	68%
	+Aug	20	100%	25%	0	0%	0%	0	0%	0%	20/80	25%
CA	–Aug	0	0%	0%	5	100%	4%	0	0%	0%	5/120	4%
	+Aug	–	–	–	–	–	–	–	–	–	0/80	0%
LD	–Aug	2	18%	1%	8	73%	7%	1	9%	1%	11/120	9%
	+Aug	2	100%	3%	0	0%	0%	0	0%	0%	2/80	3%

Key: *n* = raw number of errors, %/errors = percentage out of total errors, %/ctxs = percentage out of total contexts.

Looking at this table, one can observe the following: *first*, the majority of errors were produced in the low salience category, as it has already been shown in the previous sections as well. *Second*, there is a striking difference in the pattern of error production between SLI and controls: On the one hand, children of both control groups mainly gave erroneous responses that involved application of the [+augment] rule to trisyllabic pseudo verbs, which only required stress shift. This type of error constitutes the majority of the unaffected children's errors, (100% for the CA and 73% for the LM group), indicating that these children made continuous efforts to apply the more salient version of the rule (i.e. +Aug +SS), efforts that resulted in few instances of overuse. These errors bear significant implications for the nature of the syllabic augment of the Greek past. The fact that the children apply the prefixed *é-* in cases where the number of stem syllables does not require it reveals its crucial role in past tense formation in Greek. It thus seems that the syllabic augment is not processed as a mere phonological element supporting stress-related processes, but is actually a prefix, serving as the *default* past tense formation rule.

Children with SLI, on the other hand, mainly produced errors of the other two types, namely repetition of the prompt pseudo-verb and formation of the non-past perfective equivalent. Repetition of the pseudo-verb given is the most frequent error (44 out the 82 errors were of this type), revealing serious problems with forming a past equivalent by applying the rule. The children seem find it very difficult to re-form the novel word, so they fall back to repeating it unchanged.

Production of a non-past perfective was also frequent (26 instances). This form has distinctive morphosyntactic characteristics and a special status in the acquisition process. It is used only following the particles '*na*' (=to) and '*tha*' (=will) or in perfect tenses (*éxo péksi* = I have played) and is therefore unable to stand on its own, which is why it is also called a (tense) *dependent* form. Furthermore, it has been observed that, during early stages of acquisition, children tend to produce non-past perfective forms in past contexts (Tsimplici, 1996; Varlokosta et al., 1998). Thus, this error type does exist in typical acquisition as well but corresponds to much earlier developmental stages.

### 3.3. Sections a and b: comparing real and pseudo verbs

To conclude the analyses of the results, a comparison between the two main testing conditions, namely real and pseudo verbs, across the three groups could also be revealing of the way children with SLI process morphological information. The following graph provides this comparison (Fig. 6).

A striking difference between the experimental and the two control groups is visible in this graph. Specifically, it is evident that children with SLI are noticeably affected by the lexical information available for real verbs, producing much fewer target responses with pseudo verbs in both categories tested (+Aug and -Aug). The difference was tested statistically and proved to be significant in the -Aug condition ( $\chi_{\text{orévi}} - \chi_{\text{órepse}}$ ),  $t = 3.261$ ,  $df = 9$ ,  $p = .10$ , but only marginally significant in the +Aug condition ( $váfi - évapse$ ),  $t = 2.240$ ,  $df = 9$ ,  $p = .052$ . This pattern is not seen in neither of the two control groups' data, as their performance does not differ between real and pseudo verbs. This finding is of great interest, as it reveals the extent to which children with SLI depend on non-grammatical (lexical in this case) information as well as their difficulty processing purely grammatical aspects of language when lexical means are not accessible.

To conclude, it was shown in this section that the pattern exhibited by children with SLI is quantitatively and qualitatively different from that of the typically developing children of the study, suggesting fundamental differences in the acquisition processes the two populations go through. These differences and their implications are to be discussed in the following section.

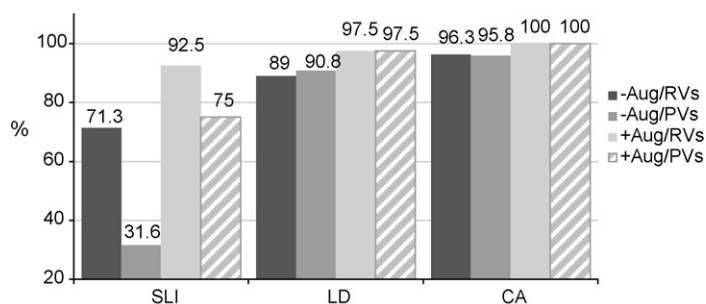


Fig. 6. Target responses – real vs. pseudo verbs.

#### 4. Summary and discussion

It was shown in this paper that the morphophonological realisation of grammatical features affects the way these features are acquired by children. Typically developing children aged between 3;0 and 3;7 exhibited signs of a salience effect in acquiring past tense formation, and although these children appeared to have acquired the morphophonology of Greek past (as their high scores indicated), their performance suggests that perceptual salience must play a role in acquisition at an early stage of language development. It could thus be plausible to assume that this effect is present in the acquisition of grammatical structures and phases out quite early in the development of morphological features that are realised morphophonologically, but an investigation of acquisition patterns at even earlier stages would be necessary to confirm this claim.

Contrary to the language-matched children, the SLI group exhibited clear salience effects in all tasks. In fact, it was shown that morphophonological salience constitutes a significant factor in SLI development, as these children appeared to be highly dependent on increased salience especially in marking novel verbs for the past. Yet, the main finding SLI performance suggests is that past tense is not fully developed in the grammar of these children, as their low scores in –Aug categories in both existing and novel verb conditions imply. Recall that these children's mean success rate dropped to 31.6% in low-salience pseudo verbs and to 71.3% in the –Aug condition of the real verbs section. These low scores constitute the most important finding of the study, as they indicate that children with SLI actually do face difficulties with past tense formation when phonological and/or lexical means are low or not available for compensation. This pattern was not evident in neither of the two control groups' data, as their performance did not drop in the low-salience category. Finally, it should also be noted that SLI performance cannot be attributable to factors like frequency, as the verbs of the two categories were of equal token and lemma frequency levels, so they clearly suggest problems in applying the low-salience version of the past tense rule, which are reduced – or compensated for – when the rule employs means of higher salience.

Another interesting finding was that children with SLI were worse than both control groups in producing the past form of pseudo verbs, which suggests that they make use of lexical/semantic information when using grammatical aspects of language to a much greater extent than unaffected children do.<sup>17</sup> Finally, it is also noteworthy that the SLI group showed lower morphological skills than both control groups, despite the fact that the language-matched children that participated in the study had been carefully matched on their development of morphosyntax (through their DVIQ scores). This finding indicates that, although the children of the SLI group seemed to be of the same developmental stage (with respect to morphology and syntax) as the language-matched controls, they appear to face problems that are *masked* by features of semantic and phonetic substance, such as lexical information and perceptual salience, and are revealed under controlled conditions where these compensatory means are reduced or made inaccessible.

Going back to the main finding of the study, the problems with low-salience formation observed in SLI performance yield a twofold interpretation: *first*, they indicate that children with SLI face considerable difficulties with acquiring purely grammatical features with low semantic import, like grammatical tense. They do not seem to fall behind in acquiring the semantic notion of time, but rather find it difficult to handle the morphological component of tense marking, namely the past tense rule.

A *second* conclusion drawn, given the salience effect observed, is that the difficulties children with SLI encounter in forming past forms are reduced when the degree of morphophonological realisation increases. In other words, it seems that PF interpretability is a significant factor in SLI language development, which plays a crucial role in the development of LF-uninterpretable features like tense. Therefore, it is assumed that specific language impairment impedes the acquisition of LF-uninterpretable formal features, while at the same time PF interpretability provides means of compensation for problematic aspects of language. Furthermore, the suggested role of PF interpretability in SLI development also provides an explanation to cross-linguistic differences in SLI performance, especially as far as tense marking is concerned. Given the high degree of variability in the way tense is morphophonologically realised in different languages, a high degree of variation in the performance of SLI populations from different linguistic backgrounds is also anticipated.

<sup>17</sup> Although it is a well documented fact that children with SLI are worse than their peers in repeating or processing pseudo words (Archibald & Gathercole, 2007; Gathercole, 2006), the present findings cannot be explained based solely on non-word repetition problems, as their increased performance in the high-salience category indicates.

On the other hand, the findings obtained in this study concerning the role of morphophonological salience in language acquisition are also in line with evidence provided by research on other languages. Specifically, it has been shown that children – as well as adults with and without language learning difficulties – are sensitive to morphophonological salience (in the sense of double marking), which seems to facilitate grammatical learning in Russian (Gerken, Wilson, & Lewis, 2005; Richardson, Laurel, Plante, & Gerken, 2006). Finally, the present findings are in line with Leonard's postulation that morphophonological and perceptual salience plays a significant role in formulating SLI linguistic profiles (Dromi, Leonard, & Shteyman, 1993; Leonard, 1989, 1992, 1996; Leonard et al., 1988; Leonard & Bortolini, 1998), with the difference that the present findings attribute a compensatory nature to this role rather than a determining one.

As far as regularity is concerned, no significant effects were found in the data of the two control groups as they both exhibited very high performance in the two categories. This could be due to the age of the children in the two groups, showing that they were at a rather advanced stage for morphological acquisition. It is likely that differences between regular and irregular past forms would be manifested in younger children's performance, at stages where the morphology of tense is still under development. However, the fact that no significant difference between regular and irregular verbs was revealed in SLI performance can be attributed to the fact that the children exhibited preference for the +augment version of past tense expression, giving the imperfective rather than the perfective of the verbs given. As it was pointed out earlier, this could be interpreted as a task effect. However, this preference could also be an indication that the children are acquiring, and thus *overusing* the perceptually salient version of the past formation rule, namely the +augment/+stress shift. Since all verbs of this category employ the +augment rule in the past imperfective, the preference for that form shown by the children with SLI could be a sign of preference or dependence on phonological means (addition of a stressed syllable) in expressing the past. Such a preference is also exhibited by the SLI group's erroneous performance in the pseudo verbs section, where overuse of the +Aug version of the rule was quite frequent. Consequently, the children's performance in the IRR category indicates that they treat cases where the morphophonological past tense rule is not applied differently from regular ones by expressing much stronger preference for the most salient version of the past tense formation rule.

As a final point, it was shown in that children with SLI presented a qualitatively different error pattern from that of the two control groups in the pseudo verbs condition. Specifically, the children of both control groups mainly performed a rule overuse by adding the syllabic augment to verbs of the –Aug type, indicating that the rule has been acquired even by the youngest controls and is overused in its *default* form, that is, [+augment]. SLI performance, however, involved three main types of errors: repetition of the nonpast form, overuse of the [+augment] rule, and production of the nonpast perfective equivalent of the novel verb given. This pattern leads to two assumptions: One is the past tense rule *is* active in SLI grammar as well, but in its most salient version (+augment), which the children over-apply in –Aug verbs. However, as this type of error was not the most frequent in SLI data, it is plausible to assume that the past tense rule has not been fully acquired by these children. A *second* conclusion is that the rule *is* present but fails to apply at the spell-out, suggesting an online production problem, attributable to difficulties with the morphological component of the feature of tense. These difficulties lead the children to repeat the nonpast, being unable to perform morphological processing on a novel verb by applying a low-salience grammatical rule. It thus seems that these children face difficulties with the morphological realisation of the past in Greek rather than the abstract feature of tense.

## 5. Conclusion

To conclude, the findings of this study suggest that specific language impairment impedes the development of semantically uninterpretable grammatical features like tense, a deficit that is compensated for through PF-relevant means. Under this view, LF interpretability – which is crosslinguistically constant – leads to comparable SLI performances across languages, but their difficulties can vary depending on the extent that PF interpretability – which is crosslinguistically variable – differentiates one language from another. Finally, the main findings provided here suggest that SLI impedes on the underlying linguistic representations of LF uninterpretable grammatical features, leading children to resort to other means – phonological, semantic or lexical – in order to compensate for the difficulties they face acquiring these aspects of their language.

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## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.jcomdis.2009.12.005](https://doi.org/10.1016/j.jcomdis.2009.12.005).

## Appendix B. Continuing education

1. The study aims to investigate:
  - (a) the acquisition of formal features by children with SLI,
  - (b) the acquisition of past tense by typically developing children,
  - (c) the way morphophonological salience affects the acquisition of past tense in Greek,
  - (d) the way morphophonological salience affects the acquisition of formal features in Greek.
2. A language-matched group was included because:
  - (a) language development in SLI is considered to fall behind by approximately 2 years,
  - (b) a comparison between children with SLI and language-matched controls could indicate deviant language development in SLI,
  - (c) a comparison between age-matched and language-matched children is necessary to investigate acquisition,
  - (d) the performance of language-matched children is similar to that of children with SLI, providing more interesting findings.
3. There is no clear-cut distinction between regular and irregular past tense formation in Modern Greek. True or false?
4. The SLI group was affected by the regularity factor (gave significantly more correct responses in Irregular verbs than in Regulars). True or false?
5. The paper concludes that SLI causes difficulties in:
  - (a) the morphological expression of the feature of [tense],
  - (b) the use of past forms,
  - (c) the acquisition of the past,
  - (d) the acquisition of irregular verbs.

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