Department of Clinical Therapies
University of Limerick
Final Year Project

“Captain Grey and the Greedy Aliens” a story retell for verb production at sentence level: Pilot standardization study

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14th May 2014

Word Count: 7,820

Submitted in partial fulfilment of the regulations for the award of the MSc (Professional Qualification) in Speech and Language Therapy, University of Limerick.
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Abstract

Background: Children with specific language impairment (CwSLI) may demonstrate difficulties with sentence production characterised by errors in use of verbs and relevant argument structures. Poor verb semantic knowledge has been linked to these sentence production weaknesses. Appropriate assessments are required to identify intervention needs in CwSLI who experience particular difficulties in acquiring and using verbs: the omission of obligatory arguments and incorrect mapping between elements. A story retell tool, “Captain Grey and the Greedy Aliens”, was designed to incorporate a range of semantic-syntactic verb classes and their associated argument structures with a view to clinical use in assessment of language impairments.

Objectives: The current study aimed to gather normative data from typically developing (TD) children using a story retell tool, to assess the sensitivity of the tool and to identify TD patterns of verb errors.

Methods: The Story Retell tool and a test of verb comprehension (ToVK), were administered to 91 TD children aged between 4;10 and 12;0 years. Participants were audio-recorded, retelling the story with graduated prompts used when the target verbs were not produced in the narrative. Transcripts were scored for mean sentence complexity and accuracy of verb argument structure. A score for verb knowledge was derived from the ToVK. Statistical analyses explored the relationship between the key variables and age, and the influence of verb knowledge on sentence production.

Results: The results showed close relationships between verb knowledge and sentence level production. A significant relationship between age and the dependent variables was identified. Ceiling effects across the older age bands were found for verb knowledge and accuracy of verb production. The majority of errors occurred on low frequency verbs. Participants <7;05 years showed particular difficulty with di-transitive verbs and optionally transitive verbs.

Conclusions: Pilot data indicates Captain Grey may be a useful tool in the assessment of language impairments. Further recruitment of younger participants would be recommended to strengthen the overall reliability of the assessment tool.

Key Words: verb argument structure, sentence production, verb knowledge, story retell tool, normative data
Introduction

Children with specific language impairment (CwSLI) exhibit difficulties with morphology, syntax, semantics, complex sentence production, and language comprehension (Bishop 2014; Leonard 2000; McGregor 2009; Schwartz 2009). This occurs despite age appropriate hearing, intelligence, neurological function, and social interactions (Ebbels et al 2012; Leonard 2000; Schwartz 2009). Both limited linguistic knowledge and processing based limitations are proposed to explain their difficulties (Rice et al 1995; Schwartz 2009). SLI affects 7% of young children (Tomblin et al 1997) and for some of these children can persist into adolescence (Nippold 2007) and into adulthood (Clegg et al 2005). Persisting SLI is associated with poor academic attainments/outcomes (Conti-Ramsden 2008) and social problems (Clegg et al 2005; Fujiki et al 1996).

Garrett’s model of sentence processing (1988, cited in Marshall 1997) incorporates the semantic and syntactic elements of sentence production. CwSLI show evidence of variable patterns of error in sentence production such as omitting function words, errors in word order, verb errors or have a preference for nouns over verbs (Marshall 1997). Verbs play a key role in sentence production as sentences are built around verbs (Chiat 2000).

Currently there is a lack of comprehensive assessments available to test children’s acquisition of verbs and verb types. To offer properly targeted intervention to CwSLI, who experience particular difficulties in acquiring verbs (Leonard 2000; Thordardottir and Weismer 2001b; 2002), appropriate assessments are required. Murphy (2013) designed a story retell tool, “Captain Grey and the Greedy Aliens”, which targets a range of specific verbs and verb argument structures. The current study aims to collect and standardise normative data from typically developing (TD) children in order for the current assessment tool to be used by clinicians in the diagnosis of language impairment.

This paper provides a review of the impact of verbs on argument structures on sentence production. Methods of elicitation will be investigated and the aims of the current study will be outlined.
**Verb Knowledge**

CwSLI often present with poor verb knowledge, difficulties with verb argument structure (VAS) production and produce significantly more errors when using more complex verbs (Conti-Ramsden and Jones 1997; Ebbels 2005; Grela 2003). During the early development of language, young children produce a number of overgeneralised errors including argument structure overgeneralisations i.e. “*The magician disappeared the rabbit*” (Ambridge *et al* 2008). The use of these error forms cease as TD children acquire the adult form of language however, CwSLI continue to produce such errors over a longer period of time (Ambridge *et al* 2011).

During the acquisition of verb productions TD children produce utterances which exhibit many obligatory argument omissions. As their knowledge of verbs develops (Thordardottir and Weismer 2002), they experience the productions of verbs at higher frequencies, significantly reducing the number of errors produced (Ambridge *et al* 2008). However, due to their difficulties with semantic representations, CwSLI experience significant problems with VAS (Ebbels 2005). Persisting language difficulties negatively affect CwSLI ability to succeed academically (Conti-Ramsden 2008).

**Verb Argument Structure**

Jones and Conti-Ramsden (1997) found that younger siblings used verbs which they were familiar with more often than their older siblings with SLI who also knew the same verbs. This suggests that CwSLI experience difficulty using the verbs within their lexicons in various contexts (Jones and Conti-Ramsden 1997). Verbs are essential features in sentence production as they capture the event (Chiat 2000) thus providing a connection between meaning and sentence structure (Thordardottir and Weismer 2002). Specific syntactic data of verbs are stored in subcategories within the lexicon referred to as the argument structure (Pinker 2013). Children require appropriately developed semantic representations of verbs in order to correctly link VAS with their verb types (Ebbels *et al* 2012; Pinker 2013) as different verbs require different argument structures (Black and Chiat 2003).
The complexity of verbs can alter depending on the number of obligatory arguments of a verb (Grela 2003). Intransitive verbs require one argument, transitive verbs require two arguments and di-transitive verbs require three arguments (Chiat 2000; Grela 2003; Thomas 1993). For example the verb *swim* requires one obligatory argument, “I swim”, while the verb *put* requires three arguments, “She put the book on the table”. Previous studies have shown that CwSLI tend to omit more obligatory and optional arguments, use verbs which require fewer arguments and use fewer verb types (Ebbels et al 2007; Ingham et al 1998; Thordardottir and Weismer 2002). Sentences can also be accompanied by adjuncts which act as optional modifiers that do not affect the complexity of the argument structure (Grela 2003; Leonard and Deevy 2004). However, the adjuncts provide additional information about the event/scene being described and contribute to increased sentence length and overall complexity.

Other sources of errors relate to the complexity of mapping between semantics and syntax for some verb classes. These include: change-of-state, change-of-location and cognitive state verbs (Owen van Horne and Lin 2011). Research has shown that TD children as well as CwSLI produce more errors when using change-of-state verbs than change-of-location verbs (Ebbels 2005; Ebbels et al 2012; Kelly 1997). Errors in the production of change-of-state persist for longer as children may have difficulty understanding the meaning of the motion changes in state verbs (Gropen et al 1991, cited in Ebbels et al 2012) which are less salient than change-of-location verbs (Ebbels 2005, cited in Ebbels et al 2007). In their study Ebbels et al (2012) found that CwSLI produced more errors than age- and MLU-matched controls in their productions of change-of-state verbs. No significant difference was found between CwSLI and both control groups in the use of change-of-location verbs.

The production of cognitive state verbs (CSVs) also causes difficulty for both TD children and CwSLI as they involve semantic, cognitive and syntactic demands including finite and non-finite complement clauses, making them quite complex (Owen and Leonard 2007). Due to the complexity of CSVs CwSLI tend to produce higher error rates than their MLU-matched peers and use general verbs more frequently than mental verbs (Johnston et al 2001). The results reported by Johnston et al (2001) contrast to those reported by Owen van Horne and Lin (2011). The latter found no significant differences in the use of CSVs in a conversational task in CwSLI and their age- and
MLU-matched controls but the CwSLI produced fewer low frequency CSVs in a narrative task than their age- and MLU-matched peers. However, Owen van Horne and Lin (2011) used controls that were two-four years older than the controls used by Johnston et al (2001), suggesting that the production of state verbs in CwSLI improves over time.

Sentence Production

During language development, children’s mean length of utterance (MLU) increases which predicts the complexity of their language (Paul and Norbury 2012). Increases in MLU relates to increases in utterance complexity (Owens 2012). When an MLU of 4.0 is obtained the development in utterance length significantly reduces (Owens 2012). According to Oetting and Hadley (2009) CwSLI often present with a low mean length utterance (MLU) for his/her chronological age which indicates frequent use of short, simple sentences.

Studies have shown that CwSLI experience particular difficulty with sentences requiring three argument structures (Ebbels 2005; Grela and Leonard 1997; 2000). Grela and Leonard (2002) compared the argument structure complexity (n=30) of CwSLI (4;2-6;7) with MLU and age-matched controls and found that both CwSLI and MLU-matched controls omitted more auxiliary forms in sentences with di-transitive verbs than in sentences with intransitive and transitive verbs, although CwSLI omitted more auxiliary verbs than MLU-matched controls. Ebbels (2005, cited in Black and Chiat 2008) also found that CwSLI frequently omitted obligatory object arguments when using di-transitive verbs compared with MLU and age-matched controls. These results contrast with Thordardottir and Weismer’s (2002) study (n=100) which compared the VAS in CwSLI (5;5-9;8) with MLU and age-matched controls and found no significant difference in the production of VAS in CwSLI and MLU-matched controls. However the CwSLI in Thordardottir and Weismer’s (2002) study produced fewer di-transitive verbs and fewer verb alternations compared with MLU-matched controls. Differences may also be attributed to Grela and Leonard (2002) and Thordardottir and Weismer’s (2002) use of controls of different age ranges and different elicitation methods. Grela and Leonard (2002) used a story completion task to
elicit targeted sentences with varying verb types and argument structures while Thordardottir and Weismer (2002) measured production of VAS in spontaneous speech. Nonetheless both studies identify limitations of the use of VAS in CwSLI.

Elicitation Methods

As CwSLI have particular difficulty with verbs and their argument structures, Loeb et al (1996) state that it is imperative to use an elicitation technique which targets verb forms by taking the following factors into consideration: verb semantics, syntactic structure and frequency of use. Spontaneous language sampling has been frequently used as an elicitation technique by clinicians for setting language therapy goals (Eisenberg 2005). However this technique has its limitations. Tyack and Gottsleben (1986, cited in Eisenberg 2005) reported that TD children tended to produce complex sentences less frequently in spontaneous speech. Paul and Norbury (2012) note that it is quite problematic to obtain a true picture of a child’s language potential in an unnaturalistic environment in both children with language impairment and TD children. McCormick (1997, cited in Paul and Norbury 2012) recommends the use of ecological assessments which involves assessing any individual with a communication difficulty regardless of whether or not their IQ is within the normal range. The intervention then focuses on supporting the individual need to participate within his/her own environments (Paul and Norbury 2012).

Murphy (2007) states that a story-retell task is an effective technique for investigating a child’s language skills as the level of input can be controlled in terms of length, complexity and content which is not feasible in story-generation tasks. Gazella and Stockman (2003) found that story retell was a more effective task for elicitation than direct questioning tasks as the story retell task elicited more complex argument structures. Murphy (2013) designed “Captain Grey and the Greedy Aliens”, which involves story-retelling, aiming to elicit a range of verbs and their argument structures presented in scenes designed to elicit a range of sentence types. This tool was previously piloted with a small group of CwSLI and was subsequently modified to include CSVs.
Assessment Tools

Assessment tools in clinical use including the new Reynell (Edwards et al 2011) and the Clinical Evaluation of Language Fundamentals (CELF 4) (Semel et al 2003) incorporate verbs in some subtests. The former includes assessment of simple argument structures but has an upper age limit of sixteen years. The CELF 4 includes verbs in some subtests but does not encompass the range of specific verbs required to analyse the client’s strengths/weaknesses. There is a lack of comprehensive assessments available for children which elicit a range of specific verbs. Ebbels et al (2007) and Loeb et al (1996) developed protocols for the elicitation of verbs and verb types however these are not widely available. Adult assessments such as the Verb and Sentence Test (VAST) (Bastiaanse et al 2002) are not standardised for childhood populations.

Conclusion

CwSLI demonstrate a limitation in their production of verb argument structure and produce a greater number of errors when using more complex verbs which ultimately effects their ability to succeed academically. As outlined before in previous studies CwSLI produce similar errors to TD children, however, these errors persist for a longer period in CwSLI (Leonard and Deevy 2011; Rice et al 1998). The purpose of this study is to collect and analyse normative data from TD children in order to standardise the assessment probe “Captain Grey and the Greedy Aliens”, which has been designed by Murphy (2013) to elicit a range of verbs and related argument structures. An error analysis of the data will ascertain the verb types and argument structures used by TD children including optional argument structure types in sentences of increased complexity. The significance of the relationship between verb knowledge and sentence production will also be explored. The data will facilitate clinicians in the identification of language difficulties as previously mentioned studies have shown evidence that CwSLI often omit obligatory verb arguments particularly when verb argument complexity increases such as for verbs which require three arguments e.g. ”to put”.

Aims

The aims of the present study were:

- To gather normative data from children aged 4;06-12;0 years on their mean complexity of sentence, production of verbs and their associated structures, using a newly designed Story Retell assessment tool, *Captain Grey and the Greedy Aliens*.

- To assess the sensitivity of the assessment tool to developmental progression across the age bands.

- To assess inter-rater reliability of the assessment tool.

- To investigate the relationship between stored verb knowledge and sentence production length and accuracy as determined by the Story Retell tool.
Methods

Participants

Data used in the current study was collected from four primary schools in Counties Clare and Cork. Each school was contacted by the principal investigator and agreed to participate in the study in accordance with the ethical approval. The schools comprised of rural and suburban locations and varied in size. Information letters and consent forms were provided to the school principals and parents prior to data collection which are presented in Appendices A and B. The study required data from TD children aged between 4;06 to 12;0 years.

Each participant was recruited in accordance with a set of inclusionary and exclusionary criteria:

Table 1.1

<table>
<thead>
<tr>
<th>Inclusionary Criteria</th>
<th>Exclusionary Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male and female TD children</td>
<td>Identified hearing difficulty</td>
</tr>
<tr>
<td>Aged between 4;06 and 12;0 years</td>
<td>Speech, language or communication difficulty</td>
</tr>
<tr>
<td>English as first language</td>
<td>Intellectual difficulty</td>
</tr>
</tbody>
</table>

The participants of the current study included 91 TD school-age children (CA range 4;10-12;0). There was an uneven spread across the age bands (see Table 1.2). There was also an uneven distribution of gender as the participants consisted of 53 males and 38 females. However, an even gender spread was not required in this study.
Table 1.2

<table>
<thead>
<tr>
<th>Age range</th>
<th>N</th>
<th>Mean age (months)</th>
<th>SD</th>
<th>Range (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4;10 – 5;05</td>
<td>7</td>
<td>62.1</td>
<td>2.4</td>
<td>58 – 65</td>
</tr>
<tr>
<td>5;06 – 6;05</td>
<td>17</td>
<td>71.6</td>
<td>3.4</td>
<td>65 – 77</td>
</tr>
<tr>
<td>6;06 – 7;05</td>
<td>17</td>
<td>82.1</td>
<td>4.0</td>
<td>78 – 89</td>
</tr>
<tr>
<td>7;06 – 8;05</td>
<td>9</td>
<td>94.6</td>
<td>4.3</td>
<td>90 – 101</td>
</tr>
<tr>
<td>8;06 – 9;05</td>
<td>9</td>
<td>109.3</td>
<td>4.2</td>
<td>102 – 113</td>
</tr>
<tr>
<td>9;06 – 10;05</td>
<td>12</td>
<td>119.3</td>
<td>3.7</td>
<td>114 – 125</td>
</tr>
<tr>
<td>10;06 – 12;0</td>
<td>20</td>
<td>133.3</td>
<td>6.0</td>
<td>127 – 144</td>
</tr>
</tbody>
</table>

Materials

A Story Retell tool, Captain Grey and the Greedy Aliens, consisted of a wordless picture book with 14 pages, including from 1 to 4 separate scenes. The probe contained a mixture of high and low frequency verbs and was designed to include verbs from a range of semantic-syntactic classes. Verb types included:

- Intransitive, transitive, optionally transitive and di-transitive verbs
- Alternating verbs i.e. give, throw
- Unergative and unaccusative verbs i.e. crawl, sank
- Semantic classes including manner of motion, change-of-location and change-of-state.

A prescribed script accompanied the assessment tool (see Appendix C). The scoring form for the Story Retell is presented in Appendix D. The Test of Verb Knowledge (ToVK) used to assess verb knowledge, includes 36 verbs, each presented as a drawing with three other distractor verbs.
Procedure

Each participant was assessed independently in their school. The ToVK was administered first as it required a non-verbal response. Therefore it allowed the child to become comfortable with the researchers and placed no pressure on the child to verbalise in the initial part of the assessment. Three initial trial items were used to familiarise the child with the test format.

For the Story Retell task each child looked at the pictures as the researcher told the story. Each child was then audio-recorded retelling the story. Graduated prompts were provided when a child did not use the target verbs. For the participants aged 4;10-6;11 years each session lasted approximately 30 minutes and for the participants aged 7;0-12;0 years each session lasted approximately 20 minutes.

The narrative probes were divided into utterances using the following segmenting rules (Owens 2004, cited in Paul and Norbury 2012):

- A sentence or command is one utterance.
- Run on sentences containing more than one ‘and’ should be segmented at the second ‘and’.
- Pauses, inhalations and falling intonation mark the end of an utterance.
- Complex and compound sentences are treated as one utterance.
- Sentences with a conjoining ‘and’ should be separated into utterances if the second part contains its own subject e.g. He sat down and then he ate his toast (Murphy 2008).

The prompts provided during the assessment were graduated. The first prompt required the researcher to direct the child’s attention to the appropriate scene and ask them to discuss it again: “Can you tell me about this picture again?” When the targeted verb was not produced the child was given the verb and instructed to form a sentence relating to the picture: “Looking at this picture, can you make a sentence with the word “email”?"
**Scoring the Mean Sentence Complexity and Length**

Each utterance was scored on a scale of 1-6 based on the number of arguments and adjuncts and complexity, where appropriate. Intransitive, transitive, and di-transitive verbs with obligatory arguments produced, received a score of one, two and three respectively. Where adjuncts were produced a score of one was awarded for each adjunct used. For example:

“Captain Grey lived on a planet called Bog” → score 2

“Once a guy called Captain Grey lived on planet Bog” → score 3 for adjunct

The following scale, (derived from a rubric developed by Webster et al 2007 and adapted by Murphy (2013) to capture developmental progression in sentence complexity) was used to derive a score for mean sentence complexity in the participants’ sentence productions.

<table>
<thead>
<tr>
<th>Score</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>One to three arguments/adjuncts with verb</td>
</tr>
<tr>
<td>4</td>
<td>2 arguments + 2 adjuncts; 3 arguments +adjunct; simple infinitive sentences and simple conjoining</td>
</tr>
<tr>
<td>5</td>
<td>Subordination/embedding “Sometimes if that didn’t work he chased them back to Planet Bog”, unmarked infinitives, relative clauses</td>
</tr>
<tr>
<td>6</td>
<td>Conjoining and embedding occurring in the same utterance or multiple embedding: “Captain Grey’s mother phoned her son and told him to get rid of the aliens when she saw the mess outside” “CG told him to stay by the spaceships and guard them”</td>
</tr>
</tbody>
</table>

The mean sentence complexity (MSC) was calculated by dividing the total score for all utterances with the target verbs produced across the narrative probe by the total number of utterances produced. The following examples of sentence production were omitted from scoring:

- A synonym of the verb
• A probe-related response

• An off-target response

• No response

• Target verb produced as a noun i.e. “He sent an email” in place of “He emailed”.

Length was scored once only when target verbs were combined in one complex sentence. Where an argument structure was incorrect the length was scored if the intended meaning and structure was considered clear. Ambiguous utterances where omitted from the length calculations.

Scoring accuracy of Verb Argument Structure

The total number of verbs produced with correct argument structure was calculated as a percentage of the total number of verbs elicited (VAS per cent correct). An utterance was scored incorrect for verb argument structure accuracy where the following errors occurred (table 1.4). It must be noted that subject omissions were not marked as errors if they occurred in a context that made the omission appropriate (Thordardottir and Weismer 2002).

Table 1.4

<table>
<thead>
<tr>
<th>Error Type</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omission of obligatory argument</td>
<td>“The aliens cleared all the food” (prepositional phrase required)</td>
</tr>
<tr>
<td>Over-generalisation of an argument</td>
<td>“He flied back to his office”</td>
</tr>
<tr>
<td>structure</td>
<td></td>
</tr>
<tr>
<td>Mapping error</td>
<td>“Captain Grey filled the petrol into the ship”</td>
</tr>
<tr>
<td>Argument ordering error</td>
<td>“Captain Grey turned water with his light sabre into petrol” (order of arguments and adjunct error)</td>
</tr>
</tbody>
</table>
**Inter-rater reliability**

To assess the reliability of the analysis and scoring methods 20% of the samples from participants aged <8 years (9 samples) and 10% of the samples from participants aged >8 years (4 samples) were randomly selected and independently scored by two student researchers. The results indicated 97.17% agreement for verb argument structure accuracy, 93.46% for verb argument structure raw scores, 96.75% for mean sentence complexity and 96.1% for length of utterance. The student researchers consulted with the principal investigator in relation to aspects of coding for items where scores were not in agreement. All samples were then re-checked to ensure accuracy of scoring.

**Study Design**

This was a cross-sectional study which gathered data from TD school-age children using a Story Retell assessment tool.

**Data Analysis**

Statistical analysis consisted of obtaining descriptive statistics from which a set of standard scores were generated. Correlational analysis determined relationships between the independent and dependent variables. Multiple regression investigated the impact of the independent variables on dependent variables. Qualitative analysis was used to describe the patterns of verb errors and levels of sentence production.
Results

Analysis of key variables

Overview of Statistical Analysis

1. Descriptive statistical analysis and Shapiro Wilks test of normality was carried out on all variables to calculate the mean scores and standard deviations.

2. An analysis of correlation was performed to investigate the relationship between age and the dependent variables verb knowledge, MSC and VAS per cent correct with partial correlations controlling for age, to determine the effect of verb knowledge on sentence production.

3. Multiple regression analysis was carried out to investigate whether verb knowledge could predict MSC and VAS per cent.

Table 2.1

<table>
<thead>
<tr>
<th>Measure</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Trimmed Mean 5%</th>
<th>Min</th>
<th>Max</th>
<th>Skewness</th>
<th>Test of Normality</th>
</tr>
</thead>
<tbody>
<tr>
<td>ToVK</td>
<td>91</td>
<td>29.35</td>
<td>3.40</td>
<td>29.50</td>
<td>21</td>
<td>36</td>
<td>-0.680</td>
<td>.001*</td>
</tr>
<tr>
<td>VASpercent</td>
<td>91</td>
<td>92.23</td>
<td>10.67</td>
<td>93.73</td>
<td>27.08</td>
<td>100.00</td>
<td>-3.321</td>
<td>.000*</td>
</tr>
<tr>
<td>MSC</td>
<td>91</td>
<td>2.83</td>
<td>0.43</td>
<td>2.85</td>
<td>1.33</td>
<td>3.61</td>
<td>-0.705</td>
<td>.012*</td>
</tr>
</tbody>
</table>

*Test of Normality: Shapiro-Wilks sig.>.05

Mean Sentence Complexity

The data was unevenly distributed (Mean=2.83, trimmed mean 5%=2.85, SD=0.43). The closeness of the mean and 5% trimmed mean indicates that extreme scores are not having a strong influence on the mean (see figure 1.1). The Shapiro-Wilks’ test of normality indicated uneven distribution as p=0.001. The histogram shows negative skewness as ceiling effects were evident in the older age bands (>8 years).
Accuracy of Verb Argument Structure

The data was unevenly distributed (Mean=92.23, trimmed mean 5%=93.73, SD=10.67). The proximity between the mean and the 5% trimmed mean which indicates that the extreme scores are not having a strong influence on the mean (see figure 1.2). The Shapiro-Wilks’ test of normality indicated uneven distribution as p=0.000. The histogram shows negative skewness as ceiling effects were evident in the older age bands (>7;06 years).
Test of Verb Knowledge

The data for verb comprehension scores on the ToVK was unevenly distributed (Mean=2.83, trimmed mean 5%=2.85, SD=0.43) (see figure 1.3). Results for mean and 5% trimmed mean which indicates that the extreme scores are not having a strong influence on the mean. The Shapiro-Wilks’ test of normality indicated a slightly uneven distribution as p=0.001. The histogram shows negative skewness due to ceiling effects were evident in the older age bands (>7;06 years).

Figure 1.3

Relationship between continuous variables

Correlation analysis was carried out to measure the relationship that age has on the following dependent variables: MSC, ToVK and VAS per cent correct (table 2.2).
Table 2.2

Correlations

<table>
<thead>
<tr>
<th>AgeGroups</th>
<th>MeanSenComp</th>
<th>TOVK</th>
<th>VASperc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation Coefficient</td>
<td>1.000</td>
<td>.622**</td>
<td>.684**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>91</td>
<td>91</td>
<td>91</td>
</tr>
<tr>
<td>Correlation Coefficient</td>
<td>.622**</td>
<td>1.000</td>
<td>.528**</td>
</tr>
<tr>
<td>MSC</td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>91</td>
<td>91</td>
<td>91</td>
</tr>
<tr>
<td>Correlation Coefficient</td>
<td>.684**</td>
<td>.528**</td>
<td>1.000</td>
</tr>
<tr>
<td>TOVK</td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>91</td>
<td>91</td>
<td>91</td>
</tr>
<tr>
<td>Correlation Coefficient</td>
<td>.503**</td>
<td>.520**</td>
<td>.385**</td>
</tr>
<tr>
<td>VASperc</td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>91</td>
<td>91</td>
<td>91</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).

**Progression with Age for Mean Sentence Complexity**

A scatter plot was used to explore the relationship between age and mean sentence complexity. Figure 1.4 shows a curvilinear pattern across the age bands. Mean scores for age groups begin to plateau from the third age band (6;06-7;05 years). Spearman’s correlation shows evidence of a strong positive relationship between the two variables ($r=0.64$, $p<0.001$, 2-tailed), with mean sentence complexity increasing with age.

**Figure 1.4**
**Progression of Age on Accuracy of Verb Argument Structure**

A scatter plot was used to investigate the relationship between the progression of age and accuracy of verb argument structure. Figure 1.5 shows evidence of a ceiling effect across all age bands with the exception of a few outliers. Spearman’s correlation outlined a positive relationship ($r=0.52$, $p<0.001$, 2-tailed).

![Figure 1.5](image)

**Progression of Age on verb knowledge**

Visual inspection of scatter plot indicates a developmental progression with age, with a moderate/strong correlation (Spearman’s rho $r=0.67$, $p>.0001$, 2-tailed). Figure 1.6 shows a linear pattern across the age bands. A ceiling effect is evident from group 3 (6;06-7;05 years).
Effect of verb knowledge on MSC and VAS per cent correct

*Impact of Verb Knowledge on Sentence Level Variables*

Partial correlation was used to investigate the relationship between verb knowledge and accuracy of verb argument structure and mean sentence complexity independently of age. The score reduced from .644 to .459 after controlling for ToVK. This demonstrates a strong positive partial correlation between perceived control of VAS and MSC.
Impact of independent variables on sentence level measures

Impact of ToVK and age independent variables on VAS per cent correct

Using the enter method with ToVK and age as the predictor variables, the model which emerged was significant at the 5% level: F (2,87) = 21.58, p>0.001, explaining 31.6 per cent of the variance (Adjusted R² = 0.316). Table 2.4 provides information regarding the different predictor variables entered into the model, showing ToVK to be a significant predictor of VAS per cent but that age does not contribute to MSC.

Table 2.3

<table>
<thead>
<tr>
<th>Control Variables</th>
<th>VASperc</th>
<th>MeanSenComp</th>
<th>TOVK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Correlation</td>
<td>.644</td>
<td>.555</td>
</tr>
<tr>
<td>VASperc</td>
<td>Significance (2-tailed)</td>
<td>.</td>
<td>.000</td>
</tr>
<tr>
<td>Df</td>
<td>0</td>
<td>.89</td>
<td>89</td>
</tr>
<tr>
<td>Correlation</td>
<td>.459</td>
<td>.620</td>
<td>1.000</td>
</tr>
<tr>
<td>MeanSenComp</td>
<td>Significance (2-tailed)</td>
<td>.000</td>
<td>.</td>
</tr>
<tr>
<td>Df</td>
<td>89</td>
<td>0</td>
<td>89</td>
</tr>
<tr>
<td>Correlation</td>
<td>.558</td>
<td>.620</td>
<td>1.000</td>
</tr>
<tr>
<td>TOVK</td>
<td>Significance (2-tailed)</td>
<td>.</td>
<td>.000</td>
</tr>
<tr>
<td>Df</td>
<td>89</td>
<td>89</td>
<td>0</td>
</tr>
<tr>
<td>Correlation</td>
<td>1.000</td>
<td>.459</td>
<td></td>
</tr>
<tr>
<td>VASperc</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOVK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MeanSenComp</td>
<td>Significance (2-tailed)</td>
<td>.000</td>
<td>.</td>
</tr>
<tr>
<td>Df</td>
<td>88</td>
<td>0</td>
<td>88</td>
</tr>
<tr>
<td>Correlation</td>
<td>.459</td>
<td>1.000</td>
<td></td>
</tr>
</tbody>
</table>

a. Cells contain zero-order (Pearson) correlations.

Table 2.4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean Sentence Complexity</th>
<th>Test of Verb Knowledge</th>
<th>Age (months)</th>
<th>B</th>
<th>SEB</th>
<th>(\beta)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ToVK</td>
<td>.558</td>
<td></td>
<td></td>
<td>1.356</td>
<td>.361</td>
<td>.436</td>
</tr>
<tr>
<td>Age</td>
<td>.472</td>
<td>.656</td>
<td></td>
<td>.078</td>
<td>.048</td>
<td>.186</td>
</tr>
</tbody>
</table>
Impact of ToVK and age independent variables on mean sentence complexity

The model which emerged from using the enter method with ToVK and age as the predictor variables, was significant at the 5% level: F (2,87) = 38.76, p>0.001, explaining 46.1 per cent of the variance (Adjusted R² = 0.461). Table 2.5 provides information regarding the different predictor variables entered into the model, showing ToVK and age to both being significant predictors of MSC.

Table 2.5

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean Sentence Complexity</th>
<th>Test of Verb Knowledge</th>
<th>Age (months)</th>
<th>B</th>
<th>SEB</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>ToVK</td>
<td>.620</td>
<td></td>
<td>.046</td>
<td>.013</td>
<td>.366</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>.631</td>
<td>.655</td>
<td>.007</td>
<td>.002</td>
<td>.389</td>
<td></td>
</tr>
</tbody>
</table>

Standardisation of raw score data

Z scores

Raw scores were transformed into Z scores by age band for MSC and verb knowledge. Mean z scores increase for age (table 2.6). A significant increase in MSC occurred from 4;10 to 9;05 years (range: -1.3 to 0.96) which decreased slightly in the 9;06 to 12;0 year old participants (range: 0.48 to 0.56). A gradual increase between 4;10 to 12;0 years was evident in ToVK (range: -1.44 to 0.73).
Table 2.6

<table>
<thead>
<tr>
<th>Age band</th>
<th>MSC</th>
<th>ToVK</th>
</tr>
</thead>
<tbody>
<tr>
<td>4;10 – 5;05</td>
<td>-1.3001</td>
<td>-1.4395</td>
</tr>
<tr>
<td>5;06 – 6;05</td>
<td>-0.7881</td>
<td>-0.9288</td>
</tr>
<tr>
<td>6;06 – 7;05</td>
<td>-0.3681</td>
<td>-0.1952</td>
</tr>
<tr>
<td>7;06 – 8;05</td>
<td>0.5129</td>
<td>0.3099</td>
</tr>
<tr>
<td>8;06 – 9;05</td>
<td>0.9634</td>
<td>0.4155</td>
</tr>
<tr>
<td>9;06 – 10;05</td>
<td>0.4824</td>
<td>0.5048</td>
</tr>
<tr>
<td>10;06 – 12;0</td>
<td>0.5569</td>
<td>0.7288</td>
</tr>
</tbody>
</table>

Clinical Utility

*Percentile equivalents of raw scores*

Raw scores were transformed into percentile equivalents by age band (tables 2.7, 2.8 and 2.9). The following tables outline the estimated raw scores for each age band mapped against percentile ranks for ToVK, MSC and VAS per cent correct. Using table 2.7 below, theoretically the performance of a child aged 6 years scoring 24 on the ToVK, falls somewhere between the 25th and 50th percentile, that is, the normal range (bearing in mind that the 16th percentile rank is the bottom of the normal range and scores at or below the 10th percentile are clinically significant).
### Table 2.7

Test of Verb Knowledge: Percentiles

<table>
<thead>
<tr>
<th>Age bands</th>
<th>5</th>
<th>10</th>
<th>25</th>
<th>50</th>
<th>75</th>
<th>90</th>
<th>95</th>
</tr>
</thead>
<tbody>
<tr>
<td>4;10 – 5;05</td>
<td>21.00</td>
<td>21.00</td>
<td>21.00</td>
<td>25.00</td>
<td>25.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5;06 – 6;05</td>
<td>22.00</td>
<td>22.80</td>
<td>23.00</td>
<td>26.00</td>
<td>28.50</td>
<td>31.00</td>
<td>-</td>
</tr>
<tr>
<td>6;06 – 7;05</td>
<td>22.00</td>
<td>23.40</td>
<td>27.00</td>
<td>29.00</td>
<td>31.00</td>
<td>32.30</td>
<td>-</td>
</tr>
<tr>
<td>7;06 – 8;05</td>
<td>28.00</td>
<td>28.00</td>
<td>30.00</td>
<td>31.00</td>
<td>33.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8;06 – 9;05</td>
<td>28.00</td>
<td>28.00</td>
<td>28.50</td>
<td>31.00</td>
<td>32.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>9;06 – 10;05</td>
<td>28.00</td>
<td>28.30</td>
<td>29.25</td>
<td>31.00</td>
<td>33.00</td>
<td>33.70</td>
<td>-</td>
</tr>
<tr>
<td>10;06 – 12;0</td>
<td>28.00</td>
<td>28.20</td>
<td>31.00</td>
<td>32.00</td>
<td>33.00</td>
<td>34.00</td>
<td>34.00</td>
</tr>
</tbody>
</table>

### Table 2.8

Mean Sentence Complexity: Percentiles

<table>
<thead>
<tr>
<th>Age bands</th>
<th>5</th>
<th>10</th>
<th>25</th>
<th>50</th>
<th>75</th>
<th>90</th>
<th>95</th>
</tr>
</thead>
<tbody>
<tr>
<td>4;10 – 5;05</td>
<td>1.33</td>
<td>1.33</td>
<td>1.93</td>
<td>2.10</td>
<td>2.74</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5;06 – 6;05</td>
<td>2.00</td>
<td>2.06</td>
<td>2.29</td>
<td>2.52</td>
<td>2.66</td>
<td>2.94</td>
<td>-</td>
</tr>
<tr>
<td>6;06 – 7;05</td>
<td>1.91</td>
<td>2.23</td>
<td>2.49</td>
<td>2.69</td>
<td>2.87</td>
<td>3.07</td>
<td>-</td>
</tr>
<tr>
<td>7;06 – 8;05</td>
<td>2.47</td>
<td>2.47</td>
<td>2.54</td>
<td>3.14</td>
<td>3.39</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8;06 – 9;05</td>
<td>2.83</td>
<td>2.83</td>
<td>2.99</td>
<td>3.25</td>
<td>3.47</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>9;06 – 10;05</td>
<td>2.60</td>
<td>2.61</td>
<td>2.88</td>
<td>3.06</td>
<td>3.25</td>
<td>3.29</td>
<td>-</td>
</tr>
<tr>
<td>10;06 – 12;0</td>
<td>2.60</td>
<td>2.79</td>
<td>2.88</td>
<td>3.09</td>
<td>3.23</td>
<td>3.34</td>
<td>3.45</td>
</tr>
</tbody>
</table>
Table 2.9  

<table>
<thead>
<tr>
<th>Age bands</th>
<th>5</th>
<th>10</th>
<th>25</th>
<th>50</th>
<th>75</th>
<th>90</th>
<th>95</th>
</tr>
</thead>
<tbody>
<tr>
<td>4;10 – 5;05</td>
<td>27.08</td>
<td>27.08</td>
<td>58.33</td>
<td>80.43</td>
<td>93.62</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5;06 – 6;05</td>
<td>62.50</td>
<td>71.04</td>
<td>84.37</td>
<td>89.58</td>
<td>93.68</td>
<td>98.34</td>
<td>-</td>
</tr>
<tr>
<td>6;06 – 7;05</td>
<td>78.72</td>
<td>79.08</td>
<td>85.10</td>
<td>95.83</td>
<td>97.91</td>
<td>100.00</td>
<td>-</td>
</tr>
<tr>
<td>7;06 – 8;05</td>
<td>91.11</td>
<td>91.11</td>
<td>91.67</td>
<td>95.83</td>
<td>98.96</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8;06 – 9;05</td>
<td>83.33</td>
<td>83.33</td>
<td>93.75</td>
<td>97.91</td>
<td>97.92</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>9;06 – 10;05</td>
<td>88.63</td>
<td>90.79</td>
<td>96.33</td>
<td>97.92</td>
<td>100.00</td>
<td>100.00</td>
<td>-</td>
</tr>
<tr>
<td>10;06 – 12;0</td>
<td>86.96</td>
<td>87.47</td>
<td>92.68</td>
<td>97.91</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Verb Error Analysis

Each utterance which contained a target verb was analysed for correct verb argument structure. The majority of errors consisted of the following:

Table 2.10

<table>
<thead>
<tr>
<th>Error Type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omission of obligatory arguments</td>
<td><em>He poured magic juice</em></td>
</tr>
<tr>
<td>Mapping errors</td>
<td><em>Captain Grey filled the petrol into the ship</em></td>
</tr>
<tr>
<td>Incorrect ordering of arguments</td>
<td><em>He put on a rock his gun</em></td>
</tr>
<tr>
<td>Omission of obligatory prepositional phrases</td>
<td><em>Mrs Grey swept the leaves</em></td>
</tr>
<tr>
<td>Misinterpretations of the target verb</td>
<td><em>He bet the aliens up</em> (misinterpreted the verb <em>bet</em> for the past tense of the verb <em>beat</em>)</td>
</tr>
</tbody>
</table>

Errors were produced in all target verbs with the exception of *fell*. The frequency of the verbs errors are outlined in Appendix D. In the sentence production of the verb *phone* a number of children substituted the target verb with synonyms of the verb such as *call*, *ring*. The target verb was also used as a noun: for example “*She called him on the*
phone”, “Captain Grey’s mum came outside and picked up the phone and told Captain Grey what happened”. It must be noted that these productions and interpretations of the verb phone are widely used in Hiberno English. Based on the productions of the verb groan it was evident that a number of the younger participants used their level of syntactic knowledge to substitute for their lack of semantic knowledge of the target verb: for example “they groaned the sandwich in the hole”, “He groaned to puke”, “He groaned they were eating cheese”. Errors of subject omission were also produced using the verb groan.

The five most problematic verbs for the participants, particularly those aged <8 years, were all low frequency, optionally transitive and di-transitive: clear, pour, bet, fill and tell. A range of errors occurred in production of most target verbs across all age bands as outlined in table 2.7. These results show that the incidence of verb errors in sentence production occurred more frequently in the younger age bands (<7;05 years) than in the older age bands (>7;06 years). Participants <7;05 years experienced particular difficulty with di-transitive and optionally transitive, and change-of-state and change-of-location verb semantic classes. Examples of the types of errors produced in the production of clear, pour, bet, fill and tell are shown in table 2.8.
Table 2.7

<table>
<thead>
<tr>
<th>Verb</th>
<th>Participants &lt;7;05 years</th>
<th>Participants &gt;7;06 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Pour</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>Bet</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>Fill</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>Tell</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Phone</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Lean</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Groan</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Lean</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Land</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Spread</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Took</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Sank</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Cover</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Stay</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Think</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Email</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Live</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Capture</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Swept</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Stuff</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Cover</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Stuff</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 2.8

<table>
<thead>
<tr>
<th>Verb</th>
<th>Error type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear</td>
<td>Omission of obligatory prepositional phrase</td>
<td>The aliens cleared all the food</td>
</tr>
<tr>
<td></td>
<td>Omission of subject argument and prepositional phrase</td>
<td>Cleared all the food</td>
</tr>
<tr>
<td>Pour</td>
<td>Omission of subject argument</td>
<td>He poured the water; He poured magic juice</td>
</tr>
<tr>
<td></td>
<td>Omitted subject argument</td>
<td>Pouring all the water; Poured something in the bottles</td>
</tr>
<tr>
<td>Bet</td>
<td>Early semantic-syntactic structuring and mapping of <em>bet</em></td>
<td>You bet that you be eating my food; He betted at them; I bet you know we are; They said bet to the aliens</td>
</tr>
<tr>
<td>Fill</td>
<td>Omitted object argument</td>
<td>He filled his spaceship thing; He filled the tank</td>
</tr>
<tr>
<td></td>
<td>Omitted subject and object arguments</td>
<td>Filled up his plane</td>
</tr>
<tr>
<td></td>
<td>Incorrect mapping</td>
<td>He filled the petrol into his spaceship</td>
</tr>
<tr>
<td>Tell</td>
<td>Omission of object argument</td>
<td>He told about the aliens; He told Mr. White</td>
</tr>
</tbody>
</table>

Participants showed difficulty in the production of correct argument structure for the verb *bet*. However, it is important to note than in Hiberno English *bet* means *to beat someone up* or *to win a race*. Therefore in some of the productions the children were accessing the past tense of the verb *beat*. This stored representation of the verb *bet* was unrelated to the context of the Story Retell task and was excluded from the analysis of accuracy of verb argument structure.

**Test Behaviours**

A number of recurrent behaviours were noted during the administration of the assessment tools particularly in the younger participants (<6 years). Some of the
younger children were so shy at the beginning of the Story Retell a prompt was required i.e. “Once upon a time there was a man called Captain Grey”. The Story Retell task was very long for the children aged 4;10 to 5;05, with some of them becoming quite restless and less attentive. A number of the older children put pressure on themselves to try and remember every part of the story word-for-word which resulted in a number of sentence fillers i.e. “and then”, “and...um...” and some incomplete sentences i.e. “Then they covered the thing with...um...I can’t remember”. Graduated prompts were often used to help children where necessary. At times, even when modelling was used, a small number of participants produced a sentence which was unrelated to the scene when they were given the target verb. Several children forgot Captain Grey’s name or that the planet was called planet Bog. Some participants also misunderstood the task i.e. producing a definition of the target verb.
Discussion

Accuracy of Verb Argument Structure

The results showed a high number of outliers across the VAS per cent correct data. Many younger participants achieved ceiling or near ceiling scores which suggests that TD children achieve VAS accuracy early. This is in-line with previous literature which found that children begin to acquire correct argument structures from the age of 5 years (Leonard 2000; Norbury et al. 2008; Schwartz 2009). However, these early ceiling effects reduce the sensitivity of the tool across the age ranges. A re-evaluation of the target verbs and the administration to younger TD children may be required.

Children <7;05 years demonstrated particular difficulty with di-transitive and optionally transitive verbs which included omission of obligatory argument omissions ("Leaning on the table") and incorrect ordering of argument structures ("He filled the petrol in his car"). This is also line with previous research which found that children up to 7 years produced incorrect argument structures (Ebbels 2005; Grela and Leonard 2000).

The narrative probe also showed difficulty of the following verb types: alternating change-of-location (clear, sweep), change-of-location (lean, sink), change-of-state (fill, spread) and cognitive state (bet, think) verb semantic classes. This supports previous studies which noted particular difficulty in the production of change-of-state and change-of-location verbs and the late acquisition of cognitive state verbs (Ebbels et al. 2012; Owen van Horne and Lin 2011).

Mean Sentence Complexity

TD children between the age bands of 4;10-5;05 to 6;06-7;05 produced fewer complex sentences than TD children in the older age bands (7;06-8;05 to 10;06-12;0) which indicates that sentence complexity increases with age. The participants >7;05 years frequently scored a maximum score of 4 for sentence complexity i.e. “With his laser he turned water into petrol” and “Then he filled the tank up with petrol”. Each of these utterances would obtain a score of 4 as they include simple infinitives. The 7;06-8;05 to 10;06-12;0 age bands showed evidence of more complex utterances which scored 5 and
6 i.e. “The alien groaned and said that there was cheese in the sandwiches” would obtain a score of 5 as it includes the use of embedding. “Captain grey turned water into petrol with his light sabre and filled the spaceship with petrol”, this example shows evidence of conjoining and embedding occurring in the same utterance which would receive a maximum score of 6.

MSC scores were highest at 8:06-9:05 due to outliers. However, a decrease in the level of performance from 9:06-12:0 was evident which may have resulted from the participants not feeling compelled to use complex sentences. This pattern of ceiling effects further reduces the sensitivity of the Story Retell Tool. The nature of the assessment task and the stimulus items do not obligate a number of the items with multiple embedding. Therefore the outcome measures across the older age bands do not capture the full language abilities of the participants.

Verb Knowledge

The correlational analysis showed the significant relationship between age and verb knowledge which indicates that the continuous development of verb knowledge is considerably impacted by age.

Partial correlations revealed the effect of verb knowledge on sentence production, independently of age. In the younger age bands (<7;05 years) the development of sentence production was transparent. As previous research has suggested, development of verb knowledge allows children to acquire the ability to produce the correct argument structures for verbs of varying complexity (Thordardottir and Weismer 2001a; 2001b; Owen van Horne and Lin 2011). Consequently, poor production of sentence production would predict difficulties of acquiring semantic and/ or acquiring syntactic knowledge which are presented in CwSLI (Ebbels et al 2012; Ambridge et al 2008).

As noted by Ambridge et al (2008) each time a child hears a verb it provides an opportunity for that child to increase his knowledge of the specific semantics of the verb and its associated argument structures. In early development children try to map the verb’s semantic features, retrieved as lemmas onto immaturesly established syntactic
structure (Ambridge et al 2011). This developmental pattern was evident in the verb error analysis as the participants <7;05 years produced significantly more errors than the participants >7;06 years, particularly in the production of di-transitive, optionally transitive and state verbs.

*Test Behaviours*

During the administration of the assessment tool many of the younger participants, particularly those under six years old, became quite restless and less attentive which may have impacted on their outcome scores. In relation to the clinical use of the Story Retell tool it is important to note these behaviours report on them. A review of the administration of the test for younger children may be required.

The younger children frequently omitted the obligatory subject argument when given the verb to produce in a sentence even though modelling was used. There are two possible reasoning for this pattern; one, a number of the children may not have fully comprehended the purpose of the task and what was expected of them. Alternatively, some of them may not yet have the necessary knowledge required to produce correct argument structures for particular verbs. More specific detailed modelling of the task requirements may improve the younger participants’ comprehension of the task.

**Clinical application of Captain Grey and the Greedy Aliens**

The Story Retell tool obtained detailed narratives that highlighted progression in the development of verbs and their associated structures across the age ranges with a group of Irish school age children with typical language development. The variety of verb types and semantic classes potentially produced using the narrative probe could provide testers scope to assess relative strengths and weaknesses in a child presenting with language impairment.

The raw scores were converted into standard scores which provide an indication of what level of sentence production an individual should have acquired by a particular age. For example: an 8 year old child obtaining a score of 28 would fall between the
25th and 50th percentile which is within the normal range. However, these standardised scores need to be interpreted with caution given the limitations of the sample size.

The Story Retell tool is a dynamic assessment which allows the clinician to actively engage with the client in a learning situation to assess the potential for learning (Paul and Norbury 2012). This involves using teaching methods during the task to allow the client to reach their maximum performance which would benefit them in language intervention. This contrasts with administration of static assessments which provide limited information on a child’s language ability, particularly children with language impairments who often become unstandardized (Hasson and Joffe 2007).

The current assessment tool involves the use of graduated prompts which provides the child with learning opportunities and support. For example if a child was experiencing word retrieval difficulties, providing him with the target verb allows the clinician to observe his learning processes. The tool provides the clinician with information on how the child approaches the task, their error patterns, ability to self-monitor and task behaviours which will allow for the development of intervention approaches or methods suitable to the child’s abilities (Hasson et al 2012; Paul and Norbury 2012).

**Limitations**

Evidence suggests that a sample size of a minimum of a 100 subjects per age group in order for it to be an adequate standardized assessment (Paul and Norbury, 2012). However, Bishop (2014) recommendations a minimum of 50 participants per age group in a normative sample. The scale of the sample used in the current study (N=91) may have an impact on the reliability of the outcome measures. Further administration to a larger sample size of TD children is required for the assessment to be standardised, ideally between 50-100 subjects per age group.

A further limitation was the timescale of the recruitment process which occurred during the spring school term. The possibility of recruiting children between the age of 4;06 to 5;05 years was limited as many children start school from the age of 4;06 – 5 years at the start of the new school term in September. As a result there was an uneven spread
across the age bands which reduced the sensitivity of the assessment tool which may have limited the outcome measures of the current study.

**Reliability and Validity**

Inter-rater reliability of the analysis and scoring methods was assessed among the student researchers. However, none of the results reached between 98-100% reliability which may impact the overall reliability of the assessment scores. Further re-evaluation/development of the rubric may increase the reliability of the assessment tool.

The test behaviours, previously noted during the administration of the Story Retell tool, may impact the reliability of the tool as these behaviours may have negatively influenced the participants’ results. The current tool sets out to measure a child’s level of mean sentence complexity and accuracy of verb argument per cent correct. However, as mentioned previously a reduction in the performance was evident in the older participants (>9;06 years) resulting in a less than accurate presentation of their full language abilities which may impact on the validity of the Story Retell tool.

**Recommendations**

A small sample and uneven distribution across the age bands reduces the power of the statistical outcomes in the current study. Therefore further recruitment of younger participants between the age of 4;06-5;05 and 7;0-8;0 years would be recommended. Based on observations of the younger participants test behaviours modifications of the graduated prompts may be necessary as it was unclear at times if the task requirements were comprehended fully.

Due to reduction of the sensitivity of the Story Retell tool across the age bands, re-evaluation of target verbs and administration to younger TD children may be required.
Conclusion

The younger participants produced more errors and more simple sentences compared to the older participants highlighting the effect of age on sentence complexity. Correlational analysis showed evidence of a strong relationship between verb knowledge and sentence production, independent of age. Ceiling effects on MSC, ToVK and VAS per cent correct became evident from the age of 7;06 years and onwards. These ceiling effects, along with the uneven spread across the age bands decreased the sensitivity of the Story Retell assessment which reduced the power of the statistical analysis. Further recruitment of younger participants would be recommended to strengthen the reliability of the tool.

The normative data drawn up from the current control sample can be used by clinicians to assess for specific areas of language difficulties. The narrative probe includes a wide range of verb types and verb classes which would provide a detailed sample of a child’s language abilities.
References


Ebbels, S. H. (2005) Argument structure in specific language impairment: from theory to therapy, PhD, University College London.


Appendices

- **Appendix A**: Information forms
- **Appendix B**: Consent forms
- **Appendix C**: Captain Grey narrative probe
- **Appendix D**: Captain Grey scoring form
- **Appendix D**: Frequency of verb errors
Appendix A

Information forms

(Letter for School Principal)

Dear ____________________.

Re Study title: Investigating School aged children’s verb production at sentence level, using a story retell tool called “Captain Grey and the Greedy Aliens”.

Further to our previous telephone conversation, I am outlining the research project and recruitment requirements for your information. I am a researcher and lecturer in Speech and Language Therapy at the University of Limerick. I developed a tool to assess children’s knowledge of verbs and production of sentences with verbs. I am seeking assistance from schools to develop the tool further by facilitating recruitment and data gathering from children.

Reasons for the study:

There are no comprehensive tests of children’s verb related sentence production for use clinically. The Captain Grey story was developed with a small number of children with language impairments. To better identify the strengths and weaknesses of children with language impairments, we need data from typically developing children on this tool for comparison purposes.

The project aims to answer the following questions:

- What verbs and sentences are produced by typically developing school-age children on this Story Retell tool?
- How does their sentence production on the story retell tool relate to age and their knowledge of verbs?

To undertake the study I need to recruit children who meet the following criteria:

- Who are in the age range of the study: 4; 06 to 12 years.
• Whose first language is English. (There may be scope for versions of this story in languages other than English in the future, but the current version is in English only)
• Who do not have hearing, speech, language, communication and/or learning difficulties (as the purpose of this study is to collect information on typical language development).
• We wish to recruit 20-22 children from each school.

I have enclosed copies of a recruitment poster that can be sent home to parents, with parent information letters and parent and child consent (for children of 9 years up) forms. You can choose to send the recruitment posters to parents of all children in the class, then send information and consent forms to the parents of those who respond. Parents read the information sheet, decide whether their child meets the criteria for inclusion and if they would like to participate. If a greater number is recruited than required, we will look at the age spread and select names from a hat.

We would like to see each child once at school. The research will be conducted by a pair of student speech and language therapists. From experience of developing the picture pointing and story retell tool, the sessions will take 20 to 35 minutes. The younger children may take longer telling the story. We wish to start data gathering by the beginning of February 2014.

Please do not hesitate to contact me if you would like further information in relation to the project, its rationale or recruitment. Participants can contact me anonymously if they would like further information and/or to discuss the contents of the information and consent forms.

Participant recruitment:

Under the terms of the Data Protection Act (1998), I am not in a position to directly access school records, but have access to potential recruits through those who are gatekeepers of this information. For the purpose of this study, names of children will not be linked to their responses should they choose to participate. The study will analyse their responses (e.g. the sentences they compose) with reference to their age group. No names will be used in the research.

This research study has received Ethics approval from the Education and Health Sciences Research Ethics Committee (approval number 2013_10_24). If you have any concerns about this study and wish to contact someone independent you may contact:

Chairman Education and Health Sciences Research Ethics Committee, EHS Faculty Office
University of Limerick, Tel (061) 234101

Sincerely,

______________________
Carol-Anne Murphy
Principal Investigator
Department of Clinical Therapies
Study title: Investigating School aged children’s verb production at sentence level, using a story retell tool called “Captain Grey and the Greedy Aliens”.

Dear Parent,

We would like to invite your child to take part in a research study. Before you decide, you need to understand why the research is being done and what it would involve for your child. Please take time to read the following information carefully. Talk to others about the study if you wish.

What is the purpose of the study?
We do not have detailed tests of children’s production of verbs (action words) at sentence level. Children with language difficulties can have difficulties with verbs and sentences. This new story (Captain Grey and the Greedy Aliens) has been developed to fill this gap. We need information from children who do not have language difficulties, on their responses to the story. When we have information about the sentences of children without language difficulties on the story, this can help with using the test to identify children who do have language difficulties.

Why has my child been invited to take part?
Eighty-five children will take part in this study from a variety of primary schools. We are inviting children to take part:
- Who are in the age range of the study: 4; 06 to 12 years.
- Whose first language is English
- Participating children should have normal hearing, speech, language and learning abilities.

Do I have to let my child take part?
It is up to you to decide. We will describe the study in this information sheet. We will then ask you to sign a consent form to show you have agreed to take part. You are free to withdraw at any time, without giving a reason.

What will happen to my child if we take part?
Your child will be given seen by a pair of researchers, who are final year students of speech and language therapy, supervised by the principal researcher who is a lecturer and qualified Speech & Language Therapist. Your child will first be asked to point to pictures of verbs. One of the student researchers will then read them the story while the child looks at the pictures and the
child will then repeat the story. The other student will record the responses on paper and with a
digital voice recorder. This will take about 20-35 minutes and will be carried out in his/her
school.

Are there any disadvantages or risks in taking part?
There are no risks to your child. A disadvantage is that your child may miss other activities
while participating in the language activities. The activities used in the programme are meant to
be fun for the child.

Are there any benefits in taking part?
The information we get from this study should help children with language difficulties in the
future.

What happens when the research study finishes?
After all the results have been collected, the researchers will write up the study. The results will
be analysed and shared with others who are interested in children’s language and language
difficulties. We hope to make the story available to Speech & Language Therapists to be used
with language difficulties. We will send a summary of the findings from the study to your
child’s school.

Will my child’s taking part in the study be kept confidential?
Yes. Your child will not be identified in any research report or publication. Your child’s
responses, and their age will be recorded but not their name. They will be assigned a number to
ensure anonymity. All information which is collected about your child during the study will be
kept strictly confidential. You have the right to check any data held about your child for
accuracy and to correct any errors.

Who is organising and funding the research?
The research is being carried out as part of final year Speech & Language Therapy students’
Master’s project under the supervision of Carol-Anne Murphy, a lecturer and qualified speech
and language therapist at the University of Limerick, Castletroy, Limerick.

What if there is a problem?
If you have a concern about any aspect of this study, you can ask to speak to the principal
investigator who will do her best to answer your questions (Carol-Anne Murphy, 061 213076).

Who has reviewed the study?
All research in the University is looked at by independent group of people, called a Research
Ethics Committee to protect the safety, rights, wellbeing and dignity of those taking part. This
research study has received Ethics approval from the Education and Health Sciences Research
Ethics Committee (2013_10_24). If you have any concerns about this study and wish to talk to
someone independent you may contact: Chairman Education and Health Sciences Research
Ethics Committee, EHS Faculty Office, University of Limerick, Tel (061) 234101

Further information and contact details:
For further information please contact the researcher, Carol-Anne Murphy (phone 061 213076,
or email carol-anne.murphy@ul.ie).

Thank you for taking the time to read this information sheet. If you decide to let your
child take part in the study, I have attached an information sheet for your child also.
He/she may read this or you can use it to explain the study to him/her. A consent form for
children aged 9 years upward is also attached.
Children’s information sheet

Title of Project: “Captain Grey and the Greedy Aliens”; A project to look at the words and sentences children use when telling a story.

What is this about?

We are doing a project looking at the action words children know and the sentences children use with action words. We would like help from children your age.

What would I have to do?

We will see you in your school. We will say words and ask you to point to pictures of those words. We will also tell you a story with pictures. Then you will tell us the story. We will write down what is said and we will record you telling the story on a digital recorder.

Do I have to help you?

You can decide if you want to be in this project or not. You can talk to a grown up about it if you are worried or not sure.
Appendix B

Consent forms

Parent Consent Form

Study title: Investigating School aged children’s verb production at sentence level, using a story retell tool called “Captain Grey and the Greedy Aliens”.

- I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

- I understand that my child’s participation is voluntary and that I am free to withdraw him/her at any time without giving any reason.

- I understand that my child’s identity will be kept confidential and it will not be possible to identify him or her in any reported findings.

- I agree to let my child take part in the above study.

Name of Child: ______________________________   DOB:__________

Name of Parent: _______________________________           Date:__________

Parent’s Signature:________________________________________

Principal Investigator Signature: ________________________________________

This research study has received Ethics approval from the Education and Health Sciences Research Ethics Committee (approval number 2013_10_24). If you have any concerns about this study and wish to contact someone independent you may contact: Chairman Education and Health Sciences Research Ethics Committee, EHS Faculty Office, University of Limerick, Tel (061) 234101.
Child Consent Form

Title of Project: “Captain Grey and the Greedy Aliens”; a project to look at the words and sentences children use when telling a story.

- I have read or discussed the information sheet for the study.
- Any questions that I asked about the study were answered.
- I understand that my name will not be on the story and picture forms. No-one will be able to tell which my answers are and my name will not be included in papers about the study.
- I understand that I can stop being in this study any time and I don’t have to say why.
- I agree to taking part in this study.

Name of Child: ______________________________   DOB: __________

Child’s Signature: ________________________________________

Principal Investigator Signature: ________________________________

This research study has received Ethics approval from the Education and Health Sciences Research Ethics Committee (approval number 2013_10_24). If you have any concerns about this study and wish to contact someone independent you may contact: Chairman Education and Health Sciences Research Ethics Committee, EHS Faculty Office, University of Limerick, Tel (061) 234101.
Appendix C

Captain Grey Narrative Probe

NARRATIVE FOR PRODUCTION OF ARGUMENT STRUCTURE: VERB SELECTION

SCENE 1: Captain Grey lived in a city on planet Bog. Greedy aliens came to planet Bog to steal food, they stole vehicles and they sometimes stole people. Captain Grey’s job was to capture the aliens. When that didn’t work he chased them to back to planet Zirk from where they came.

SCENE 2: Last year Captain Grey’s Mother swept the leaves from the path at her house. Aliens came with guns and lasers. They destroyed the plants in the field. They cleared all the food from the shelves. Then they emptied the rubbish from the bins on to the streets.

SCENE 3: Mrs Grey came out later and saw the mess. She was very cross and phoned her son. “Do something about those aliens” she said.

SCENE 4: Captain Grey was out in his flying machine. He flew the machine back to his office. He emailed the best soldiers. They had a meeting. He leaned against his desk and said “We have to stop them or there will be no food left. They will destroy Planet Bog with pollution. Let’s go and find them.”

SCENE 5: Captain Grey went to get sandwiches and drinks for everyone to take on the journey. He hadn’t much petrol. His petrol tank was empty. So he pushed his space machine along the road to his mother’s house. He ran into the house. We need drinks and sandwiches for the journey to catch the aliens.

SCENE 6: Captain Grey poured magic juice into bottle. Some apples fell on the floor. His mother picked them up. She spread butter on bread. She peeled the apples. Then she grated some cheese. She made cheese and apple sandwiches. Then she covered the sandwiches with cling film.

SCENE 7: Captain Grey turned water into petrol with his light sabre. He filled the space machine with petrol and flew it to meet the others.

SCENE 8: He gave the food to the men. They stuffed the sandwiches into their backpacks and left planet Bog.

SCENE 9: They landed on the planet Zirk and looked around. They covered their spaceships with shields.

SCENE 10: One of the soldiers stayed to mind the spaceships. He yawned and leaned his gun against the rock. He took his lunch out to eat. The rock shook and he jumped. It was an alien. There were aliens everywhere. He dropped his lunch and ran.

SCENE 11: The aliens sat and ate the sandwiches. The alien captain came and saw them eating. He groaned. “Oh no” he said. “You know we can’t eat cheese.”
The aliens **threw** the rest of the sandwiches into a hole. The sandwiches **sank** all the way to the bottom. The aliens got sick and **crawled** to the rocks.

**SCENE 12:** The soldier who ran away, hid behind some trees. He **pretended** he was dead. Captain Grey came along and saw the soldier. I think he’s dead said Captain Grey. The soldier opened his eyes. He **told** Captain Grey there were aliens everywhere.

**SCENE 13:** “Come on everyone”! **shouted** Captain Grey. I want to find them now. The soldiers **marched** off to find the aliens and came to the “picnic” site. I **bet** they’re sorry they ate my lunch, laughed the soldier

**SCENE 14:** The soldiers **captured** the aliens and **brought them back** to planet Bog. They **put** the aliens into prison. Captain Grey, his mother and the other people on the planet lived happily ever after.
# Appendix D

## Captain Grey Scoring Form

**ID:** CC  
**D.O.B:**  
**Date of Assessment:**

<table>
<thead>
<tr>
<th>TARGET SENTENCE</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; RESPONSE</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; PROMPT</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; PROMPT</th>
<th>Elicited Correct</th>
<th>VAS Length</th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Captain Grey <em>lived</em> in a city on planet Bog.</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Greedy aliens came to planet Bog to <em>steal</em> food, they stole vehicles and they sometimes stole people</td>
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<tr>
<td>Captain Grey’s job was to <em>capture</em> the aliens.</td>
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<td></td>
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<tr>
<td>When that didn’t work he <em>chased</em> them to back to planet Zirk from where they came</td>
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<td></td>
</tr>
<tr>
<td>Last year Captain Grey’s Mother <em>swept</em> the leaves from the path at her house.</td>
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</tr>
<tr>
<td>Aliens came with guns and lasers.</td>
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<td></td>
</tr>
<tr>
<td>They <em>destroyed</em> the plants in the fields <em>cleared</em> all the food from the shelves.</td>
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</tr>
<tr>
<td>Then they <em>emptied</em> the waste from the bins on to the streets.</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mrs Grey came out later and saw the mess. She was very cross and <em>phoned</em> her son. “Do something about those aliens” she said.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Captain Grey was out in his flying machine. He <em>flew</em> the machine back to his office.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
He emailed the best soldiers.

They had a meeting.

He leaned against his desk

and said “We have to stop them or there will be no food left. They will destroy Planet Bog with pollution. Let’s go and find them”

Captain Grey went to get sandwiches and drinks for everyone to take on the journey.

He hadn’t much petrol. His petrol tank was empty. So he pushed his space machine along the road to his mother’s house.

He ran into the house. We need drinks and sandwiches for the journey to catch the aliens.

Captain Grey poured magic juice into bottles.

Some apples fell on the floor.

His mother picked them up.

She spread butter on bread.

She peeled the apples.

Then she grated some cheese.

She made cheese and apple sandwiches. Then she covered the sandwiches with cling film.

Captain Grey turned water into petrol with his light sabre.
He filled the space machine with petrol and flew it to meet the others.

He gave the food to the men.

They stuffed the sandwiches into their backpacks and left planet Bog.

They landed on the planet Zirk and looked around.

They covered their spaceships with shields.

One of the soldiers stayed to mind/with the spaceships.

He yawned and leaned his gun against the rock.

He took his lunch out to eat.

The rock shook and he jumped.

It was an alien. There were aliens everywhere. He dropped his lunch and ran.

The aliens sat and ate the sandwiches. The alien captain came and saw them eating.

He groaned. “Oh no” he said. “You know we can’t eat cheese”.

The aliens threw the rest of the sandwiches into a hole.

The sandwiches sank all the way to the bottom.

The aliens got sick and crawled to the rocks.

The soldier who ran away, hid behind some trees.
He pretended he was dead.

Captain Grey came along and saw the soldier. I think he's dead said Captain Grey.

The soldier opened his eyes. He told Captain Grey there were aliens everywhere.

"Come on everyone!" shouted Captain Grey. I want to find them now.

The soldiers marched off to find the aliens and came to the “picnic” site.

I bet they’re sorry they ate my lunch, laughed the soldier

The soldiers captured the aliens.

and brought them back to planet Bog

They put the aliens into prison.

Captain Grey, his mother and the other people on the planet lived happily ever after.
## Appendix E

**Frequency of verb errors**

<table>
<thead>
<tr>
<th>Ditransitive Verbs</th>
<th>Error Frequency</th>
<th>Transitive verbs</th>
<th>Error Frequency</th>
<th>Intransitive Verbs</th>
<th>Error Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear</td>
<td>24 (L)</td>
<td>Bet (takes complement)</td>
<td>17 (L)</td>
<td>Groan</td>
<td>11</td>
</tr>
<tr>
<td>Pour</td>
<td>21 (L)</td>
<td>Tell (takes complement)</td>
<td>12</td>
<td>Sank</td>
<td>9 (L)</td>
</tr>
<tr>
<td>Fill</td>
<td>17 (L)</td>
<td>Phone</td>
<td>11 (H)</td>
<td>Stay</td>
<td>8 (H)</td>
</tr>
<tr>
<td>Lean</td>
<td>10 (L)</td>
<td>Lean</td>
<td>11 (L)</td>
<td>Live</td>
<td>6 (H)</td>
</tr>
<tr>
<td>Spread</td>
<td>9 (L)</td>
<td>Land</td>
<td>10 (L)</td>
<td>Shook</td>
<td>6 (L)</td>
</tr>
<tr>
<td>Cover</td>
<td>8 (H)</td>
<td>Took</td>
<td>9</td>
<td>Yawn</td>
<td>4</td>
</tr>
<tr>
<td>Swept</td>
<td>6 (L)</td>
<td>Think (takes complement)</td>
<td>8 (H)</td>
<td>Crawl</td>
<td>4 (L)</td>
</tr>
<tr>
<td>Stuff</td>
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<td>5 (L)</td>
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<tr>
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<tr>
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