Department of Clinical Therapies
University of Limerick
Final Year Project MSc Speech & Language Therapy

Grammatical processing load and verb argument structure effects on the production of past-tense morphology

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Abstract

Background: Children with language impairments often present with morphological and verb argument structure (VAS) difficulties (Leonard, 2014). Complexity of VAS (see Grela and Leonard, 2000) as well as an increase in task demand (i.e., processing load) as found in narrative production (see Thordardottir, 2008) have been shown to affect production of grammatical morphology in children. Moreover, children with SLI employ a less diverse range of verbs than their peers and are prone to inappropriate substitutions (Black and Chiat, 2008). There is a need for an ecologically valid assessment tool (e.g., narrative retell) which examines tense elicitation and VAS of a range of verbs in child-language production.

Objectives: Using grammatical complexity (mean length of utterance: MLU) as a proxy measure of processing load, this study examines the effect of MLU on the production of both past-tense morphology and obligatory arguments, and of VAS on past-tense elicitation.

Methods: A secondary analysis was undertaken using data from a narrative retell task undertaken with 91 typically developing children (aged 4;06 to 12;0 years). The task targeted 44 different verbs chosen based on their semantic-syntactic properties.

Results: Errors in tense elicitation and VAS were rare. Cross-tabulations did not yield evidence of an inter-relationship between number of obligatory arguments and past-tense elicitation. Correlations between grammatical complexity and some verbs were found regarding omissions of obligatory arguments and tense. Grammatical complexity decreased in utterances with obligatory argument and/or tense omissions.

Conclusions: At times, typically developing school-aged children present with omissions of obligatory arguments and/or past-tense morphology. These omissions correlate to a decrease in grammatical complexity in language production. The implications of processing load and age are discussed.

Key words: Grammatical complexity; processing load; argument structure; inflectional morphology; child language; Specific language impairment
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Introduction

It is estimated that 7% of children have specific language impairment (Tomblin, Records, Buckwalter, Zhang, Smith and O'Brien, 1997). The term specific language impairment (SLI) is used to describe children who have difficulty in the acquisition and use of language, be it receptive language, expressive language or both. When compared to their age-matched typically-developing peers, a child with SLI will score at least one standard deviation below the mean on standardised measures of language (e.g., CELF 5; Semel, Wiig and Secord, 2013). The following criteria must also be present to rule out language disorders attributable to other conditions (see Schwartz, 2009, p.4): (1) no hearing impairment present in the child, (2) there is no general developmental delay, that is, the child has a “normal performance IQ” (Schwartz, ibid), (3) there is no frank neurological impairment, and (4) the child does not have a diagnosis of autism spectrum disorder. A point worth noting is that children with SLI, for the most part, develop language along the same path as typically developing children, albeit on a slower trajectory, with most of the errors in their language being similar to those of younger typically developing children (Hulme and Snowling, 2009, p.143). Despite there being considerable heterogeneity among children in the symptoms of SLI (Leonard, 2014) with SLI being a multifactorial disorder (see, e.g., Bishop, 2006), Leonard (2014, p.34) highlights two frequently occurring weaknesses in children with SLI: “problems with grammatical computation and/or phonological memory.” This paper will focus on aspects of grammatical computation that are vulnerable in children with SLI: finiteness (specifically past-tense marking), verb argument structure (VAS) and grammatical complexity (specifically mean length of utterance in morphemes, MLU). By highlighting such vulnerabilities and interactions between aspects of grammar (i.e., whether certain aspects are more vulnerable than others in children with limited processing capacity), interventions can be more specifically tailored to meet the needs of different children with language impairment, particularly in light of the heterogeneous nature of SLI.
Background

Finiteness

Typically developing children generally have mastered the use of grammatical morphology by 5 years-of-age (see Brown, 1973; Rice and Wexler, 1996); yet, finiteness morphology (i.e., tense morphology) may continue to be problematic for school-aged children with SLI (Conti-Ramsden, Botting and Faragher, 2001; Oetting and Hadley, 2009). Children with SLI omit tense morphemes and produce bare-stem verbs in contexts of obligatory finiteness (i.e., errors of omission) more often than both their typically developing peers, and younger MLU-matched typically developing children (Rice and Wexler, 1996; Rice, Wexler and Cleave, 1995; Rice, Wexler and Hershberger, 1998; Rice, Wexler, Marquis and Hershberger, 2000). As Bishop (2014) notes, use of bare infinitives instead of either irregular past tense forms or over-regularised irregular past tense is indicative of children with SLI, with inconsistency in tense marking being typical in this population (Hulme and Snowling, 2009, p.153). Errors of omission make up the majority of tense marking errors in children with SLI. However, although errors of commission are rare, Oetting and Horohov (1997) note that children with SLI produce such errors in similar type and rate to typically-developing younger children. A model called the Extended Optional Infinitive account (EOI; see Rice and Wexler, 1996, Rice, Wexler and Cleave, 1995) explaining omission of tense in children with SLI is explained below (see also Leonard, 2014). Although present from an early age in children with SLI, difficulties with tense morphology become most apparent by 5 years of age, that is, school-going age (Oetting and Hadley, 2009, p.342 and references therein). However, verb morphology alone may not be a wholly useful clinical marker for SLI particularly for children over 7 years old (see Jones Moyle, Karasinski, Weismer and Gorman, 2011; Oetting and Hadley, 2009, p.343). For this reason, looking at the interactions between finiteness and other aspects of morphosyntax (e.g., argument structure or sentence/grammatical complexity) and more broadly, language processing, may shed some light on the phenotype of SLI in both younger and older children.
Argument structure in school-age children

Unlike grammatical morphology, argument structure learning in typically developing children is a process that continues throughout childhood and into adolescence (see, e.g., Ebbels, Dockrell and van der Lely, 2012; Naigles, Fowler and Helm, 1992). Although infrequent, argument omissions occur in school-aged children, with typically developing children found to omit subject, theme, copula complement and goal arguments (Thordardottir and Ellis Weismer, 2002). Furthermore, research has indicted that children with SLI have greater difficulties with verbs and verb argument structure than their typically developing peers (see, e.g., Chiat, 2000, Chapter 9; Ebbels, van der Lely and Dockrell, 2007). Grela and Leonard (2000) suggest that as argument structure complexity increases, so too does processing load. In a study with 30 participants (10 children with SLI aged 4;2 to 6;7; 10 aged-matched children; 10 children matched for mean length of utterance (MLU)), Grela and Leonard (2000) examined the influence of verb argument structure on the omission of auxiliary ‘be’ verbs in children. Using a story completion task, the children were required to produce sentences of differing length using verbs of differing valency (i.e., 1, 2, and 3 argument predicates with and without an adjunct). With the aged-matched children reaching ceiling levels in their production of the auxiliary verb, results showed that children with SLI omitted more auxiliary verbs than their aged-matched counterparts. No significant differences were found regarding sentence length effects (adjunct versus no adjunct) between the SLI and MLU-matched groups. However, there was a significant effect for argument structure type in both SLI and MLU-matched groups (specifically 3 argument predicates), suggesting that argument structure complexity affects both typically developing children and children with SLI. These findings were interpreted as processing capacity limitations in children with SLI and MLU-matched children. In other words, argument structure complexity appears to add to processing load for younger children and children with SLI to an extent that processing capacity limitations may be reached and other domains of language can be affected (i.e., tense markers).
Using a sentence elicitation task, Owen (2010) also investigated the influence of verb transitivity on the use of past tense morphology in children aged 5-8-years-old with and without SLI. Results indicated that verb transitivity had no influence on past tense accuracy. This finding is still compatible with Grela and Leonard’s (2000) in that it is not transitivity that affects morphological production, but the use of three-argument predicates.

Thordardottir and Ellis Weismer’s (2002) study examined VAS in school-aged children with SLI, typically developing peers and an MLU-matched group also of school-going age. The authors investigated argument structure types and valency effects, not only examining frank errors of omission, but also limitations in the use of argument structure in the absence of errors. Using spontaneous language samples of 100 monolingual English-speaking children (50 children with SLI, and 50 typically developing children), the authors found that omission of obligatory arguments in pragmatically unacceptable situations in the output of children with SLI and typically developing children was rare (as noted above). Perhaps if processing load was further increased in the task, argument omissions would have increased. That is a question that remains to be answered. When compared in their use of a variety of arguments (e.g., agent, theme, goal, etc.) and argument structures (i.e., one-, two-, or three-place predicates), the children with SLI differed from typically developing children. The authors conclude that children with SLI have significant delays in VAS development compared to their age-matched peers. When compared to the MLU-matched group, children with SLI produced significantly fewer types of complex argument structures (i.e., 3-place predicates). This finding is consistent with Grela and Leonard (2000), indicating that ditransitive verbs may increase processing load beyond capacity in the language output of children with SLI. This finding was present across tasks, that is, in an elicitation task in Grela and Leonard (2000) and in a spontaneous language sample in Thordardottir and Ellis Weismer (2002). However, while Grela and Leonard (2000) found no effect for length of utterance, such an effect would be worth examining in a task that demands a greater processing load. A final conclusion to note from Thordardottir and Ellis Weismer (2002, p.246) is their assertion that “the absence of argument structure errors should not be taken as evidence of age-appropriate mastery of argument structure.”
Mean length of utterance (MLU) in children with SLI

Since Brown (1973) and colleagues research on the acquisition order of morphemes, mean length of utterance (MLU) has become integral as a measurement for children’s emerging language development (Rice, Smolik, Perpich, Thompson, Rytting and Blossom, 2010, p.333). That said, it is not without its critics, and MLU as a stand-alone assessment tool in the diagnosis of language impairment in children is not recommended (Eisenberg, McGovern Fersko and Lundgren, 2001). MLU may have positive predictive value (i.e., a very low MLU indicates language impairment), but has poor negative predictive value (i.e., an age-appropriate MLU does not eliminate the possibility of language impairment) (Oetting and Hadley, 2009, p.352). Yet, in a study of 306 children aged 2;06-9;0 years, Rice et al. (2010, p.333) suggests that MLU is a reliable and valid index of normative language development as well as a marker for language impairment. With such conflicting conclusions in the literature, an important question to ask is this: what does MLU really measure? Eisenberg et al. (2001, p.338) suggest that it should not be used as a measurement of morphosyntax; instead, it should be used as one possible way of measuring utterance length. Adopting a cautious stance towards using MLU as a sole indicator of language impairment, in this paper MLU will be used as a proxy measure of processing load, with the assumption that an utterance with a larger MLU may have a greater processing load than one with a smaller MLU, other variables being equal (e.g., the same verb, argument structure and types of argument in both utterances). Although Grela and Leonard (2000) found no utterance length effect, MLU should not be ruled out as one tool in a set of tools that may be used to assess language. Moreover, MLU may be dependent on task type, with narrative sampling producing a longer MLU than conversation samples (Thordardottir, 2008). This finding may influence the choice of task type in assessment, especially if MLU will form part of any assessment procedures and analysis.

Two perspectives to explain SLI

Two broad perspectives have been proposed to explain difficulties in grammar among children with SLI (see Grela, Collisson and Arthur, 2011). The first
proposes that these children have problems with the innate structure of grammar which, for example, prevent the child from applying productive morphosyntactic rules (see Rice and Wexler, 1996, Rice, Wexler and Cleave, 1995). In Rice and colleagues’ Extended Optional Infinitive account (EOI) of tense marking, they propose that children with SLI remain in a tense-optional grammar stage of language development, where finiteness morphemes (including past-tense marking) in obligatory contexts are considered optional by the child. This stage is found in younger typically developing children, and is called the Optional Infinitive (OI) stage (Wexler, 1994). The EOI stage proposed for some children with SLI occurs due to an under-specification of the tense feature in a clausal representation (Guasti, 2002, p.133). Although the child may know that a matrix clause must be specified for tense, unlike adults and typically developing, the child with SLI chooses to omit tense.

The second broad perspective proposes that a child’s underlying grammatical structure is intact, but that processing systems (e.g., working memory, attention or general processing) that are essential to the acquisition and use of language are not functioning as optimally as in typically developing peers (Grela et al., 2011, p.374). This perspective proposes a capacity limitation in processing in children with SLI. With such processing capacity limitations, children with SLI are unable to acquire grammatical rules as efficiently or as speedily as their typically developing peers; this in turn leads to weaker representations of grammatical structures and variation in the child’s language production (Grela et al., 2011, p.374). This current study assumes a limited capacities approach to explain the morphosyntactic errors that occur in output in children with SLI.

**Processing limitations and deficits in sentence production**

Charest and Johnston (2011, p.18) highlight three important characteristics of language production processing: (1) the processing cost needed to produce an utterance can exceed the speaker’s processing resources, (2) processing costs can vary between language operations, and (3) processing costs in one domain (e.g., syntax) can affect performance in another domain. In other words, there are costs associated in the production of utterances, particularly if you are a child with limited processing capacity. With these in mind, studies have shown
how one aspect of morphosyntax may have an effect on another. Sentence complexity has been shown to influence the use of past tense morphology in children with SLI (Owen, 2010). Using a sentence elicitation task, Owen (2010) investigated the influence of sentence type, clause order, and verb transitivity on the production of past tense in children aged 5-8 years. Results indicated that sentence type and clause order influenced the use of past tense morphology; however, verb transitivity was shown to have no influence. This latter point is still compatible with Grela and Leonard’s (2000) findings in that it is not transitivity per se that affects morphological production, but the use of three-argument predicates. Moreover, Owen (2010) employed an elicitation task to gather data. It may be that narrative retell would place an even greater burden on processing than an elicitation task.

Thordardottir (2008) examined the effect of task demand (i.e., conversation, narration, and expository discourse) on the production of verb-phrase morphology in English-speaking school-aged children with SLI (mean age 9;09 years). The children were instructed to tell a plot of a book, film, or television show that they had recently read or watched (i.e., narrative production). Results indicated that for English-speaking children with SLI, an increase in task demand (i.e., processing load) affected the production of grammatical morphology, that is, more demanding contexts like narratives place an even greater burden on the production of grammatical morphemes in English-speaking children with SLI, with these morphemes being a vulnerable area of language for these children. This finding was deemed interesting given that the children were over 8 years old, where verb morphology alone may not be a wholly useful clinical marker for SLI. Thordardottir (2008, p.932) suggests that past tense morphology is still a fragile skill for children with SLI, even at this age, particularly when processing demands in other areas of language are competing for the (limited) available processing resources.

Although Thordardottir (2008) employs an ecologically valid tool to garner a speech sample, it may not target specific enough aspects of morphosyntax, for example, intransitive, transitive and ditransitive verbs, change-of-state verbs, change-of-location verbs, and alternating verbs (see Ebbels et al., 2012); nor does it consider the syntactic-semantic interface of event structure, the complexity of which may also further increase processing
load (see Gennari and Poeppel, 2003). As children with SLI employ a less diverse range of verbs than their peers and are prone to inappropriate substitutions (Black and Chiat, 2008), it is possible that using such a less diverse range may decrease the possible error count in the child’s output. For this reason, a tool is required that is both ecologically valid, and specific enough to assess different aspects of morphosyntax. In this way, if and when errors occur, they can be examined with respect to aspects of processing load in the utterance.

Norm-referenced assessment tools: Narrative retell

Many norm-referenced standardised tools used by SLTs lack ecological validity as they reflect performance in an artificial setting, that is, not real-life situations as many of the tasks are decontextualized (Danahy Ebert and Scott, 2014, p.338). For example, difficulty in sentence repetition tasks is a reliable clinical marker of specific language impairment (SLI) (Archibald and Joanisse 2009; Conti-Ramsden et al., 2001). Yet, sentence repetition tasks draw on an array of language processing skills, with the interactions of these skills as of yet not fully understood (see, e.g., Alloway and Gathercole, 2005; Klem et al., 2014; Polišenská, Chiat and Roy, 2014; Riches, 2012). Even when such a task shows high levels of sensitivity and specificity in identifying children with language impairments (see, e.g., Conti-Ramsden et al., 2001), and are designed and manipulated to provide quantitative and qualitative aspects of language that may be used in the intervention process in choosing targets and outcome measures (Komeili and Marshall, 2013, p.153, and references therein), such tasks may not reflect real-life situations of language use. As such, many SLTs also use language sampling as an assessment tool (Caesar and Kohler, 2009, and references therein). Examples of language sampling include conversation samples, narratives, and expository discourse (Hadley, 1998). However, naturalistic language sampling also has limitations. Assessing conversational language samples may under-estimate children’s expressive language ability (Steel, Rose, Eadie and Thornton, 2013). They may also fail to elicit specific
examples of language under investigation, as highlighted in the previous section.

Botting (2002) argues that the use of narratives in assessing children’s language production is an important tool, and proposes that narratives can be both “structured enough to form the basis of a comparison between children” and “naturalistic enough to reflect conversational style and the errors within this” (Botting, 2002, p.5). Story retell with picture support is seen as a more facilitative method for a child to produce a narrative, where specific target structures (e.g., specific verbs or tense morphology) can be modelled by the examiner in the initial story telling which subsequently may facilitate their use during the child’s retelling, provided they are within the child’s productive capacity (Hesketh, 2004, p.163). As the narrative retell is more demanding both linguistically and cognitively than, for example, a more structured elicitation task, Hesketh (2004, p.176) notes that it is more representative of a child’s everyday performance ability, that is, it is more ecologically valid. Moreover, Thordardottir (2008, p.933) suggests that a narrative task is suitable to assess grammatical morphology in younger and older school-aged children, given that the task is demanding and will thus highlight vulnerabilities in a child’s language that might not otherwise be seen in a less demanding task. The narrative task is more functional than an impairment-based assessment, particularly when choosing grammatical targets for intervention and possible generalisation into everyday communicative situations (Hesketh, 2004, p.177-9).

Hesketh (2004, p.177) proposes that “the salience of items or their importance to the story” affects their subsequent use in a child’s retelling, and that the initial tester’s model may be adapted to incorporate more complex syntactic structures and thus facilitate the testing of older children. This is an important point as it allows for the possibility of modelling and assessing specific grammatical targets (e.g., different verb types or morphosyntactic elements) in a more ecologically valid assessment procedure. Such an assessment tool would combine the diagnostic strength of standardised tests with the more-ecologically valid language sample, and would be useful in planning subsequent intervention targets for children with language impairments, for example, ditransitive verbs (e.g., give, lean; see Black and
Chiat, 2008; Grela and Leonard, 2000) or change-of-state verbs (e.g., *cover*, *fill*; see Ebbels et al., 2012).

The narrative retell task ‘Captain Grey and the Greedy Aliens’ was developed in part to address these issues and to meet a need for an ecologically valid clinically useful tool that could assess primary-school-aged children in their use of a specific range of verbs based on their semantic and morphosyntactic characteristics, in light of there being no verb specific tests available for children. In this way, not only is a range of argument structure types (i.e., intransitive, transitive, and ditransitive verbs) examined, but additionally a range of event structure types, where differences in the semantics of a verb can also be assessed, for example, the intransitive verbs *fall* (unaccusative verb) and *run* (unergative verb), and the transitive verbs *cover* (change-of-state verb), *pour* (change of location verb), and *peel* (alternating verb) (see Ebbels et al., 2012). Given the discussion so far, such an assessment tool could increase processing load in children when compared to spontaneous speech, and its set of specifically chosen verbs may or may not further increase processing load, depending on the targeted verbs. This tool can highlight not only processing load difficulties, but difficulties with respect to specific semantic and morphosyntactic features. A previous study undertook to gather data from typically developing children using this tool with a view to gathering normative data prior to subsequently evaluating its use with children with language impairment. The data from the normative study provides a useful source to address questions relating to processing load. The children’s output also merits further analysis in relation to verb specific and processing load effects prior to further developing the tool for clinical use.

**Aims and objectives (including hypotheses)**

From the review outlined so far, the following points of interest can be extracted:

1. Narrative elicitation is an ecologically valid assessment method in child language;
A narrative retell task may increase processing load in child language production; Sentence complexity may increase processing load in child language production; Argument-structure complexity may affect processing load in child language production; Additional processing load in sentence production affects production of English morphosyntax; Children with language impairment have difficulties with verb semantics and morphosyntax; Children with language impairment have a more limited cognitive processing capacity.

Complexity of VAS (i.e., ditransitive verbs versus non-ditransitive verbs) as well as an increase in task demand (i.e., processing load) as found in narrative production have been shown to affect production of grammatical morphology in children. Not only is there a need for an ecologically valid assessment tool (e.g., narrative retell) which examines VAS and tense elicitation in child-language production (i.e., targeting specific verb tokens), such a tool also presents an opportunity to further address questions relating to the impact of processing load on grammatical production. Using MLU as a proxy measure of additional processing load, this study examines the effect of ditransitivity on past-tense elicitation, and the effect of MLU on production of past-tense morphology and obligatory arguments in specific verbs. In doing so, a more ecologically valid assessment tool is employed: a narrative retell. The hypotheses that will be tested are as follows:

1. In a narrative retell task, VAS (as measured by number of arguments: 3, <3, to compare ditransitive verbs to non-ditransitive verbs) affects the production of past-tense morphology in typically developing children.
2. In a narrative retell task, grammatical complexity (i.e., MLU) affects the production of past-tense morphology in typically developing children.
3. In a narrative retell task, mean length of utterance affects the production of obligatory arguments in typically developing children.
Methods

Participants
The study sample consisted of 91 typically-developing school-aged children aged 4;6 to 12;0 years-of-age, and were divided into the following age bands: 5;06 and younger (n=8), 5;07-6;06 (n=19), 6;07-7;06 (n=16), 7;07-8;06 (n=9), 8;07-9;06 (n=10), 9;07-10;06 (n=9), 10;07-11;06 (n=12), and 11;07 and older (n=8). The children were recruited from 4 primary schools in the south of Ireland from both rural and urban communities. Inclusion criteria for participants were as follows: English was their first language; no diagnosis of an intellectual disability; no history (previous or current) of receiving speech and language therapy or suspected speech language and communication needs; no hearing impairment. The final sample comprised of 90 participants as one participant was omitted due to insufficient biographical data. Table 1 below shows the age bands of the participants and how many were in each group.

Table 1: Number of participants in each age group.
Design
This study is a secondary analysis of data collected by MSc Speech and Language Therapy students in a previous study of the n=91 children. The data are transcripts of a narrative task in which participants were told the ‘Captain Grey and the Greedy Aliens’ story (a narrative retell task developed by Dr. Carol-Anne Murphy) and subsequently asked to retell it using a wordless picture book. 44 different target verbs (48 target verb-tokens in total) were selected to be included in the story, each based on their morphosyntactic and semantic characteristics, for example, transitive chase and sweep; ditransitive tell and put; intransitive run, and fall, change of state verbs cover and fill, change of location verbs pour, lean, and put, and alternating verbs empty, clear, and sweep (see Appendix 1 for a full list of the verbs). The task is designed for primary-school-aged children. The data from the retell task were gathered without the assistance of prompts from the researcher. As such, elicitation of every verb from every child did not occur. Although the retell task does facilitate 2 levels of prompting to gather all verb tokens, this aspect of the tool’s design was not examined in this study due to inconsistent methods of prompting among the original researchers affecting past tense production.

Picture 1: Scenes from the Captain Grey picture book
**Analysis**

Data was analysed using SPSS-22 to investigate if significant correlations are present between omission of morphology, argument structure and sentence complexity (as measured by MLU) in primary-school-aged children. Each utterance from each of the 90 children that contained a target verb was coded as follows:

1. MLU (i.e., length of utterance in morphemes)
2. VAS as measured by valency (i.e., 1, 2 or 3 obligatory arguments, noting errors of omission)
3. Past-tense marking (regular, irregular or over-regularisation) on the target verbs and errors of omission of tense markings.

Utterance length was calculated by number of morphemes using guidelines as recommended by Paul and Norbury (2012, p.303). However, utterances joined with the conjunction *and* which contained overt external arguments in both (i.e., subjects) were treated as distinct utterances. For example, ‘Green aliens came to the planet Bog and they stole cars and sometimes people’ was treated as two distinct utterances, ‘Green aliens came to the planet Bog’, and ‘They stole cars and sometimes people’. ‘And’ in these instances was considered a “discourse filler, with no semantic or thematic motivation other than to indicate that ‘more is still to come’” (Berman and Slobin, 1994), and was not included in the MLU count.

A possible limitation of using MLU as a variable in this study regards the amount of utterances that should ideally be included in a conversation sample for the purpose of capturing MLU (Paul and Norbury, 2012, p.303). No participant produced 50 utterances in the retell task. That said, the MLU was used to measure the length of individual sentences and was not employed as a means of finding the mean sentence length for each participant in each narrative. MLU was used merely as a proxy measurement to assess processing load in sentences where the target verbs were elicited. A further limitation with using MLU as a measure of processing load is that complex utterances (for example, clauses containing both a matrix clause and a subordinate clause) and simple utterances (i.e., no subordination or coordination in the clause) are treated similarly, that is, on their length in morphemes and not syntactic
complexity. Research has shown that complex sentences are problematic for children with SLI (see, e.g., Leonard, 2014; Hulme and Snowling, 2009, p.149).

Three statistical tests were run on the data: Spearman’s Rho correlation (where both variables are scalar), Pearson’s Chi-squared (where both variables are categorical/qualitative), and Mann-Whitney U test (where one variable is binary/categorical, and one is scalar).
Results

Frequencies of verb elicitation, VAS and tense errors

The frequency with which the target verbs were elicited on initial retell is not high. Table 2 below shows the mean number of targeted verbs (from a total of 48 tokens) that were elicited among our participants. The range of verbs elicited was 28 (a low of 9 verbs to a high of 37 verbs), and was elicited across verb classes and across the chronological order of the story.

Table 2: Mean Total of Verbs Elicited by Age-Group

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>5;06 and Under</td>
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<td>3.071</td>
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<td>11;07 and above</td>
<td>24.00</td>
<td>8</td>
<td>4.870</td>
</tr>
<tr>
<td>Total</td>
<td>21.88</td>
<td>90</td>
<td>5.780</td>
</tr>
</tbody>
</table>

A Spearman rho test of correlation (as both variables being tested are scalar) was performed to establish whether there was a correlation between age in months and number of verbs elicited. A statistically significant correlation was found between age in months and number of verbs elicited ($r = .46, n = 90, p < .000$). There was a medium positive correlation between age in months and the number verb token elicited; as age increased the number of verbs elicited on the initial retell also increased.

Omissions of obligatory past-tense markings and obligatory arguments were rare. Table 3 and Table 4 below show the number of errors recorded from our participant groups.
Given the distribution of the errors across the age bands, and since age related change could influence errors, Spearman rho tests of correlation (as all variables being tested are scalar) were performed to establish whether there
was a correlation between age in months and number of tense omissions, and age in months and number of VAS errors. Statistically significant correlation was found between age in months and tense omissions ($r = -0.37, n = 90, p < .000$) and age in months and omissions of obligatory arguments ($r = -0.35, n = 90, p < .001$). There were medium negative correlations between age in months and the number of VAS errors and age in months and the number of tense omission, that is, as age increased number of VAS and tense omissions decreased.

Further Spearman rho tests of correlation were performed to establish whether there was a correlation between age in months and omission of external arguments, and age in months and omission of internal arguments. Statistically significant correlation was found between age in months and omissions of external argument omissions ($r = -0.35, n = 90, p = .001$) and age in months and omissions of internal arguments ($r = -0.24, n = 90, p = .021$). There was a medium negative correlation between age in months and omissions of external arguments and a small negative correlation between age in months and omissions of internal arguments; that is, as age increased the number of internal and external argument omissions decreased.

The results from our original hypotheses are as follows:

**Hypothesis 1**
In a narrative retell task, VAS (as measured by number of arguments: 3, <3, to compare ditransitive verbs to non-ditransitive verbs) affects the production of past-tense morphology in typically developing children.

A Pearson Chi-squared test of correlation was performed on each of the 48 targeted verb tokens (as all variables are categorical). Cross-tabulations did not yield evidence of a relationship between the number of obligatory arguments and past-tense elicitation. The null hypothesis cannot be rejected.

**Hypothesis 2**
In a narrative retell task, grammatical complexity (i.e., MLU) affects the production of past-tense morphology in typically developing children.

Mann-Whitney U tests were performed on each of the 48 verb tokens to assess whether MLU (scalar variable) affected production of past-tense morphology.
(binary/categorical variable). Two verbs, *sweep* and *grate* showed statistical significance: *Sweep*: Mann-Whitney U: $z = -2.42$, $p = .02$, $r = .29$, a medium effect; *Grate*: Mann-Whitney U: $z = -2.59$, $p = .01$, $r = .15$, a small effect. For both verbs, MLU decreases when errors are present.

**Hypothesis 3**

In a narrative retell task, mean length of utterance affects the production of obligatory arguments in typically developing children. Mann-Whitney U tests were performed on each of the 48 verb tokens to assess whether MLU (scalar variable) affected production of obligatory arguments (binary/categorical). Two verbs, *sweep* and *give*, showed statistical significance: *Sweep*: Mann-Whitney U: $z = -2.42$, $p = .02$, $r = .29$, a medium effect; *Give*: Mann-Whitney U: $z = -2.42$, $p = .02$, $r = .26$ a medium effect. For both verbs, MLU decreases when errors are present.
Discussion

In this study of typically developing school-aged children, omissions of past-tense and obligatory arguments were not common-place. This is in keeping with findings from previous studies (e.g., Thordardottir, 2008; Thordardottir and Ellis Weismer, 2002).

Hypothesis 1: the effect of ditransitivity on past-tense production

In Grela and Leonard’s (2000) study of the influence of argument-structure complexity on the use of auxiliary verbs, typically developing children (aged 4;02-6;7 years) were found to reach ceiling levels in their production of tense morphology on a sentence elicitation task; (di)transitivity was found to have no effect on the elicitation of auxiliaries in the language production of their participants. Our findings are in line with Grela and Leonard (2000), with our participant group of typically-developing children also not showing any significant correlation between their use of ditransitive verbs and tense omission errors. In addition, the present study extends the findings of Grela and Leonard (2000) by indicating that argument structure complexity may not affect tense production in both younger and older typically developing primary-school children. This study further adds to Grela and Leonard’s (2000) findings to include tense morphology on lexical verbs. These results are noteworthy as they suggest that even when processing load is increased (i.e., using a narrative retell versus a story-completion/elicitation task), ditransitivity does not affect the production of past-tense morphology in typically developing children. Such finding, however, are presented with one caveat. Tense omission errors did occur in some instances during our data collection, and a definitive ceiling effect was not observed for the production of past-tense morphology. This point will be discussed later with regard to age of participants.

Hypothesis 2: the effect of MLU on past-tense production

In line with Eisenberg et al. (2001) but contra Rice et al. (2010), this study adopted a cautious stance towards using MLU as a sole indicator of possible language impairment. Instead MLU was employed as a proxy measure of additional processing load so as to investigate whether an increased MLU
would cause difficulties in past-tense production. Although Grela and Leonard (2000) found no utterance length effect regarding tense omission errors, Charest and Johnston (2011, p.21) note that when children attempt longer and more complex utterances, errors have been shown to increase in their production (e.g., omission of obligatory arguments, omission of tense morphology). Such equivocal findings should not rule out MLU as a tool that can assist in the language assessment of school-age children. A narrative task has been found to promote an increased MLU in utterances (Thordardottir, 2008). However, our findings regarding the effect of MLU on past tense production in typically-developing school-aged children indicate that an increased MLU may not affect tense production. Instead, results indicate that MLU decreases with the use of specific verbs: sweep and grate.

With regard to sweep, it may be interpreted as an alternating verb with many argument realisation options (e.g., John swept; John swept the floor; John swept the crumbs into the corner; John swept the leaves into a pile; John swept the leaves off the path; John swept the floor clean; see Levin and Rappaport Hovav, 2005, p.232). It is possible that with the amount of options, a verb like sweep is not detailed enough in some children’s semantic representations. Gropen, Pinker, Hollander and Goldberg (1991) and Pinker (1989), cited in Ebbels et al. (2012, p.2) propose that without such detailed semantic representations of verbs like sweep, children have problems using its VAS correctly. A possible consequence of inadequate semantic representations may be that both MLU and tense morphology are more vulnerable. An increase in processing load may also be implicated as shorter sentences have been shown to result from an increase in processing load in adults (see Charest and Johnston, 2011, and references therein). Both suggestions would need to be investigated further.

With regard to grate, there is no obvious answer as to why errors of tense omission and a decrease in MLU occurred. As error totals are few in the data set, perhaps this verb is later acquired by children and, like sweep, may have weaker semantic representations.

The possibility that age is the causative factor in omission errors in tense will be discussed below.
Hypothesis 3: the effect of MLU on the production of obligatory arguments

As was highlighted earlier, there are three important characteristics of language production processing: (1) the processing cost needed to produce an utterance can exceed the speaker's processing resources, (2) processing costs can vary between language operations, and (3) processing costs in one domain (e.g., syntax) can affect performance in another domain (Charest and Johnston, 2011, p.18). With this in mind, this study examined whether an increase in MLU (a proxy measure of additional processing load) would affect the production of obligatory arguments. As with hypothesis 2, only 2 verbs showed a statistically significant correlation between MLU and argument omission, with a decrease in MLU co-occurring with argument omission with the verbs *sweep* and *give*. We have already presented a discussion on *sweep*, with incomplete semantic representations being a probable cause for argument omissions, coupled with the possibility of an increased processing load causing median MLU to decrease when errors are present. Such an explanation is far from definitive and would need further study to unravel processing load capacity and areas of language that are relatively more vulnerable than others.

With regard to *give*, this is a change-of-possession verb with 3 obligatory arguments. Black and Chiat (2008, p.293) note that children with SLI have greater difficulty with three-argument structures and double-object structures expressing change of possession and change of state. However, this study is of typically developing children. Moreover, according to the MacArthur-Bates Communicative Development Inventory (2007), *give* is a verb that is acquired relatively early. Perhaps with increased processing load (in a narrative retell task and a ditransitive verb) and the possibility of age being a factor, as younger children have a more limited processing capacity than their older typically-developing counterparts (Kail and Salthouse, 1994), *give* has shown a statistically significant difference between the verb and MLU, with median MLU decreasing when argument omissions are present.
Tense omission, obligatory argument omission, and age

Although omissions errors in tense and obligatory argument occurred in children up to the age of 10;07-11;06, most of the errors that occurred were in younger participants. Of the 18 tense omission errors, almost two thirds (11/18) were from children aged 6;06 and younger. Of the 22 errors of omission of obligatory arguments, almost two-thirds (14/22) were from children aged 6;06 and younger. The statistically significant correlations between age and tense omission and age and obligatory argument omission may be attributed to a more limited processing capacity in younger children relative to their older typically developing counterparts (Kail and Salthouse, 1994). This age effect could be explained as a process of typically developing children.

Limitations

As has been highlighted in passing throughout this paper, this study does have some limitations. Firstly, in assuming that MLU (as a proxy measure of processing) would increase overall processing load, it was not considered that MLU itself would be a vulnerable aspect of language to other increased processing demands and would decrease as processing load increased. Further examination of the data using regression analyses to test for a combined effect of VAS and tense errors on MLU, VAS and MLU on tense omission, or tense production and MLU on VAS errors may facilitate a more in-depth analysis of VP errors (tense and argument) and production limitations in errorless utterances (e.g., MLU). That said, this fact can be an additional indicator in the language assessment process of school-aged children, whereby a decreased MLU may be indicative of increased processing demands or processing capacity. As narratives facilitate an increased MLU (Thordardottir, 2008), where MLU decrease in narratives may indicate difficulties in specific aspects of language (e.g., verb types).

A further limitation is the inability to compare these data to those after participants received prompting to elicit all remaining targeted verbs. As was highlighted in the results section, verb-token elicitation on the initial retell was low, with a statistically significant correlation between age and tokens elicited (i.e., younger participants produced less target verbs on the initial retell than the
older participants). Although the retell task does facilitate prompting to target all verb targets, this aspect of the tool’s design could not be examined due to inconsistent methods of prompting among the original researchers affecting past tense production. A test where all tokens are elicited would increase its validity.

**Conclusions**

At times, typically developing school-aged children present with omissions of obligatory arguments and/or past-tense morphology. With specific verbs (sweep, give, and grate), these omissions correspond to a decrease in grammatical complexity (MLU) in language production. A factor that may explain tense errors and obligatory argument omission is age. Younger children make more errors on tense morphology and VAS than their older counterparts suggesting that the data set in this study has captured the developmental progression of typically-developing school-age children in their production of specific verb types and finiteness using an ecologically valid tool, a narrative retell. Although this narrative retell tool, *Captain Grey and the Greedy Aliens*, has yielded some interesting finding from the data collected from an initial retell, it is vital that the all verb token be elicited during assessment so as to fully explain how VAS, MLU and finiteness may interact to increase (and at times surpass) a child’s processing capacity. Moreover, it is recommended that further data be collected from typically developing children and children with SLI using this tool so as to compare and contrast both data sets and to further assess the validity and reliability of this language assessment.
References


Owen, A.J. (2010). ‘Factors affecting accuracy of past tense production in children with specific language impairment and their typically developing


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**Appendix 1**

**The target verbs from the retell task are as follows:**

Live, steal, capture (x2), chase, sweep, destroy, clear, empty, phone, fly, email, lean (x2), push, run (x2), pour, fall, pick (up), spread, peel, grate, cover (x2), turn, fill, give, stuff, land, stay, yawn, take (out), shake, jump, drop, groan, throw, sink, crawl, pretend, think, tell, shout, marched (off), bet, bring x back, put.