

Persistent problems in SLI: which grammatical problems remain when children grow older?*

Iris Duinmeijer

Amsterdam Center for Language and Communication, University of Amsterdam

Grammatical problems are a hallmark of SLI: most children with SLI seem to have problems with grammatical rules like inflection, agreement or those involved in complex syntactic structures. While grammatical abilities have been studied extensively in younger children with SLI, fewer studies have considered what happens with their grammatical problems as children with SLI grow older. In this article, the literature on outcomes of SLI is reviewed, with special focus on the linguistic outcomes. The studies on adolescents/adults with SLI indicate that, besides problems in socio-emotional functioning and psychiatric wellbeing, language impairments are often persistent into adolescence. Studies on specific grammatical aspects indicate that the problems that characterize SLI in childhood are still present in adulthood, but performance seems to depend on the type of task and linguistic context. Different theoretical frameworks are evaluated with respect to their ability to explain these particular outcomes. The Vulnerable Markers Hypothesis is proposed as the framework that seems to explain the outcomes the best.

1 Introduction

Wexler (1998) once claimed that children can informally be described as ‘little inflection machines’, for they seem to learn the inflectional rules of their language efficiently and very quickly in their first years of life. The description is a striking characterization of the way typically developing children acquire their first language, but for some children, the machine does not seem to work properly. Children with a *Specific Language Impairment* (SLI) have profound problems in

* I am grateful to Anne Baker, Jan de Jong and Fred Weerman for their valuable feedback and I would like to thank Nada Vasic for her suggestions for improvements in the review.

learning the linguistic rules of their language, although there is no clear etiology for these problems. They have normal hearing, a non-verbal IQ in the normal range (above 85) and no neurological or cognitive deficit or socio-emotional problems that can explain their language impairment (Stark and Tallal 1981, Leonard 1998). Yet, they exhibit problems in several aspects of language (Leonard 2009, Tomblin, Freese and Records 1992).

In the last decennia, several studies point towards a genetic factor in the etiology of SLI (Bishop, North and Donlan 1995, Bishop 2008, Fisher et al. 1998). SLI seems to occur more in families with a history of language problems, the disorder often affects multiple siblings in a family and boys are more often affected than girls. There thus seems to be a genetic influence in SLI but to date no gene or genetic profile has been found that can predict and explain SLI.

A large group of children with SLI have problems in the grammatical domain. These children are often described as ‘typical or classical SLI’ (Bishop 2004). Inflection is one of the areas in which the disorder manifests itself relatively clearly. Subject-verb agreement and past tense marking have for instance been shown to be vulnerable areas in children with SLI from different language backgrounds (Schwartz 2009, de Jong 1999). The severity of the problems seems to be negatively correlated with the richness of the morphological system of a language since fewer problems are reported in morphologically rich languages like Italian. The inflectional problems in SLI are not restricted to the verbal domain. Some languages, such as Dutch, also have inflection in the nominal domain, for instance in the agreement between adjectives and nouns for grammatical gender. In Dutch, these problems in adjectival inflection in SLI go hand in hand with problems in the assignment of definite determiners to nouns, in which the grammatical gender is also expressed (Orgassa and Weerman 2008). Once the correct definite determiner is assigned, adjectival inflection is also reasonably accurate. The problems in the grammatical domain thus extend beyond the rules involved in inflection and also seem to involve assignment of grammatical features. A third example of cross-linguistically attested problems in the grammatical domain in children with SLI are problems with complex syntactic structures like relative clauses or *wh*-questions (van der Lely and Battell 2003, Stavrakaki 2006, Hamann 2006). The grammatical problems in SLI are thus quite extensive.

While grammatical abilities have been studied widely in younger children with SLI, that is between four and eight years of age, fewer studies have considered what happens in later development. Do they eventually learn the grammatical rules they are struggling with during childhood or do they still show

the same errors? Or do they perhaps develop ways to avoid or conceal their persisting problems? These questions are of theoretical relevance, since they may shed light on what happens to an impaired language system when it is beyond a certain age and is thought to have limited access to implicit rule learning mechanisms. Furthermore, the answers to these questions could provide valuable information for the treatment of language disorders. The aim of this article is therefore to find out whether the specific problems that are seen in younger children with SLI remain in adolescence or adulthood and in what form. To this end, the literature was thoroughly reviewed and evaluated in terms of possible explanations for the findings.

Because there is no clear consensus on the use of the label SLI, articles on individuals with language impairment (LI), language disorders (LD), expressive dysphasia, primary language impairment (PLI) or developmental language disorder (DLD) were also scanned for the selection criteria used. If the criteria used matched the generally accepted exclusion criteria for SLI (no other impairment or deficit that can interfere with language ability, no nonverbal IQ below average), the study was included in this review. Studies on subjects with language problems secondary to other conditions such as general learning disabilities, hearing problems, neurological or cognitive deficits, socio-emotional problems or psychiatric disorders were thus excluded. However, because there is a debate on the proper 'inclusion criteria' for SLI, studies with varying cut-off points for the language problems (from -1 SD to -2 SD) are included. The term SLI will be used henceforth in this article for the sake of simplicity.

In the studies to be reported, two groups of subjects are involved. One consists of adolescents with a history of SLI, often reported on in follow-up studies. The other consists of adolescents who still meet the criteria for SLI. Both types of studies are included and the subject group will be specified. The studies that were retrieved varied furthermore considerably in terms of age of subjects, design of the study (longitudinal, cross-sectional), type of data (parent reports, standardized tests, spontaneous language samples, experiments) and the domain of outcomes (linguistic, academic, socio-emotional, behavioral, psychological). Since we are interested in persistence of SLI into adolescence, we chose to select only those studies reporting the outcomes of children older than 10 years of age (following the definition of adolescence of the World Health Organization (2005): 10-20 years).

The structure of this paper is the following. In section 2, studies reporting persistence of general language problems will be discussed. These studies shed light on the proportion of children with SLI who still have language problems in

adolescence. In section 3 we will then focus on the persistence of specific grammatical disabilities in adolescent SLI. In the final section, the literature will be evaluated in terms of possible explanations. The Vulnerable Markers Hypothesis is proposed as the framework that explains the particular patterns seen in SLI the best.

2 Language problems in adolescents with (a history of) SLI

Many studies on adolescents or adults with (a history of) SLI concentrate on non-linguistic outcomes like socio-emotional functioning or psychological wellbeing. These studies indicate persistent problems in the social, emotional, behavioural and psychiatric domain (Davison and Howlin 1997, Weiner 1974, Clegg et al. 2005, Conti-Ramsden and Durkin 2008, Baker and Cantwell 1987, Beitchman et al. 1996b, Beitchman et al. 2001, Arkkila et al. 2009, Snowling et al. 2006). Language development is closely related to development in these domains and this relationship may be the strongest in adolescence, since this is a period where a child faces developmental changes in the emotional, social, physiological and psychological domain. The nature of the relationship is however not immediately clear. The relation might be a direct one, in the sense that there are remaining problems in the language domain that directly cause problems in the socio-emotional and psychiatric domain. Another possibility is an indirect relationship, where language problems in childhood resulted in socio-emotional or psychiatric problems in adolescence while the language problems themselves have been resolved.

Several studies have been published that indicate persistence of language deficits into adolescence and adulthood (see Leonard 1998 for an overview of studies reporting the persistence of language impairments). Many studies report measures of general language abilities in adolescents or adults with (a history of) SLI, but do not specify which specific aspects of language remain problematic in this developmental phase. The next section reviews the language abilities of adolescents or adults with (a history of) SLI in a general, non-specific sense (2.1). Afterwards, we focus on the studies that report grammatical disabilities in adolescents with (a history of) SLI in more detail (2.2).

2.1 Persistence of general language problems

To what extent are language problems in SLI persistent over time? An answer to this question is not straightforward since adolescence is a period in which language

milestones cannot be distinguished as easily as they are in childhood (Nippold 1995). Furthermore, fewer standardized tests and criteria are available for this developmental phase. Statistics on the number of adolescents with a diagnosis of a language disorder are therefore not representative of the real prevalence of language disorders in adolescence (Larson and McKinley 1995). A few studies have been published that report longitudinal or follow-up data on a group of children with SLI and thus can tell us something on the persistence of SLI in adolescence or adulthood.

Stothard et al. (1998), carried out a follow-up study on the data of Bishop and Edmundson (1987). A group of 87 English children had been divided at 4 years of age into a 'general delay' group (N=19) and a group of children with 'SLI' (N=68). At age 5;6, the children with SLI had been reassessed and were divided in a group of children whose language problems had 'resolved' (N=30), and a group of children with 'persistent' SLI (N=38). Stothard et al. were able to retest 30 children with 'persistent SLI', 26 of the children with 'resolved' SLI and 15 children with a 'general delay' of the original group at the age of 15-16. In the group of children with 'persistent SLI at age 5;6', 70% was still classified as speech and language impaired at age 15/16 (N=21). The basis for classification was a score below -1.89 SD on one of the subtests, or scores below -1.29 on more than one subtest. Another 50% of the adolescents whose language problems seemed to have had resolved at age 5;6 and 33% of the adolescents who seemed to have had a general delay at age 5;6 (both verbal and nonverbal IQ below the norm) obtained scores that fell in the category of speech and language impairments (N=8 and N=5, respectively). Language impairments thus seem quite persistent over time and although they may seem to have disappeared in childhood, they can appear again at a later age (Stothard et al. 1998).

Similar findings on the persistence of language problems were reported in a large-scale longitudinal study (N=242) on the speech and language outcomes of a group of English participants with speech and/or language impairments (Johnson et al. 1999). Participants had been identified at age 5, and were revisited at ages 12 and 19. Language impairment at the later testing point was defined as scoring more than 1 SD below the mean on a general language test for adolescents/adults or scoring more than 2 SD below the mean on any of the language subtests. Of the group that was categorized as 'language impaired' at age 5 (on the basis of test scores and clinical judgments), around 70-73% continued to have a language impairment at age 19. Furthermore, the study reports considerable stability in language performance over time (the ranking on the basis of scores remained the

same) and better outcomes for adolescents with speech impairments compared to adolescents with language impairments.

Another large scale follow-up study was performed by Botting et al. (2001). They tested 117 English children with SLI at 7 years of age and reassessed them at 11 years of age. In the original sample, children had been selected on the basis of a clinical judgment and not on a priori SLI-criteria¹. Many of the original subjects (75.2%) had poor outcomes (below -1SD) on at least three language measures at 11 years of age, indicating a high percentage of persistence of SLI. This study furthermore reports that the best predictor for a good or bad outcome at age 11 was the score for narrative retelling and expressive syntax at the age of 7.

Finally, Clegg et al. (2005) reported longitudinal data of 17 English children with SLI at several points in time (9, 13, 24 and 36 years of age). They were compared to non-impaired siblings and a control group matched on IQ. The longitudinal data shows persistence of receptive and expressive impairments over time, even into adulthood. Both on receptive and expressive measures the adolescents and adults with a history of SLI scored significantly below unimpaired siblings and IQ-matched peers ($p < .001$).

The literature thus reports percentages of persistent SLI between 70% and 80%. Even when language problems may seem to have disappeared in childhood, they can appear again at a later age in adolescents with (a history of) SLI. While children with speech impairments seem to catch up, children with language impairments keep falling short when they are compared to their typically developing peers. Their persistent language problems also influence academic achievement since adolescents with SLI often have reading and spelling problems and reach lower levels of academic achievement (Stothard et al. 1998, Aram, Ekelman and Nation 1984, de Ajuriaguerra et al. 1976, Beitchman et al. 1996a, Conti-Ramsden et al. 2002, Hall and Tomblin 1978, Law et al. 2009, Nippold and Schwarz 2002, Rescorla 2000, Stark et al. 1984, Snowling, Bishop and Stothard 2000, Young et al. 2002, Conti-Ramsden, Durkin and Walker 2012). These problems are clearly associated with (a history of) problems in the language domain, since adolescents who only had speech problems in childhood without having language problems do not encounter the same problems in reading and spelling when they are older (Hall and Tomblin 1978, Beitchman et al. 1996a, Young et al. 2002).

¹ According to another article on the same data, 85% of the children that were tested met the criteria for SLI (Conti-Ramsden et al. 2001).

2.2 *Persistent grammatical problems*

The studies discussed above do not indicate which specific grammatical problems remain in SLI. In this section, literature on specific syntactic and morphological problems in adolescents with (a history of) SLI will be discussed in more detail in order to answer the question what grammatical problems remain when children with SLI grow older. First, problems in complex syntactic structures will be described. Afterwards, problems in morphological rules are listed.

2.2.1 *Problems with complex syntactic structures*

As mentioned in section 1, children with SLI are often reported to have problems with complex syntactic structures like relative clauses, passives or *wh*-questions. Problems with complex structures can express themselves in two ways. Children with SLI either use them to a lesser extent than typically developing children, or they make more errors in these structures. The studies reported here indicate both types of problem in adolescents with (a history of) SLI.

Marinellie (2004) for instance analyzed spontaneous language samples of older English children with SLI (N=15, average age 10;8) and age-matched typically developing peers on several complex constructions such as adverbial relative clauses, coordinate clauses, *wh*-clauses etc. Most of the structures used by the typically developing older children were also used by the older children with SLI, although to a lesser extent. Similar findings were presented in a study by Hesketh (2006), who examined relative clauses in an elicitation task and a narrative task in a somewhat younger group of English children with SLI (N=66, aged 6-11). It was hard to elicit full relative clauses from the group of children with SLI (the construction was avoided but it is not specified how), and in the narrative data they used more reduced relatives instead of full relative clauses.

This finding of less frequent use of subordination in SLI was recently confirmed for French (Tuller et al. 2012). Tuller et al. investigated the complexity of the spontaneous speech of French adolescents with SLI (N=18, aged 11-16) in comparison to different age groups of typically developing children/adolescents (6 years, 8 years and 11 years of age). The results are interpreted as indicating that English and French adolescents with SLI tend to avoid complexity in their spontaneous speech by using coordination/juxtaposition (rather than subordination), the omission of a complementizer and via direct speech. They used even fewer complex clauses than their 6-year old language matched peers (matched on MLUw).

In two small studies of Dutch adolescents with SLI, adolescents with SLI did not use complex sentence structures less frequently than typically developing peers. A study by Burger and Rijpma (1998), based on narrative data, found no difference between 10 adolescents with SLI (average age 14;3) and their age-matched peers on MLU and syntactic complexity. The groups did, however, differ on the number of grammatical errors. Another study on older children with SLI examined the correlation between the complexity and correctness of sentences in three age groups of Dutch children with SLI (8-9, 9-10, 10+, total N=24) and did find some support for the idea that complex syntactic structures are difficult for older children with SLI. The mean number of errors per utterance correlated significantly with the complexity of the sentence (the more complex the sentence, the more errors were made). Subordinate clauses appeared to be the most problematic structures for the older Dutch children with SLI because they make more errors in these structures (van Groningen 2010). Dutch adolescents with SLI thus seem to use complex structures to the same extent as their typically developing peers, but find them more difficult since they make more errors. The contrasting findings between languages may be explained by methodological or cross-linguistic differences between studies. Perhaps, some contexts or methodologies elicit more complex constructions than others.

Problems with complex syntax thus seem to be a characteristic of adolescents with SLI. They use them to a lesser extent and they make more errors within them. While typically developing adolescents make few errors in complex clauses, these were frequent in the language samples of adolescents with SLI (omissions, errors in inflectional features or syntactic errors like word order errors). The amount of errors was independent of sentence length, but correlated with the amount of subordinate clauses. Within the SLI group, those adolescents using more coordinated/juxtaposed clauses had fewer grammatical errors in their sentences. The production of coordinate/juxtaposed clauses thus seems a possible avoidance strategy for adolescents with SLI (Tuller et al. 2012). The finding that English and French adolescents with SLI used few complex clauses in their spontaneous speech indicates why questionnaires and spontaneous language samples are not appropriate for testing whether these adolescents have mastered these grammatical rules of their language (Nippold et al. 2008). If certain structures are hardly elicited, it is difficult to test whether the grammatical knowledge required to produce this construction is present or not. Testing grammatical structures directly gives more information concerning which errors persist in SLI. Several authors therefore conclude that experimental tasks are

needed in order to know whether adolescents are able to produce or understand the constructions they are using less frequently.

2.2.2 Morphological errors

Which morphological errors are problematic in SLI is partly language-dependent. In English, problems in past tense marking and third-person singular are core characteristics of SLI and these aspects are reported to be still problematic in adolescence. Past tense marking seems to be the most difficult, with 64% of the 11-year old subjects with SLI scoring 1 SD below the mean, and 27% scoring 2 SD below the mean (Conti-Ramsden et al. 2001, Botting et al. 2001). Problems in the domain of finite verb morphology were also confirmed by Norbury, Bishop and Briscoe (2001), who studied English children with SLI in the age range of 7 to 11 years on past tense marking and third person singular and compared them to language-age matched and chronological age-matched peers. On both tasks, children with SLI performed significantly worse than the two control groups, especially on past tense marking.

Marchman, Saccuman and Wulfeck (2004) report similar results in a group of English children with SLI (mean age 8.9, SD 2;6 years, some children were above the age of 10). However, they give more details on the type of errors. Errors mainly consisted of zero-marking (leaving out the third-person singular morpheme) and suffixation in irregular verbs (for example *the bell ranged* instead of *the bell rang*). Van der Lely and Ullman (2001) tested a somewhat older group of English SLI subjects on past tense marking (N=12, age 9;3-12;10). Adolescents with SLI performed worse than both a control group matched on morphological abilities (comprehension and production task of regular and irregular morphemes) and a control group matched on vocabulary level (passive and active) in regular verb contexts only. In irregular contexts, past tense marking only showed a difference between the adolescents with SLI and the vocabulary-matched controls. According to this study, the regular past tense formation is particularly impaired in SLI.

Miller, Leonard and Finneran (2008) showed that even at the age of 16, English adolescents with SLI (N=48) are less sensitive to the omission or substitution of grammatical morphemes. Although scoring relatively high on grammaticality judgment tasks (90%), adolescents with SLI scored significantly worse than age-matched controls. They were less sensitive to the omission of tense morphemes (*-ed* and third person singular present *-s*), non-tense morphemes (*-ing* and the possessive *-s*), and commission of the same tense morphemes (*It is impolite to stared at people at the Mall*). Omission of *-ed* was the most difficult to

perceive. The authors indicate that the adolescents with SLI do not seem to have a deficit in their grammatical representations because they have a high correct judgment rate on tasks tapping the perception of grammatical rules. However, they make some errors in their production and they still have problems perceiving specific grammatical violations.

English older children/adolescents with SLI thus clearly have problems with the third-person singular affix in English and the production (and perception) of past tense marking in English. Similar findings have been reported for Dutch, in which subject-verb agreement also seems to be a persistent problem into adolescence. Data on grammatical problems in Dutch older children with SLI (8-12 years, N=36) indicates that in spontaneous language samples, grammatical errors mainly occur in subject-verb agreement. Problems with adjectival inflection, and past tense marking were expected on the basis of the literature, but were not found (Hoek 2010). Another study by Weerman, Duinmeijer and Orgassa (2011) made use of experimental tasks for testing subject-verb agreement. Dutch adolescents with SLI (N=9, age 12-13) performed better than the younger SLI-group and obtained high accuracy rates. However their performance is not yet 100% (around 95%) while typically developing children reach ceiling around 6 years of age. With novel verbs, the adolescents with SLI performed worse than with existing verbs, although not significantly. Furthermore, the error rate appeared to be higher in main clauses which in Dutch involve movement of the verb to second position of the sentence. Subject-verb agreement thus seems to remain a vulnerable area for SLI into adolescence also in Dutch, but performance seems to be dependent on the linguistic context.

Another morphological domain that has been tested in experiments in Dutch is the assignment of gender to nouns and gender agreement between adjectives and nouns. Keij (2009) tested knowledge of grammatical gender in articles in Dutch and compared younger (N=11, 6-10 years) and older age groups with SLI (N=9, 8-12 years) to controls. Both the younger and the older group of children with SLI had significant problems in gender assignment in comparison to their typically developing peers. Although older children were better at assigning gender to nouns in a knowledge task (grammatical judgment), they did not perform any better than the younger children on a production task. Gender assignment to nouns thus seems to be an area in which Dutch children with SLI persistently make errors into adolescence. This observation was confirmed in a study by Weerman et al. (2011), who tested article assignment with a production task and obtained similar results. Adolescents with SLI (N=9, aged 12;3-13;3) were not significantly better in assigning correct articles to nouns than younger children with SLI (N=25, aged 6-

8). In adjectival inflection (inflection according to the gender of the noun) adolescents with SLI seemed to have picked up the rules for inflection of the adjective, but because they persistently fail to assign the correct gender to nouns, the adjective was not inflected correctly.

In sum, the review of studies that discuss grammatical problems in adolescents with SLI indicate that there are persistent problems in complex syntax (marked by less use of- and a higher rate of errors in complex structures) and the morphological domain (mainly in finite verb inflection). Concerning the morphological errors, adolescents with SLI perform well on judgment tasks, but still make errors in their production. These errors are partly dependent on the linguistic context, since particular structures elicit higher error rates in experiments and the amount of grammatical errors in spontaneous speech is correlated to the complexity of the sentence.

3 A theoretical perspective on SLI

As long as children with SLI have been studied, researchers have been searching for explanations for the language disorder. Explanations can be sought at different levels, as has been visualised clearly in the causal model of developmental disorders by Bishop and Snowling (2004). In this model a distinction is made between observed behaviour, cognitive processes, neurobiology and aetiology (genetic and environmental factors). Furthermore, the model illustrates the fact that various causes can underlie the same observed behaviour and vice versa, the same underlying cause can cause different observed phenotypes. It may therefore not be sufficient to search for explanations at one level only.

As has been discussed in the introduction, recent findings suggest a genetic factor in the aetiology of SLI (e.g. Bishop et al. 1995, Bishop 2008, Fisher et al. 1998), but a clear genetic profile for individuals with language impairments has not been found yet. Genetics therefore does not provide an answer yet to the question what causes a specific language impairment. The same holds for studies focussing on the neurobiological level, measuring brain activation in language disordered children. Although several effects have been shown on the neurobiological level (e.g. differences in the amount of activation in certain areas or in the timing of activation, Leppänen et al. 2005), language disorders cannot yet be explained on the basis of neurobiological patterns. Explanations for SLI are therefore still largely based on observations of cognitive processes and behaviour.

In the literature on explanations for SLI, roughly two groups of accounts can be distinguished. The first group is often denoted as *representational accounts*, because the locus of the problems is sought in the representation of knowledge. According to these theories, children with SLI are lacking a certain linguistic principle that causes the specific language problems that can be observed. Although the locus of this deficit is variable across different theories, these accounts all predict problems to show up in the grammatical domain – in the learning of grammatical rules and the representation of grammatical knowledge (e.g. Clahsen, Bertke and Göllner 1997, Rice and Wexler 1996, Wexler 2003, van der Lely and Battell 2003, Marshall and van der Lely 2007). The other group of explanations can be referred to as the *processing accounts*. In this type of accounts, the problems in SLI are thought to stem from an information processing problem, while the language faculty itself is intact. Some theories propose a quite specific problem in the processing of auditory or phonological information (e.g. Gathercole and Baddeley 1990, Gathercole 2006 and Chiat 2001) or in speech perception (Joanisse and Seidenberg 2003). Others assume a broader deficit in the processing of both linguistic and non-linguistic information (e.g. Kail 1994, Windsor and Hwang 1999). The processing accounts have in common that they assume a processing deficit (either general or specific) that causes inadequate or incomplete processing of the input, which makes linguistic notions that require a great deal of input in order to be acquired particularly vulnerable for SLI. Linguistic features that are acquired relatively late in typical language development are therefore thought of as being problematic for children with SLI.

How can the observed language behavior in the adolescent SLI-group be best explained? What does the difference between judgment and production, and the dependence of error rates on linguistic context tell us about the nature of SLI? Miller et al. (2008) indicate that their results cannot be explained in terms of a specific grammatical deficit since accuracy rates were quite high, but may be better described by a model of general processing limitations. They discuss additional data which shows that adolescents and adults with SLI have persistent problems in the processing of auditory information. Adolescents with SLI encode sentences less quickly and have been shown to have slower reaction times and neurological under-activation on several aspects of information processing (Aram et al. 1984, Weismer et al. 2005, Miller et al. 2006). Processing limitations thus seem to persist into adolescence in SLI.

One of the theories that is based on the idea of a processing deficit underlying SLI and is particularly taking into account the observation that results in SLI-subjects can be inconsistent is the *Vulnerable Markers Hypothesis* (Bishop

1994). In this hypothesis, a processing problem in SLI is assumed, due to a limited capacity system that is handling several operations in parallel (decoding of the message at different linguistic levels, for instance, or processing and storing information at the same time). This processing problem causes problems in the acquisition of grammatical rules. At the same time, however, the hypothesis assumes that this processing problem causes a problem in the deployment of rules, leading to omission of grammatical morphemes. The theory predicts that 'errors will occur when the speech production system is stressed by the need to produce output that makes heavy demands on its processing capacity' (Bishop 1994, page 528), for instance because the message that has to be conveyed is more complex or contains more complex sentences, or because the retrieval of lexical items requires more effort. The theory was based on the observation that the errors in children's production of plural markers on nouns and past tense marking on verbs is consistent in the direction of the error (nearly all omissions of an inflection) but not consistent in occurrence of the error (sometimes the inflection is produced and sometimes it is omitted).

From a representational perspective, the inconsistency in production is often taken as evidence that knowledge of rules is missing. It seems implausible to assume a grammatical rule is known at one moment but absent at the next. In the light of representational theories it therefore seems reasonable to take the correct productions as instances of stored lexical entries (for instance plural forms of nouns or past tense forms of verbs can be separately stored in the lexicon). However, as Bishop puts forward, performance also varies within the same lexical items, rejecting an explanation in terms of lexical storage to explain variability. She interprets the results as indicating that children with SLI have knowledge of grammatical functions of morphological markers, but these markers are highly sensitive to loss if sentence processing puts a 'severe strain on a limited capacity system' (page 526). Bishop mentions factors like sentence complexity, message complexity, phonological complexity and the amount of material to be processed before the critical point as possible factors influencing performance (Bishop 1994). In the literature sentence length, the position of the word to be inflected in the sentence, the gap between dependent elements and the frequency have also been suggested as factors that play a role in performance breakdown (Grela and Leonard, 2000, Marchman et al. 1999, Marshall and van der Lely 2007, Roulet-Amiot and Jakubowicz 2006, Yung et al. 2009).

The Vulnerable Markers Hypothesis seems to be able to explain the results discussed in this review quite nicely. The fact that Dutch adolescents with SLI do not improve in the production of article assignment compared to younger

populations, but do improve in judgment indicates that knowledge can develop while performance keeps falling short. Also the fact that adolescents with SLI obtain high accuracy rates on the judgment and production of past tense marking and subject-verb agreement, but still make a significant amount of errors seems to indicate that rule knowledge is there, but is not implemented in performance. And the fact that a difference was found between error rates on the same grammatical construct in different linguistic contexts, seems to indicate that the processing load caused by the context plays a role.

Some of these aspects can be explained by representational accounts as well. The *Representational Deficit for Dependent Relations* (RDDR) Hypothesis (van der Lely and Battell 2003) for instance interprets the variable results in terms of optionality of the rule that drives movement (many of the characteristic problems in SLI involve movement). While movement is obligatory in normal grammatical development, it is optional in the grammar of a child with SLI due to a missing principle². By assuming a missing principle which causes optionality of a rule, this theory can explain why children exhibit both correct and incorrect use of the same lexical item. However, it cannot explain the context dependent patterns that we see in the error rates.

Another representational theory that does take into account the idea of influence of linguistic context on performance is the *Computational Grammatical Complexity* (CGC) Hypothesis (van der Lely 2005). This theory assumes that children with SLI have a problem in the representation of structures that require hierarchical organization in the three core components of grammar: the phonological, the syntactic and the morphological component (Marshall and van der Lely 2007). As Bishop puts forward in her article, this theory assumes that a child with SLI prefers storage of regular forms instead of computing them by rules. This makes regular forms subject to word effects like frequency and thus predicts patterns in error rates of different lexical items. However, it cannot explain why correct and incorrect production show up in the same lexical item. Although representational theories are thus also able to explain aspects of the variability found in the SLI-data, there is no representational theory that can account for both the variability in performance between tasks, within tasks and within the same items, and the influence of context.

The Vulnerable Markers Hypothesis thus seems best explaining the variability in error rates in SLI in terms of problems in performance, but which

² A more detailed explanation of the impairment in SLI according to the RDDR can be found in van der Lely and Battell (2003).

factors influence performance remains open to debate. The adolescent population provides a good testing ground for further testing the hypotheses put forward by the Vulnerable Markers Hypothesis. In childhood, problems in rule learning and rule implementation cannot easily be separated because rule knowledge is still developing. In adolescence, however, rule knowledge is thought to be relatively stabilized since access to implicit rule learning mechanisms is assumed to be limited. On the basis of the Vulnerable Markers Hypothesis, differences between rule knowledge and rule implementation are expected in the whole range of grammatical aspects that are problematic SLI when processing load is increased (problems in inflection, assigning gender, using complex syntax). Furthermore, clear patterns are hypothesized in the contexts causing performance breakdown. Finally a link between language scores and processing abilities can be assumed, although the theory does not specify which aspects of processing are impaired in SLI. To test these predictions, experimental studies are needed that can complement the existing data on the problems in adolescents with SLI and that can investigate why children and adolescents with SLI show an inconsistent error pattern in their language production. Experiments need to be designed in which processing demands can be varied in terms of sentence length, sentence structure, the position of the word to be inflected in the sentence, the gap between dependent elements, the frequency and the phonological complexity of words. Furthermore, both receptive and expressive tasks should be used, to test whether there is indeed a gap between knowledge and performance in SLI.

4 References

- Aram, D.M., Ekelman, B.L. and Nation, J.E. (1984). Preschoolers with Language Disorders: 10 Years Later. *Journal of Speech and Hearing Research*, 27, 2: 232–44.
- Arkkila, E., Räsänen, P., Roine, R.P., Sintonen, H., Saar, V. and Vilkman, E. (2009). Health-related quality of life of adolescents with childhood diagnosis of specific language impairment. *International Journal of Pediatric Otorhinolaryngology*, 73, 9: 1288–1296.
- Baker, L. and Cantwell, D.P. (1987). A Prospective Psychiatric Follow-up of Children with Speech/Language Disorders. *Journal of the American Academy of Child & Adolescent Psychiatry*, 26, 4: 546–553.
- Beitchman J.H., Wilson, B., Brownlie, E.B., Walters, H. and Lancee, W. (1996a). Long-Term Consistency in Speech/Language Profiles: I. Developmental and Academic Outcomes. *Journal of the American Academy of Child & Adolescent Psychiatry*, 35, 6: 804–814.
- Beitchman, J.H., Wilson, B., Brownlie, E.B., Walters, H., Inglis, A. and Lancee, W. (1996b). Long-Term Consistency in Speech/Language Profiles: II. Behavioral, Emotional, and

- Social Outcomes. *Journal of the American Academy of Child & Adolescent Psychiatry*, 35, 6: 815–825.
- Beitchman, J.H., Wilson, B., Johnson, C., Atkinson, L., Young, A., Adlaf, E., Escobar, M. and Douglas, L. (2001). Fourteen-Year Follow-up of Speech/Language-Impaired and Control Children: Psychiatric Outcome. *Journal of the American Academy of Child & Adolescent Psychiatry*, 40, 1: 75–82.
- Bishop, D.V.M. (1994). Grammatical errors in specific language impairment: Competence or performance limitations? *Applied Psycholinguistics*, 15: 507–550.
- Bishop, D.V.M. (2004). Specific Language Impairment: diagnostic dilemmas. In: L. Verhoeven and H. van Balkom (eds.). *Classification of developmental language disorders: theoretical issues and clinical implications*. Mahwah, New Jersey: Lawrence Erlbaum Associates, 309–326.
- Bishop, D.V.M. (2008). Specific language impairment, dyslexia and autism: Using genetics to unravel their relationship. In: C. Frazier Norbury, J.B. Tomblin and D.V.M. Bishop (eds.) *Understanding Developmental Language Disorders*, Sussex: Psychology Press, 67–78.
- Bishop, D.V.M. and Edmundson, A. (1987). Language-impaired 4-year-olds: distinguishing transient from persistent impairment. *Journal of Speech and Hearing Disorders*, 52: 156–173.
- Bishop, D.V.M. and Snowling, M.J. (2004). Developmental Dyslexia and Specific Language Impairment: Same or Different? *Psychological Bulletin*, 130, 6: 858–886.
- Bishop D.V.M., North T. and Donlan C. (1995). Genetic basis of specific language impairment: evidence from a twin study. *Developmental Medicine and Child Neurology*, 37: 56–71.
- Botting, N., Faragher, B., Simkin, Z., Knox, E. and Conti-Ramsden, G. (2001). Predicting Pathways of Specific Language Impairment: What differentiates good and poor outcome? *Journal of Child Psychology and Psychiatry*, 42, 8: 1013–1020.
- Burger, E.A. and Rijpma, G. (1998). Taalvaardigheidsonderzoek bij taalgestoorde leerlingen in het voortgezet onderwijs. *Toegepaste Taalwetenschap in Artikelen*, 60, 3: 29–38.
- Chiat, S. (2001). Mapping theories of developmental language impairment: Premises, predictions and evidence. *Language and Cognitive Processes*, 16: 113–142.
- Clahsen, H., Bartke, S. and Göllner, S. (1997). Formal features in impaired grammars: A comparison of English and German SLI children. *Journal of Neurolinguistics*, 10: 151–171.
- Clegg, J., Hollis, C., Mawhood, L. and Rutter, M. (2005). Developmental language disorders? A follow-up in later adult life. Cognitive, language and psychosocial outcomes. *Journal of Child Psychology and Psychiatry*, 46, 2: 128–149.
- Conti-Ramsden, G., Botting, N., Simkin, Z. and Knox, E. (2001). Follow-up of children attending infant language units: outcomes at 11 years of age. *International Journal of Language & Communication Disorders*, 36, 2: 207–219.

- Conti-Ramsden, G. and Durkin, K. (2008). Language and Independence in Adolescents With and Without a History of Specific Language Impairment (SLI). *Journal of Speech, Language, and Hearing Research*, 51, 1: 70–83.
- Conti-Ramsden, G., Durkin, K. and Walker, A.J. (2012). The messages they send: e-mail use by adolescents with and without a history of specific language impairment (SLI). *International Journal of Language & Communication Disorders*, 47, 2: 217–228.
- Conti-Ramsden, G., Knox, E., Botting, N. and Simkin, Z. (2002). Focus on Practice: Educational placements and National Curriculum Key Stage 2 test outcomes of children with a history of specific language impairment. *British Journal of Special Education*, 29, 2:76–82.
- Davison, F.M. and Howlin, P. (1997). A follow-up study of children attending a primary-age language unit. *International Journal of Language and Communication Disorders*, 32, 1: 19–36.
- de Ajuriaguerra, J., Jaeggi, A., Guignard, F., Kocher, F., Maquard, M., Roth, S. and Schmid, E. 1976. The development and prognosis of dysphasia in children. In: D. Morehead and A. Morehead (eds.) *Normal and deficient child language*. Baltimore: University Park Press, 345–386.
- de Jong, J. (1999). *Specific language impairment in Dutch: inflectional morphology and argument structure*, Doctoral thesis. Groningen: Rijksuniversiteit Groningen.
- Fisher S.E., Vargha-Khadem F., Watkins K.E., Monaco A.P and Pembrey M.E. (1998). Localisation of a gene implicated in a severe speech and language disorder. *Nature Genetics*, 18: 168–170.
- Gathercole, S.E. (2006). Nonword repetition and word learning: The nature of the relationship. *Applied Psycholinguistics*, 27, 4: 513–543.
- Gathercole, S.E. and Baddeley, A.D. (1990). Phonological memory deficits in language disordered children: Is there a causal connection? *Journal of Memory and Language*, 29, 3: 336–360.
- Grela, B.G. and Leonard, L.B. (2000). The Influence of Argument-Structure Complexity on the Use of Auxiliary Verbs by Children With SLI. *Journal of Speech, Language, and Hearing Research*, 43, 5: 1115–1125.
- Hall, P.K. and Tomblin, J.B. (1978). A Follow-Up Study of Children with Articulation and Language Disorders. *Journal of Speech and Hearing Disorders*, 43, 2: 227–241.
- Hamann, C. (2006). Speculations about early syntax: the production of wh-questions by normally developing French children and French children with SLI. *Catalan Journal of Linguistics*, 5: 143–189.
- Hesketh, A. (2006). The use of relative clauses by children with language impairment. *Clinical Linguistics and Phonetics*, 20, 7/8: 539–546.
- Hoek, P. (2010). *Older Dutch children with Specific Language Impairment: Constructing an error profile*. Master thesis. Amsterdam: University of Amsterdam.

- Joanisse, M.C. and Seidenberg, M.S. (2003). Phonology and syntax in specific language impairment: Evidence from a connectionist model. *Brain and Language*, 86, 1: 40–56.
- Johnson, C.J., Beitchman, J.H., Young, A., Escobar, M., Atkinson, L., Wilson, B., Brownlie, E.B., Douglas, L., Taback, N., Lam, I. and Wang, M. (1999). Fourteen-Year Follow-Up of Children With and Without Speech/Language Impairments: Speech/Language Stability and Outcomes. *Journal of Speech, Language, and Hearing Research*, 42, 3: 744–760.
- Kail, R. (1994). A Method for Studying the Generalized Slowing Hypothesis in Children With Specific Language Impairment. *Journal of Speech and Hearing Research*, 37, 2: 418–421.
- Keij, B. (2009). *De verwerving van grammaticaal geslacht in het Nederlands*. Master thesis. Nijmegen: Radboud University Nijmegen.
- Larson, V.L. and McKinley N.L. (1995). *Language Disorders in Older Students: Preadolescents and Adolescents*. Eau Claire: Thinking Publications.
- Law, J., Rush, R., Schoon, I. and Parsons, S. (2009). Modeling Developmental Language Difficulties From School Entry Into Adulthood: Literacy, Mental Health, and Employment Outcomes. *Journal of Speech, Language, and Hearing Research*, 52, 6: 1401–1416.
- Leonard, L. (2009). Cross-linguistic studies of child language disorders. In: R. Schwartz (ed.) *Handbook of Child Language Disorders*. New York: Psychology Press, 308–324.
- Leonard, L.B. (1998). *Children with Specific Language Impairment*. Cambridge, Massachusetts, London: The MIT Press.
- Leppänen P. H. T., Lyytinen H., Choudhury N. and Benasich A.A. (2005). Neuroimaging Measures in the Study of Specific Language Impairment. In: L. Verhoeven and H. van Balkom (eds.) *Classification of Developmental Language Disorders: Theoretical Issues and Clinical Implications*. Mahwah, New Jersey: Lawrence Erlbaum Associates, 99–136.
- Marchman V.A., Saccuman C. and Wulfeck B. (2004). Productive use of the English past tense in children with focal brain injury and specific language impairment. *Brain and Language*, 88, 2: 202–214.
- Marchman, V.A., Wulfeck, B. and Weismer, S.E. (1999). Morphological Productivity in Children With Normal Language and SLI: A Study of the English Past Tense. *Journal of Speech, Language, and Hearing Research*, 42, 1: 206–219.
- Marinellie, S.A. (2004). Complex syntax used by school-age children with specific language impairment (SLI) in child–adult conversation. *Journal of Communication Disorders*, 37, 6: 517–533.
- Marshall, C.R. and van der Lely, H.K.J. (2007). The impact of phonological complexity on past tense inflection in children with Grammatical-SLI. *International Journal of Speech-Language Pathology*, 9, 191–203.

- Miller, C.A., Leonard, L.B. and Finneran, D. (2008). Grammaticality judgments in adolescents with and without language impairment. *International Journal of Language and Communication Disorders*, 43, 3: 346–360.
- Miller, C.A., Leonard, L.B., Kail, R.V., Zhang, X., Tomblin, J.B. and Francis, D.J. (2006). Response Time in 14-Year-Olds With Language Impairment. *Journal of Speech, Language, and Hearing Research*, 49, 4: 712–728.
- Nippold, M.A. (1995). Language norms in school-age children and adolescents: an introduction. *Language, Speech & Hearing Services in Schools*, 26, 4: 307–308.
- Nippold, M.A., Mansfield, T.C., Billow, J.L. and Tomblin, J.B. (2008). Expository discourse in adolescents with language impairments: examining syntactic development. *American Journal of Speech-Language Pathology*, 17, 4: 356–366.
- Nippold, M.A. and Schwarz, I.E. (2002). Do children recover from specific language impairment?. *International Journal of Speech-Language Pathology*, 4, 1: 41–49.
- Norbury, C.F., Bishop, D.V.M. and Briscoe, J. (2001). Production of English Finite Verb Morphology: A Comparison of SLI and Mild-Moderate Hearing Impairment. *Journal of Speech, Language, and Hearing Research*, 44, 1: 165–178.
- Orgassa, A. and Weerman, F. (2008). Dutch gender in specific language impairment and second language acquisition. *Second Language Research*, 24, 3: 333–364.
- Rescorla, L. (2000). Do late-talking toddlers turn out to have reading difficulties a decade later? *Annals of Dyslexia*, 50, 1: 85–102.
- Rice, M.L. and Wexler, K. (1996). Toward Tense as a Clinical Marker of Specific Language Impairment in English-Speaking Children. *Journal of Speech and Hearing Research*, 39, 6: 1239–1257.
- Roulet-Amiot, L. and Jakubowicz, C. (2006). Production and perception of gender agreement in French SLI. *International Journal of Speech-Language Pathology*, 8, 4: 335–346.
- Schwartz, R.G. (2009). *Handbook of Child Language Disorders*. New York: Psychology Press.
- Snowling, M.J., Bishop, D.V.M., Stothard, S.E., Chipchase, B. and Kaplan, C. (2006). Psychosocial outcomes at 15 years of children with a preschool history of speech-language impairment. *Journal of Child Psychology and Psychiatry*, 47, 8: 759–765.
- Snowling, M., Bishop, D.V.M. and Stothard, S.E. (2000). Is Preschool Language Impairment a Risk Factor for Dyslexia in Adolescence? *Journal of Child Psychology and Psychiatry*, 41, 5: 587–600.
- Stark, R.E. and Tallal, P. (1981). Selection of children with specific language deficits. *Journal of Speech and Hearing Disorders*, 46: 114–122.
- Stark, R., Bernstein, L., Condino, R., Bender, M., Tallal, P. and Catts, H. (1984). Four-year follow-up study of language impaired children. *Annals of Dyslexia*, 34, 1: 49–68.

- Stavrakaki, S. (2006). Developmental perspectives on Specific Language Impairment: Evidence from the production of wh-questions by Greek SLI children over time. *International Journal of Speech-Language Pathology*, 8, 4: 384–396.
- Stothard, S.E., Snowling, M.J., Bishop, D.V.M., Chipchase, B.B. and Kaplan, C.A. (1998). Language-Impaired Preschoolers: A Follow-Up Into Adolescence. *Journal of Speech, Language, and Hearing Research*, 41, 2: 407–418.
- Tomblin, J.B., Freese, P.R. and Records, N.L. (1992). Diagnosing Specific Language Impairment in Adults for the Purpose of Pedigree Analysis. *Journal of Speech and Hearing Research*, 35, 4: 832–843.
- Tuller, L., Henry, C., Sizaret, E. and Barthez, M. (2012). Specific language impairment at adolescence: Avoiding complexity. *Applied Psycholinguistics*, 33, 1: 161–184.
- van der Lely, H.K.J. (2005). Domain-specific cognitive systems: insight from Grammatical-SLI. *Trends in Cognitive Sciences*, 9, 2: 53–59.
- van der Lely, H.K.J. and Battell, J. (2003). WH-Movement in Children with Grammatical SLI: A Test of the RDDR Hypothesis. *Language*, 79, 1: 153–181.
- van, der Lely and Ullman, M.T. (2001). Past tense morphology in specifically language impaired and normally developing children. *Language and Cognitive Processes*, 16, 2/3: 177–217.
- van Groningen, R. (2010). *Complexity and correctness in older children with SLI: Related or not?* Master thesis. Amsterdam: University of Amsterdam.
- Weerman, F., Duinmeijer, I. and Orgassa, A. (2011). Effecten van SLI op Nederlandse congruentie. *Nederlandse Taalkunde*, 16, 1: 30–55.
- Weiner, P.S. (1974). A Language-Delayed Child at Adolescence. *Journal of Speech and Hearing Disorders*, 39, 2: 202–212.
- Weismer, S.E., Plante, E., Jones, M. and Tomblin, J.B. (2005). A Functional Magnetic Resonance Imaging Investigation of Verbal Working Memory in Adolescents With Specific Language Impairment. *Journal of Speech, Language, and Hearing Research*, 48, 2: 405–425.
- Wexler, K. (1998). Very early parameter setting and the unique checking constraint: A new explanation of the optional infinitive stage. *Lingua* 106: 23–79.
- Wexler, K. (2003). Lenneberg's dream: learning, normal language development, and specific language impairment. In: Y. Levy and J. Schaeffer (eds.). *Language Competence Across Populations, Toward a Definition of Specific Language Impairment*. Mahwah, NJ: Erlbaum, 11–62.
- Windsor, J. and Hwang, M. (1999). Testing the Generalized Slowing Hypothesis in Specific Language Impairment. *Journal of Speech, Language, and Hearing Research*, 42, 5: 1205–1218.

- World Health Organization (WHO) (2005). Child and adolescent mental health policies and plans. Available at http://www.who.int/mental_health/policy/Childado_mh_module.pdf
- Young, A.R., Beitchman, J.H., Johnson, C., Douglas, L., Atkinson, L., Escobar, M. and Wilson, B. (2002). Young adult academic outcomes in a longitudinal sample of early identified language impaired and control children. *Journal of Child Psychology and Psychiatry*, 43, 5: 635–645.
- Yung Song, J., Sundara, M. and Demuth, K. (2009). Phonological Constraints on Children's Production of English Third Person Singular –s. *Journal of Speech, Language, and Hearing Research*, 52, 3: 623–642.

Iris Duinmeijer
University of Amsterdam
Spuistraat 210
1012 VT Amsterdam
The Netherlands
i.duinmeijer@uva.nl
<http://home.medewerker.uva.nl/i.duinmeijer/>