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DOI
10.1111/1460-6984.12013

Publication date
2013

Document Version
Final published version

Published in
International Journal of Language and Communication Disorders

Link to publication

Citation for published version (APA):
Blom, E., de Jong, J., Orgassa, A., Baker, A., & Weerman, F. (2013). Verb inflection in monolingual Dutch and sequential bilingual Turkish-Dutch children with and without SLI. *International Journal of Language and Communication Disorders*, *48*(4), 382-393. https://doi.org/10.1111/1460-6984.12013

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Download date:08 Dec 2021

International Journal of Language & Communication Disorders

INT J LANG COMMUN DISORD, JULY–AUGUST 2013,
VOL. 48, NO. 4, 382–393

Research Report

Verb inflection in monolingual Dutch and sequential bilingual Turkish–Dutch children with and without SLI

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(*Received May 2012; accepted January 2013*)

Abstract

Both children with specific language impairment (SLI) and children who acquire a second language (L2) make errors with verb inflection. This overlap between SLI and L2 raises the question if verb inflection can discriminate between L2 children with and without SLI. In this study we addressed this question for Dutch. The secondary goal of the study was to investigate variation in error types and error profiles across groups. Data were collected from 6–8-year-old children with SLI who acquire Dutch as their first language (L1), Dutch L1 children with a typical development (TD), Dutch L2 children with SLI, and Dutch L1 TD children who were on average 2 years younger. An experimental elicitation task was employed that tested use of verb inflection; context (3SG, 3PL) was manipulated and word order and verb type were controlled. Accuracy analyses revealed effects of impairment in both L1 and L2 children with SLI. However, individual variation indicated that there is no specific error profile for SLI. Verb inflection use as measured in our study discriminated fairly well in the L1 group but classification was less accurate in the L2 group. Between-group differences emerged furthermore for certain types of errors, but all groups also showed considerable variation in errors and there was not a specific error profile that distinguished SLI from TD.

Keywords: specific language impairment (SLI), bilingualism, child L2, finiteness, inflection, Dutch.

What this paper adds?

What is already known on the subject?

Monolingual Dutch children with specific language impairment (SLI) have profound difficulties using verb inflection. Previous studies report overlap between the frequency and type of verb inflection errors in SLI and second language (L2) children with a typical development (TD). This overlap raises the question if verb inflection discriminates between TD and SLI in L2 contexts.

What this paper adds?

This study reports new data obtained in a constrained experimental setting on verb inflection use across L1 Dutch SLI, L2 Dutch TD, L2 Dutch SLI and L1 Dutch TD. Both in the L1 and L2 context, TD groups outperformed SLI groups, but verb inflection appears to be a less accurate clinical marker in individual bilingual children than in individual monolingual children. In all groups children made various errors and showed individual variation in error profiles. SLI in Dutch was not associated with a specific error profile.

Introduction

Elementary school children with specific language impairment (SLI) who are acquiring Germanic languages have difficulties using verb inflection (Leonard 2009) and this feature has been suggested as a clinical marker. Research on English, French and Swedish has however indicated overlap in the type and frequency of errors made by monolingual children with SLI on the one hand and by typically developing (TD) bilingual peers who learn the target language as their second language

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International Journal of Language & Communication Disorders
ISSN 1368-2822 print/ISSN 1460-6984 online © 2013 Royal College of Speech and Language Therapists
DOI: 10.1111/1460-6984.12013

(L2) on the other (for an overview, see Paradis *et al.* 2008). This overlap makes it debatable if verb inflection errors can be strictly interpreted as a clinical marker of SLI, since they could be due to either bilingualism or language impairment. Furthermore, with respect to Dutch, researchers have reached different conclusions regarding the types of errors that are characteristic for SLI (de Jong 1999, Verhoeven *et al.* 2011, Wexler *et al.* 2004). This discrepancy raises questions regarding variation in errors within and between TD and SLI groups. The primary goal of this study was to examine whether verb inflection could be used as a clinical marker in Dutch, regardless of whether Dutch is the children's first language (L1) or second language (L2). The secondary goal was to investigate variation in errors by comparing types of errors and error profiles across groups with TD and SLI.

Dutch verb inflection across L1 and L2 groups, with and without SLI

Dutch finite verbs convey information on the temporal interpretation of the sentence (tense) and information regarding person and number of the sentence subject (agreement) through a suffix attached to the verb stem. The Dutch present tense paradigm is illustrated in (1) using the verb *drinken* 'to drink':

(1)	1SG	drink	'I am drinking'	Stem+Ø[1]
	2SG	drinkt	'you are drinking'	Stem+*t*
	3SG	drinkt	'he/she is drinking'	Stem+*t*
	1PL	drinken	'we are drinking'	Stem+*en*
	2PL	drinken	'you are drinking'	Stem+*en*
	3PL	drinken	'they are drinking'	Stem+*en*

The position of the main verb varies in Dutch. In main clauses, finite verbs are in second position — see (2) and (3). Non-finite verbs (e.g. infinitive) are in sentence-final position, as in (4), where an infinitive occurs with a modal verb in finite form.[2]

(2)	Jan	drinkt	koffie		
	Jan	drink-3SG	coffee		
	'Jan is drinking coffee'				
(3)	Jan	en	Piet	drinken	koffie
	Jan	and	Piet	drink-3PL	coffee
	'Jan and Piet are drinking coffee'				
(4)	Jan	wil	koffie	drinken	
	Jan	want-3SG	coffee	drink-INF	
	'Jan wants to drink coffee'				

Between ages 2 and 3, Dutch L1 children with TD commonly use infinitival main clauses ('root infinitives') in contexts where adults would use a finite sentence. Root infinitives contain an infinitive (stem+*en*; homophonous with finite plural forms) and lack a finite verb; examples illustrating root infinitives are in (5) (selected from the CHILDES Groningen Corpus; for references, see http://childes.psy.cmu.edu/).

(5)	a.	Vrachtwagen	emmer	doen	Matthijs 2;04.24
		Truck	bucket	do.INF	
		'You must put the truck in the basket'			
	b.	boot	varen		Laura 2;04.01
		boat	sail.INF		
		'The boat is sailing'			

At a later age, when children consistently place verbs in finite position, other verb inflection errors might still occur. Polišenská (2010: 93) found that the most frequent error up to age 5 is incorrect use of bare verbs with 2SG and 3SG subjects (across 3, 4 and 5 year olds between 5% and 19%). Incorrect bare verbs in plural contexts or substitution of SG *-t* for PL *-en*, and vice versa, seldom occurred however. In Dutch L1 children with SLI verb inflection errors are persistent. In a group of children with SLI who were on average 7 years old, de Jong (1999) found that the accuracy of use of 3SG *-t* was 61% in obligatory contexts, much lower than the TD language-matched group—consisting of children who were on average 2 years younger—and the TD age-matched groups who had an accuracy of 87% and 89%, respectively. The same two TD groups had an accuracy of more than 95% with 3PL *-en* in contrast to only 69% in the SLI children. De Jong observed that children with SLI used incorrect bare verbs, substituted one inflectional suffix for another and used root infinitives. He thus concluded that the frequency of errors rather than the type of error distinguishes between SLI and TD in Dutch (de Jong 1999). In a study with younger children with SLI (4–8 years), Wexler *et al.* (2004) argued that root infinitive errors in children with SLI (between ages 4 and 8) occurred persistently, being 15% across the board. In TD children aged only 3 years as little as 7% root infinitives were used.

The accuracy rates reported in studies of Dutch L2 children of a similar age suggest that verb inflection is less affected by (factors related to) bilingualism than by SLI. Pooled data of Dutch L2 TD children between ages 5 and 8 with Turkish L1 indicate 92% correct use of finite verbs for all contexts collapsed (Blom *et al.* 2006). Comparing effects of L2 and SLI in children between ages 6 and 8, Orgassa (2009) found that her L1 SLI group was less accurate (80% correct) than the L1 TD group (91% correct) and that the L2 SLI group (75% correct) was less accurate than the L2 TD (88% correct) group. The L1 and L2 groups were not significantly different. In terms of error types incorrect bare verb use was the most frequent in the L1 TD, L2 TD and L1 SLI group, as it was for the L2 children in the first study (Blom and Baayen 2012). Substitution of PL *-en* by

SG *-t* was proportionally a more frequent error in the L2 SLI group. Verhoeven *et al.* (2011) comparing 7- and 9-year-old children assigned to one of three groups, L1 SLI, L2 TD or L2 SLI, also conclude that verb inflection errors, in particular incorrect bare verbs, could be a clinical marker of SLI in Dutch. L2 children tended to substitute inflectional endings (SG *-t* in PL contexts).[3]

To summarize, previous research has shown that Dutch L1 children with SLI make more errors with verb inflection than L1 TD and this also appears to hold for L2 children with SLI. L2 children without SLI make fewer errors. There is however discussion as to whether the impairment can be characterized by the frequency of errors, regardless of the type of error (de Jong 1999), or whether the type is crucial, Wexler *et al.* (2004) claiming root infinitives as characteristic in contrast to Verhoeven *et al.* (2011) who propose incorrect bare verbs. In the present study, this issue is further investigated through cross-group comparisons based on data collected in a controlled experimental setting. To do so, we analysed for the present study a subset of the data reported in Orgassa (2009). Error frequency, error types and distributions of error profiles were compared across groups The results also allowed us to determine classification accuracy, which is important for identifying SLI in individual children.

Processing limitations and verb inflection in Dutch SLI

It is intriguing to consider what might cause persistent verb inflection errors in children with SLI. Leonard (1998, 2007) has pointed to the role of processing deficits. Numerous studies have indicated that children with SLI have processing limitations, i.e. a smaller working memory capacity and slower speed of processing (for an overview, see Marinis 2011). Such limitations can affect both verb inflection knowledge and performance and predict optionality and variability in verb inflection use (Leonard 2007). In particular, this last aspect is relevant to our study, where we look more closely into variation in verb inflection errors.

What error types could be expected given that children with SLI have limited processing abilities? Slower processing in SLI could lead to failures to retain inflectional morphemes long enough to test them against their grammatical functions. This could delay building inflectional paradigms. Consequently, children with SLI may persist in using bare verbs. Hence, a Dutch-speaking child with SLI may use bare verbs in contexts that require inflected verbs, e.g. in second position with 3SG subjects (*Jan *loop op de straat*; 'John *walk on the street'). Due to input-related factors infinitives are forms acquired early in Dutch, leading to use of root infinitives (Wijnen *et al.* 2001). Children's delays in building inflectional paradigms could therefore also lead to use of root infinitives as a fall back strategy when finite forms are not readily available. Finally, when a greater number of dimensions must be kept in memory, a child with SLI may miss out on a dimension, resulting in 'near miss errors', e.g. use of a 3SG form instead of a 1SG or a 3PL form. In short, the global nature of a processing approach to SLI could predict prolonged use of incorrect bare verbs, root infinitives and substituted inflection.

Processing approaches to SLI assume that verb inflection problems are secondary to general processing limitations of children with SLI. Such an approach to SLI may predict more variation in error types than a contrasting view that assumes the linguistic deficit to be primary, the Extended Optional Infinitive (EOI) hypothesis (Rice and Wexler 1996). Our study was not designed to evaluate the two types of hypotheses, but its results could be informative as is further explained in the Discussion section. The question may arise whether there would be any empirical evidence falsifying a processing approach to SLI. Verb inflection data only will not suffice in this respect. If in future research it appears that there are children who make persistent errors with verb inflection but have no processing deficit, then this would be evidence against this hypothesis.

A processing account provides ample room for speculating about the combination of bilingualism and SLI (Paradis 2010). L1 SLI, L2 TD and L2 SLI would be expected to have lower accuracies than L1 TD. For children with SLI this would be because processing limitations affect their knowledge and performance. As pointed out above, knowledge could be affected because children with SLI lack (stable) knowledge of finite inflected verbs, lowering accessibility and availability of finite inflected verb forms in online performance and, consequently, resulting in incorrect bare verbs and root infinitives. In L2 TD, factors related to bilingualism could yield similar effects. Shorter length of exposure and division of language input over two languages may lead to reduced Dutch input in L2 children, which could affect their building of inflectional paradigms. Retrieval of the correct inflected form may be less automatized in L2 children, affecting their online performance (Prévost 2003). Different predictions could be envisaged for the combined effect of SLI and bilingualism. The combination of the two conditions may exert more influence than the single effect of SLI or bilingualism, in which case the L2 SLI group would perform worse than L2 TD and L1 SLI. Recent research has shown that L2 children transfer verb inflection knowledge from their L1 (Blom and Baayen 2012, Blom *et al.* 2012). If L2 children with SLI transfer verb inflection information, this could place them more on equal footing with L1 SLI or L2 TD (Armon-Lotem 2010, de Jong 1999, 2010).

This study

Three research questions guided the study:

- Do Dutch L1/L2 TD groups differ in frequency of errors when using verb inflection from Dutch L1/L2 groups with SLI?
- Does verb inflection accuracy discriminate between SLI and TD at the level of individual children and is this the same in L1 and L2 contexts?
- Do error types and error profiles differ across L1/L2 TD and L1/L2 SLI groups?

To answer these questions, L2 children with TD were compared with a group of L1 children with SLI and to L2 children with SLI, all age-matched. Previous research has indicated that Dutch L1 children with SLI perform less accurately with verb inflection than children who are 2 years younger with matching general language abilities (de Jong 1999). Therefore, in this study a fourth group was included consisting of L1 TD children who were on average 2 years younger (instead of an age-matched L1 TD group). We compared accuracy across groups (first research question) and estimated sensitivity and specificity of the test administered based on accuracy (second research question). Finally, error types and profiles of individual children were compared across the four groups (third research question).

Error types were divided into incorrect bare verbs, substitution of one inflected form by another, and root infinitives to allow comparisons with previous research. Note that the Dutch data provide more possibilities than English data, because the verb paradigm is richer and placement and form of Dutch verbs enable distinguishing between root infinitives and incorrect verbs in finite position. Our expectation was that L2 children with SLI due to their processing limitations would show a delay, and hence, that they would make more errors than age-matched L2 children with TD and, also, that the L1 SLI group would make more errors than a younger L1 TD control group. However, we did not expect error profiles to be distributed differently across groups; more specifically we did not expect children with SLI to be typical 'root infinitive users' (Wexler *et al.* 2004) or typical 'incorrect bare verb users' (Verhoeven *et al.* 2011).

Most studies on Dutch SLI have used data from narratives and spontaneous speech (de Jong 1999, Verhoeven *et al.* 2011, Wexler *et al.* 2004). Although these methods provide rich data with great ecological validity, the lack of control in such contexts can fail to show the influence of variables such as context, frequency, phonology and position of the verb (cf. Blom and Baayen 2012, Blom *et al.* 2012, Oetting and Horohov 1997, Song *et al.* 2009). For the present study, we reanalysed the 3SG and 3PL contexts from the experimental study reported in Orgassa (2009). This reanalysis allowed us to keep all the factors mentioned above constant and thus improve in this respect on previous research. Various studies have indicated that 3SG and 3PL contexts in Dutch are prone to errors with possible variation across L1/L2 and SLI/TD groups.

Method

Participants

Children were assigned to four groups: L1 SLI ($N = 23$), L2 TD ($N = 20$), L2 SLI ($N = 20$) and L1 TD ($N = 31$). All children were recruited from the western part of the Netherlands (Randstad). The L2 children were born in families from Turkish descent. Although the children were born in the Netherlands, Turkish input dominated during their early childhood years. Information regarding Dutch exposure was gathered through a parental questionnaire.[4] To estimate how much Dutch input the children had received, we calculated exposure to Dutch by subtracting a child's age of onset (in months) from the child's age at time of testing (in months) (table 1). Age of onset was determined based on the onset of regular and substantial exposure to Dutch. For many L2 children in the sample this was when they started going to preschool (around age 2), but for other children this was from the age of 4 when they entered elementary school.

None of the children in the TD groups had apparent language or speech problems, according to teacher report. For the L2 TD group this was confirmed by the parental questionnaire, which also contained questions about the history of development in Turkish. All children in the TD group were in regular mainstream schools. Children who were visiting a speech language therapist were excluded from the study as were L2 children with parental concern regarding their development based on L1 history. Besides the exclusionary criteria common to SLI—the requirement that there is normal hearing, no socio-emotional disorder, no cognitive deficit or frank neurological disorder (Stark and Tallal 1981)—the children were diagnosed with SLI on the basis of their low language level (the inclusionary criterion). The children in our sample were assessed by the special schools for SLI. Admission criteria include the SLI exclusion and inclusion criteria commonly referred to in the literature (Records and Tomblin 1994): children had to have significant speech and language problems which could not be attributed to cognitive limitations. The language proficiency of the children in our sample fell below age expectations as measured by a standardized Dutch language test, i.e. they scored at least 1.5 SD (standard deviation) below the norm on

Table 1. Participant characteristics

	L1 SLI	L2 SLI	L2 TD	L1 TD
Mean (SD) age at testing (months)	87 (7.8)	89 (7.3)	87 (6.7)	61 (8.8)
Range of age at testing (months)	73–96	71–99	75–101	47–75
Mean (SD) length of exposure (months)	87 (7.8)	62 (14.4)	63 (15.3)	61 (8.8)
Range of length of exposure (months)	73–96	41–91	39–101	47–75
Mean (SD) age of onset (months)	0	27 (15)	23 (12.5)	0
Range of age of onset (months)	0	0–48	0–42	0

Notes: L1 = (Dutch) first language; SLI = specific language impairment; L2 = (Dutch) second language; TD = typical development.

tests for at least two language domains (speech production, auditory processing, grammatical development, lexical–semantic development)[5]or they scored at least 2 SD below the norm on a general language test—e.g. Language assessment for all children (TAK) (Verhoeven and Vermeer 2002), or the Language assessment for children (TvK) (Van Bon and Hoekstra 1982) (Landelijke Commissie Toezicht Indicatiestelling (LCTI) 2006). The TAK has standardized norms for native Dutch children and for children from families that had immigrated from the Mediterranean (including Turkey and Morocco), Surinam or the Dutch Caribbean. Since in the original research no differences were found between the groups, they were collapsed into one larger Mediterranean norm group (Verhoeven and Vermeer 2006). All children had a non-verbal IQ of at least 85, as assessed by the SON-R (Tellegen *et al.* 1998), so that the children's language problems could not be attributed to a more general learning impairment. Children with severe phonological deficits were excluded to reduce the potential interference of phonological problems with the production of verb inflection.

Materials

The data were collected in a task that tested the children's ability to express verbal and adjectival agreement. The adjectival data will not be discussed here (Orgassa 2009). For the present study, children's responses on the 3SG and 3PL subject–verb agreement items in main clauses were analysed. Items for eliciting adjectives and verbs were mixed, making filler items unnecessary. 3SG and 3PL items consisted of photographs of human agents manipulating an object (figure 1; the actual items were in full colour).

L1 SLI, L2 TD and L2 SLI groups were tested with five verbs, three existing verbs (*tekenen* 'draw', *drinken* 'drink', and *poetsen* 'brush') and two novel verbs (*pieren* and *spollen*). One verb was used for practising (*lezen* 'read'). Existing verbs were selected based on age of acquisition (Schaerlaekens *et al.* 1999), imageability and transitivity; we return to the issue of transitivity below. The L1 TD group was tested with one existing verb less (*poetsen* 'brush') in order to reduce the length of the test for this younger group. Both existing and novel verbs were included in the analysis to maximize statistical power. However, any differences between existing and novel verbs are not further discussed here (for this, see de Jong *et al.* 2013). Because the test elicited the same verbs in the same sentence type across groups, any potentially confounding effects of verb frequency, verb phonology and verb position were controlled for.

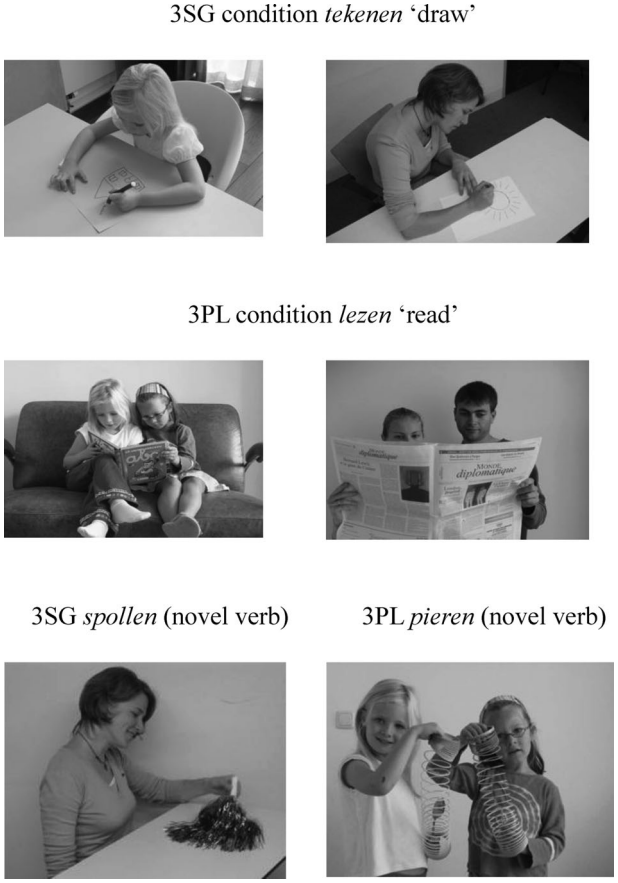

Figure 1. Examples of experimental material.

Procedure

Children were instructed to describe the contrast between two photographs next to one another in the

context of a sentence completion task. The experimenter prompted the response by producing the sentence subject (e.g. *The children* [RESPONSE: *lezen een boek* 'are reading a book'] *and the parents* [RESPONSE: *lezen een krant* 'are reading a newspaper']). The two photographs depicted the same action. The contrast between them forced use of a direct object, e.g. house versus sun or book versus newspaper (as in the first two pairs in figure 1). Direct objects were important for determining the position of the verb, and consequently for deciding if an incorrect stem+*en* form indicated a root infinitive (i.e. stem+*en* in post-object position) or a substitution error (stem+*en* in pre-object position in singular contexts). To elicit novel verbs *pieren* and *spollen*, two objects (a 'pier(der)' and a 'spol(ler)') were introduced to the child prior to the test; for the instructions and protocol, see Appendix A.

Children were tested individually. The L2 children were tested in both Turkish and Dutch, during separate sessions with, on average, one month between the Turkish and Dutch sessions. A total of 27 children were first tested in Dutch, 13 children were first tested in Turkish. The order of the two sessions was not counterbalanced across the groups. The Turkish test differed from the Dutch test regarding material and contexts, and hence, it is not to be expected that the order of the test sessions would influence the outcomes (for the children's Turkish outcomes, see de Jong *et al.* 2010). Test sessions were audio-taped and transcribed. The questionnaire was administered to the parents of the L2 children by a native Turkish research assistant during an oral interview.

Results

Data analysis

For each child, a maximum of ten responses was collected (five verbs, in two conditions). For each verb two responses were elicited per condition because the children described a contrast between two pictures. However only the first response was analysed, firstly, because the second response could be primed by the first response, and secondly, because the children sometimes omitted the verb in the second response by using the grammatical option of ellipsis (*The woman reads a book and the man a newspaper*). The ten items were found to be reliable (Cronbach's $\alpha = 0.73$).

Several types of response had to be excluded ($N = 194$): null responses, responses without a verb or a verb not targeted were coded as 'Other' and then excluded; non-target verbs were excluded to keep the verbs constant across groups. As pointed out by de Jong (1999: 57), inclusion of auxiliary verbs could inflate between-group differences for verb inflection accuracy, due to the irregularity of these verbs. Therefore, responses with periphrastic verbs (finite auxiliary followed by infinitival main verb) were also excluded for periphrastic verb use in this sample, see de Jong *et al.* (2013). Finally, stem+*en* responses for which finiteness could not be decided (e.g. because the object was omitted) were excluded from analysis. Those responses could either be substituted inflection or root infinitives. It is important to point out that by excluding them we did not underestimate one of these two types of errors in the SLI group, since unclear stem+*en* responses were more frequent in the TD groups ($N = 12$) than in the SLI groups ($N = 7$).

Table 2. Coding criteria used to classify analysable responses

Response category	Position	Morphology
Finite stem+Ø	Second	Zero suffix
Finite stem+*t*	Second	-t suffix
Finite stem+*en*	Second	-en suffix
Root infinitive	Final	-en suffix

The responses that were included in the analysis ($N = 684$) were assigned to four response categories based on verb position and form (table 2). Verbs classified as 'finite' were placed in second sentence position, preceding any (direct/indirect) object (e.g. *De vrouw lezen boek* 'The woman read book'), adverb or negation. We labelled these verbs as finite, because Dutch finite verbs are placed in second position. Non-finite verbs are placed in sentence-final position. In root infinitives, the fourth response category, the verb followed any (direct/indirect) object (e.g. *De vrouw boek lezen* 'The woman book read'), adverb or negation and was placed in non-finite position. This coding scheme does not cover incorrect bare verbs in non-finite final position (e.g. *De vrouw boek lees* 'The woman book read') or *-t* forms in non-finite final position (e.g. *De vrouw boek leest* 'The woman book reads'); these errors were not found in our sample.

The coding of the responses was completed by the third author according to the criteria set out above; three research assistants also coded a part of the data following the same coding conventions. The inter-rater reliability was 0.89 (based on 20% of the data in each group).

Table 3 summarizes the numbers of incorrect and correct responses in the four groups; percentages are indicated between brackets. Incorrect responses are divided into root infinitives, incorrect bare verbs, and substituted inflection. Root infinitives were rare, with some more root infinitives in the L2 SLI group. Incorrect bare verbs (= finite stem+Ø in 3SG/3PL contexts) were most frequent, although both SLI groups also substituted inflected verbs (= finite stem+*t* in 3PL contexts or finite stem+*en* in 3SG contexts, of which the latter hardly ever occurred (13% versus 0.9%)). Accuracy refers to use of finite stem+*t* in 3SG and finite stem+*en* in 3PL contexts; other responses were incorrect.

Table 3. Numbers of root infinitives, incorrect bare verbs, substituted inflection and correct verb forms produced across groups

	L1 SLI ($N = 23$)	L2 SLI ($N = 20$)	L2 TD ($N = 20$)	L1 TD ($N = 31$)	Number of responses
Root infinitive	0.6%	10.4%	1.9%	1.8%	22
Incorrect bare verb	13.2%	13.4%	10.8%	4.1%	67
Substituted inflection	10.9%	13.4%	3.8%	0.5%	44
Correct	75.4%	62.7%	83.4%	93.6%	551
Number of responses	174	134	157	219	684

Note: L1 = (Dutch) first language; SLI = specific language impairment; L2 = (Dutch) second language; TD = typical development.

Table 4. Percentages of children in the four groups in two different cut-off ranges of accuracy

	L1 SLI ($N = 23$)	L2 SLI ($N = 20$)	L2 TD ($N = 20$)	L1 TD ($N = 31$)
90% correct cut-off	3 (13%)	2 (10%)	9 (45%)	22 (75%)
75% correct cut-off	13 (55%)	9 (45%)	16 (80%)	31 (100%)

Note: L1 = (Dutch) first language; SLI = specific language impairment; L2 = (Dutch) second language; TD = typical development.

Accuracy in both SLI groups was lowest, the L1 TD group was at ceiling (above 90%).

Accuracy across groups (research question 1)

Logistic mixed effects modelling was used to analyse the simultaneous effect of the fixed-effect variables GROUP (L1 SLI, L2 TD, L2 SLI, L1 TD), NUMBER (plural, singular), and VERBTYPE (existing, novel) on accuracy, a binary variable (correct versus incorrect, where incorrect = incorrect bare verb/substituted inflection/root infinitive). The predicted variable is the log odds ratio, that is, the log transformed ratio of the probability of a correct response over the probability of an incorrect response. Logistic mixed effects modelling is more robust than ANOVA in datasets with many missing data, and, in contrast to ANOVA, it makes it possible to include effects of subject (CHILD) and item (VERB) as random-effect factors in one model. Including these random-effect variables enables generalizing the predictions of the statistical model to the wider population of children and verbs from which the samples were drawn, which is important for the external validity of the study.

The variable GROUP emerged as a significant predictor of accuracy. The L2 SLI group was less accurate than the L1 TD group ($p < 0.001$) and the L2 TD group ($p < 0.001$). The L1 SLI group was less accurate than the L1 TD group ($p < 0.001$), and the L2 TD group was less accurate than the L1 TD group ($p = 0.02$). This last difference was not statistically significant after Bonferroni correction. Specifications for the optimal regression model are in Appendix B.

Classification accuracy (research question 2)

Children were classified based on production of at least 90% correct responses, and then based on at least 75% correct responses (table 4). The majority of L1 TD children were highly accurate (at least 90% correct), and the others were quite accurate (at least 75% correct). In the L2 TD group the majority of children was quite accurate and scored at least 75% correct. In the two SLI groups there were only a few highly accurate children, and about half of the children performed below 75% correct.

Based on these two accuracy criteria, we calculated estimates of how well verb inflection use in our task discriminated between TD and SLI in L1 and L2 groups. Sensitivity indicates how many children diagnosed with SLI would have SLI based on their performance with verb inflection, as measured by performance below a certain cut-off point (here either at least 90% or 75% correct).[6] Specificity indicates how many TD children would be TD based on their performance with verb inflection, measured by performance at or above these two cut-off points. Taking 90% correct as the cut-off point, we find that the sensitivity for discriminating TD and SLI in L1 children is 87%, whereas the specificity is 75%. For the L2 group, the sensitivity is 90%, whereas the specificity is 45%. Taking 75% correct as the cut-off point, the sensitivity for L1 children is 45% and the specificity 100%. For the L2 group, the sensitivity is 55% and the specificity 80%.

Error analyses (research question 3)

Two additional mixed logistic regression analyses were performed with incorrect bare verbs (incorrect bare verbs versus correct responses) and substituted inflection (substituted inflection versus correct responses) as the outcome variables. Root infinitives were too infrequent for reliable statistical analysis. For fixed-effect and random-effect variables, see above. Use of incorrect bare verbs was predicted by both GROUP and NUMBER. The L1 TD group used fewer incorrect bare verbs than the L1 SLI group ($p = 0.006$) and the L2 SLI group

Table 5. Individual differences based on error profiles across the four groups

	L1 SLI ($N = 23$)	L2 SLI ($N = 20$)	L2 TD ($N = 20$)	L1 TD ($N = 31$)
No errors	3	2	7	22
Root infinitives only	0	0	0	1
Incorrect bare verbs only	8	3	5	7
Substituted inflection only	5	3	3	0
Root infinitives + incorrect bare verbs	1	5	3	1
Root infinitives + substituted inflection	0	3	0	0
Incorrect bare verbs + substituted inflection	6	4	2	0

Note: L1 = (Dutch) first language; SLI = specific language impairment; L2 = (Dutch) second language; TD = typical development.

($p = 0.005$). Children used more incorrect bare verbs in 3SG (53/378 = 14%) than in 3PL (16/307 = 5%) contexts ($p < 0.001$). Substitution of inflection (*-t* instead of *-en*, or vice versa) was predicted by GROUP, NUMBER and VERBTYPE. Children in the L2 SLI group substituted forms more frequently than L2 TD children ($p = 0.02$) and L1 TD children ($p < 0.001$); only the latter difference remained significant after Bonferroni correction. Substitution of *-en* by *-t* was more frequent (42/333 = 13%) than the reverse substitution (3/328 = 0.9%) ($p < 0.001$). Substitution was more frequent with novel verbs (32/286 = 11%) than with existing verbs (13/375 = 3.5%) ($p < 0.001$).

A bottom-up procedure yielded the seven error profiles shown in table 5. The individual variation in types of errors was considerable in all groups; it was least in the L1 TD group because many children performed at ceiling. A 4×7 contingency table analysis indicated a significant effect (χ^2 (18) = 56.6, $p < 0.001$), which was due to the L1 TD group whose distribution of error profiles differed from all other groups: L1 TD versus L1 SLI (χ^2 (5) = 25.9, $p < 0.001$), L1 TD versus L2 TD (χ^2 (5) = 13.5, $p = 0.02$), L1 TD versus L2 SLI (χ^2 (6) = 31, $p < 0.001$). No other differences emerged.

Discussion and conclusion

The primary goal of this study was to examine whether verb inflection can be used as a clinical marker in Dutch, regardless of whether Dutch is the children's first language (L1) or second language (L2). The first two research questions that guided this study were relevant with respect to this goal. The first research question asked whether accuracy at using verb inflection distinguished between L1/L2 TD groups on the one hand and L1/L2 SLI groups on the other. L1 children with SLI made more errors than TD children who are 2 years younger, consistent with previous research on L1 Dutch (de Jong 1999, Wexler *et al.* 2004) and L2 Dutch (Orgassa 2009, Verhoeven *et al.* 2011). L2 children with SLI were less accurate than age-matched TD L2 children, confirming that in Dutch the same difficulties in L1 SLI also emerge in L2 SLI, as has been reported for English (Jacobson and Schwartz 2005). These results lead to an affirmative answer to the first research question, and to the tentative conclusion that the frequency of verb inflection errors holds promise as a clinical marker of SLI in Dutch L1 and L2.

The second research question aimed at determining if correct use of verb inflection accuracy can discriminate well between individual children with TD and SLI. A clinical marker with poor classification accuracy will lead to under- or over-diagnosis. In case of under-diagnosis there will be children with SLI whose impairment is not recognized. These children will not receive treatment and as a result they may not reach their potential. Over-diagnosis will increase the costs for healthcare and special education unnecessarily and may have unwanted effects on children's further development and their self-esteem.

Based on age-matched TD and SLI groups, Greenslade *et al.* (2009) observed that opinions differ regarding the standard of diagnostic accuracy. While some researchers recommend a criterion of 90% or higher for sensitivity and/or specificity to be considered 'good' and a criterion of 80–89% for sensitivity and/or specificity to be considered 'fair', others are more liberal. Applying the above criteria to the age-matched L2 TD and SLI groups, we conclude that the 90% cut-off point would lead to over-diagnosis (specificity of 45%). The 75% cut-off point would result in under-diagnosis (sensitivity of 55%). Ideally, classification accuracy is estimated based on age-matched groups. For L1 Dutch, we can only speculate that the 90% correct cut-off point for verb inflection accuracy classifies children fairly well, because comparisons of SLI children and younger children with TD indicated a sensitivity and specificity of 87% and 75%, respectively. Comparisons with age-matched L1 children may increase specificity outcomes, since an older TD group will include fewer children who score less than 90%. Polišenská (2010) indeed reports that from the age of 6 Dutch TD children do not make any errors with verb inflection, neither with existing nor with novel verbs.

The third research question was relevant for the secondary goal of the study and aimed at exploring errors

types and error profiles across groups. The L1 TD group used fewer incorrect bare verbs and substituted inflection less often than L1 and L2 SLI groups. The L2 TD group substituted inflection less often than the L2 SLI group. Group data thus suggest that incorrect bare verbs could be a characteristic of L1 SLI, whereas substitution of inflection may characterize SLI in L1 and L2 contexts. However, error profiles of individual children did not support the existence of errors that are exclusive for SLI. The L1 TD group was the only group with a different distribution of error profiles, but this effect was caused by ceiling performance. In all groups types of errors varied from child to child; all groups included children whose errors consisted of either root infinitives, incorrect bare verbs or substituted inflection, and all groups contained children who combined different errors. Therefore, we conclude that specific errors are a property of individual children rather than a measure that distinguishes SLI from TD. Consequently, a Dutch-speaking child with SLI is identified by the quantity of errors rather than by a specific type of error as de Jong (1999, 2010) argued.

Returning to the discussion of the deficit that might underlie verbal inflection errors in SLI, we can conclude that the variation in errors could be explained by a processing approach to SLI. In addition, differences in the frequency of errors between TD and SLI emerged but not in the quality or type of errors, which would also be consistent with a processing approach. No differences in accuracy were found between L2 TD and L1 SLI, confirming that the identification of SLI in Dutch L2 child populations is susceptible to a diagnostic confound. This similarity could be expected given a processing account of SLI: whereas L2 children with TD have reduced intake because of external factors, that is, late onset of acquisition and less input due to a having their input divided over Turkish and Dutch, the children with SLI have reduced intake due to an internal factor (processing limitations) which affects how effectively they can use information in the input. If the external factors are kept constant across L2 TD and L1 SLI, the L2 TD group is expected to outperform the L1 SLI group.

The findings seem less compatible with an explanation for SLI often contrasted with processing accounts, the EOI hypothesis (Rice and Wexler 1996). This hypothesis holds that SLI is caused by maturational delays that primarily affect internal mechanisms to acquire language, more specifically the Unique Checking Constraint (UCC). Because of delayed maturation of the UCC, children with SLI sometimes omit the functional category Tense, at other times they omit Agreement. Wexler *et al.* (2004) predict that the omission of Tense (and presence of Agreement) leads to omission of finite inflection (incorrect bare verbs) and, possibly, also root infinitives, whereas omission of Agreement (and presence of Tense) will cause root infinitive errors.[7] Neither omission of Tense nor omission of Agreement predicts substitution of inflection. According to the EOI hypothesis, not only is the variety of errors limited and SLI would be characterized by specific errors, but also because highly specific language areas are affected individual variation in types of errors is expected to be limited. In our study, root infinitives were infrequent and used by a few children, both TD and SLI, and children with SLI both used incorrect bare verbs and substituted inflection. Thus, although the EOI hypothesis could account for the profile of a few individual children with SLI, the hypothesis does not explain the profile of SLI based on a larger group.

Regarding the low root infinitive rate, the findings resemble the results reported by Verhoeven *et al.* (2011), but contrast with those in Wexler *et al.* (2004). The children in our study—and in Verhoeven *et al.* (2011)—were somewhat older and may have used fewer root infinitives because of their more developed processing mechanisms. Young Dutch L1 children typically use root infinitives with a modal meaning (Wijnen 1998), which is not surprising given that they often hear infinitives in modal contexts because modal auxiliaries select infinitival main verbs in Dutch. It is possible that our task did not elicit many root infinitives because the children had to describe non-modal actions.

A final issue concerns the combined effect of bilingualism and SLI. In our study, being bilingual did not add to the problems with verb inflection in the L2 SLI group (for a discussion, see Paradis 2010). Possibly, with larger groups the proportional difference in accuracy between the L1 SLI and L2 SLI group as observed in table 3 may translate into a statistically significant difference. However, it is also possible that compensatory mechanisms in the L2 group made up for effects of bilingualism (e.g. less exposure) to a certain extent. For instance, knowledge of verb inflection in Turkish could have aided the children's development of verb inflection in Dutch (de Jong 2010) because it provides the children with all functions needed for Dutch verb inflection and, as such, could facilitate mapping of inflectional suffixes to inflectional functions. Also, Turkish is a pro-drop language where the sentence subject is often identified through verb inflection. This property of Turkish might have shaped children's perceptual focus, leading to specific attention to verb inflection in Dutch, However, currently it is unknown whether L2 children with SLI can make use of their L1 in the same way as L2 children with TD (Blom *et al.* 2012, Blom and Baayen 2012), and further research is needed where L1s are systematically varied in both L2 TD and L2 SLI groups.

To conclude, Dutch verb inflection has the potential to be a clinical marker in L1 contexts, but verb inflection appears to be a less accurate clinical marker in

bilinguals than in monolingual children. Across groups, within groups and within individual children variation in verb inflection errors was found. Consequently, SLI in Dutch is identified by the quantity of errors rather than by specific errors. These observations are consistent with a processing approach to SLI. However, to investigate whether verb inflection errors are causally related to processing limitations, future research is needed tailored to test specific hypotheses. In addition, although a processing approach in principle allows for variation in errors both within and between children, our understanding of the factors that modulate such variation is still limited and research into sources of individual variation in SLI would be welcome. The difference between L2 TD and L2 SLI groups suggests that further investigation into verb inflection as a clinical marker of SLI in L2 Dutch would be worthwhile. The effect of a larger number of probes and use of a composite score based on agreement and past tense inflection (Rice and Wexler 1996) could be investigated. ROC curve analyses could be employed to determine the optimal cut-off point for accurate classification of TD and SLI. We also recommend exploring combinations of measures and use of parental questionnaires that provide information on children's abilities in the L1 and their exposure to the two languages. The additional information brought in by such measures can be particularly useful in bilingual contexts where possibilities to assess children's L1 are few and environmental factors, such as limited L2 exposure, can complicate adequate diagnosis.

Acknowledgements

This research was supported by grants from the Netherlands Organization for Scientific Research (NWO grant no. 360-70-110, NWO grant no. 254-70-010). ***Declaration of interest:*** The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

Appendix A: Introduction and protocol novel verbs

Introduction of novel verbs (the English translation is in parentheses)

Research Assistant (RA): '*Nu gaan we iets geks doen.* (Now we are going to do something fun). *Kijk, ik heb wat dingen meegenomen* (Look what I have brought): *Dit is een spol en dat is een pier* (This is a spol and that is a pier [RA refers to the objects]). *Kijk maar, wat je ermee kunt doen* (Look what you can do with them [RA performs activity]): *Met de spol heb ik gespold* en met de pier heb ik gepierd (With the spol I have spolled and with the pier I have piered). *Nu jij*! (Now it's your turn [RA and child perform activity together])'

Protocol novel verbs

To avoid verbatim imitations, the novel verbs were presented by the experimenter in past participle forms (*gepierd*, *gespold*). During the introductory session, the new word was presented up to ten times by the experimenter. If a child showed difficulty remembering the novel verb, the experimenter was again allowed to demonstrate and use the 'novel' objects in order to trigger the novel verbs. When this cue did not help, the introduction session on novel verbs was repeated once.

Appendix B: Regression models

Table B1. Accuracy in 3SG and 3PL contexts, reference level for GROUP = L2-SLI

	Estimate	SE	*Z*	*p*
(Intercept)	0.51	0.35	1.45	0.15
GROUP (L1-SLI)	0.71	0.39	1.82	0.07
GROUP (L1-TD)	2.5	0.45	5.55	<0.001
GROUP (L2-TD)	1.42	0.42	3.37	<0.001

Table B2. Incorrect bare verbs in 3SG and 3PL contexts, reference level for GROUP = L2-SLI, NUMBER = plural

	Estimate	SE	*Z*	*p*
(Intercept)	−2.64	0.41	−6.47	< 0.001
GROUP (L1-SLI)	−0.12	0.42	−0.29	0.77
GROUP (L1-TD)	−1.42	0.5	−2.83	< 0.01
GROUP (L2-TD)	−0.47	0.45	−1.05	0.29
NUMBER (3SG)	1.21	0.31	3.85	< 0.001

Table B3. Substitution of inflection in 3SG and 3PL contexts, reference level for GROUP = L2-SLI, NUMBER = plural, VERBTYPE = novel

	Estimate	SE	*Z*	*p*
(Intercept)	−2.38	0.54	−4.44	<0.001
GROUP (L1-SLI)	−0.28	0.54	−0.52	0.6
GROUP (L1-TD)	−4.26	1.29	−3.31	<0.001
GROUP (L2-TD)	−1.59	0.67	−2.35	0.02
NUMBER (plural)	−3.27	0.68	−4.77	<0.0001
VERBTYPE (novel)	1.99	0.59	3.38	<0.001

Notes

1. In sentences with subject-verb inversion (e.g. topicalization, questions) stem+Ø is also used in 2SG contexts. In this study, these marked contexts were not included.
2. Forms written as ending on *-en* are often pronounced as [-ə].
3. Effects of impairment and bilingualism could not be isolated in this study, however, because either the L1 SLI and L2 SLI or the L2 TD and L2 SLI groups were collapsed.
4. The demographics of the children's school neighbourhoods indicate that lower SES was more frequent in the L2 sample than

in the L1 sample. SES affects syntactic complexity (Hoff 2006), but regarding verb inflection use SES seem less relevant (Pruitt and Oetting, 2009).

5. Indications can only be based on a reliable and valid test approved by the Dutch Committee on Tests and Testing (COTAN) and administered by a qualified speech-language therapist or clinical linguist. For specific information regarding the language tests, see http://www.simea.nl/vereniging/deelprotocollen/.
6. As one reviewer pointed out, the optimal cut-off point could be determined with a ROC curve analysis. Unfortunately, there were not sufficient data points to apply this technique reliably (Metz 1978).
7. Wexler *et al.* argue that the bare stem is specified for singularity. Given the assumptions of the theoretical framework adopted by Wexler *et al.* a verb specified for agreement features (such as singularity) cannot be inserted in a sentence without Agreement (because it would violate one of the principles governing lexical insertion). Infinitives are assumed to be underspecified for both tense and agreement features and would, therefore, be compatible with sentences without Tense as well as sentences and without Agreement.

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