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The acquisition of Dutch plurals by children with dyslexia and/or SLI

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TABLE OF CONTENTS

Abstract

Purpose: This study compared the morpho-phonological process of pluralisation of 8-year-old children with dyslexia and/or children with specific language impairment (SLI) to their typically developing peers. The main purpose of this study was to explore the difference between groups and the influence of phonological and frequency factors in pluralisation.

Method: Pluralisation of words and novel words was assessed in five groups of children: 1) children with dyslexia, 2) children with SLI, 3) children with dyslexia and SLI, 4) age-matched typically developing children, and 5) language-matched typically developing children.

Results and conclusions: The results demonstrated that the language-disordered children differed from the typically developing 8-year-old children in both number of plural inflection and suffix choice and performed equal according to the typically developing 5-year-old children. The language-disordered groups were sensitive to phonotactic probability in novel pluralisation in contrast to their typically developing peers. An influence of lexical frequency was found in the SLI and the comorbid group, but not for the dyslexic group. The findings of this study point towards an underlying phonological deficit in the language-disordered groups.

KEY WORDS: word pluralisation, morpho-phonology, dyslexia, specific language impairment (SLI), comorbid.

1. INTRODUCTION

Language is a complex and robust system, consisting of multiple knowledge domains that are required in communicating a message (Parisse & Maillart, 2009). Multiple processes, where different domains are involved, are necessary in formulating and understanding a message (Fromkin et al., 2007; Rietveld & Heuven, 2001). Pluralisation is such a complex process where phonology interacts with morphology (Rispens, de Bree & Kerkhoff, 2011). Children first acquire the distinction between singular and plural words (i.e. they see the difference between one teddy bear and two teddy bears) which is later followed up by a developmental pattern in using the right suffix (i.e. they not only see the difference between one teddy bear and two teddy bears, but they can also pronounce it) (Barner, Thalwitz, Wood, Yang, & Carey, 2007).

Plural noun morphology in Dutch, which belongs to the domain of phonology and morphology, consists of 2 different main inflections (morphology): the regular forms (e.g. *beker* ‘mug’ – *bekers* ‘mugs’) and the irregular forms (e.g. *stad* ‘city’ –

steden 'cities'). Regular morphology is the most used form in Dutch. The 2 regular plural suffixes are [-s] and [–@n)] (van Wijk, 2007). For instance, the correct pluralisation of the word *konijn* 'rabbit' is *konijnen* 'rabbits', whereas the correct pluralisation of the word *gnoe* 'gnu' is *gnoes* 'gnus'. The choice of the used suffix is not always predictable. Nevertheless, different studies claim that in Dutch pluralisation is influenced by morpho-phonological principles (Rispens et al., 2011; van Wijk, 2007). The phonological cues final sound, sonority of stem and stress[1] determine the suffix selection (morphology), rendering pluralisation a morpho-phonological process. With regards to both final sound and sonority of stem, words ending in a sound with high sonority (e.g. obstruent) tend to result in the suffix [-@n] (e.g. *kip* 'chicken' – *kippen* 'chickens') and words ending in a sound with low sonority (e.g. vowel) tend to results in the suffix [-s] (e.g. *café* 'café' – *cafes* 'cafes') (Kooij & van Oostendorp, 2003; van Wijk, 2007). The sonority of a phoneme is expressed in a scale what makes the interpretation of this factor subjective and thus unreliable. Sonority increases from left to right on the scale, as shown in figure 1. Van Wijk (2007) described that final syllables should have falling sonority. Considering to the final sound, an obstruent tend to receive the suffix [-@n], for example *pet* 'cap'- *petten* 'caps' and a vowel or a sonorant receives either [-s], for example *foto* 'photo'- *foto's* 'photos' or [-©n] *been* 'leg' – *benen* 'legs'. Despite these strong patterns there are exceptions in Dutch. One example is: *zee* [ze] 'sea' – *zeeën [zEj@n]* 'seas', as words ending in a glide, which do not occur often in Dutch, have a strong preference for [-@n]. Another group of final sounds that does not seem to follow the strong patterns which are described above are the diphthongs. Diphthongs are vowels but they typically prefer the [-©n] instead of the [-s] (e.g. *trui* 'sweater' – *truien* 'sweaters') (see van Wijk, 2007).

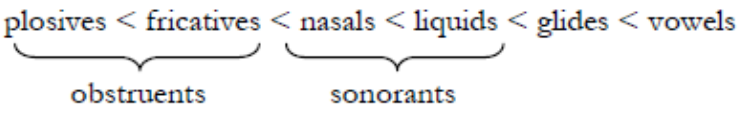

figure 1. The sonority scale adapted from van Wijk (2007).

The preferred stress pattern in Dutch is trochaic (i.e. pattern of strong-weak syllables). Due to conserving this stress pattern the suffix [-s] is used in case of a word with the accent on the first syllable (strong-weak; SW) and the suffix [-@n] is used in case of a word with the stress on the last syllable or in case of a monosyllabic word (weak-strong; WS/S). The stress pattern has a strong influence on plural suffix selection, but there are exceptions in Dutch, for example ***aard**bei* 'strawberry' (SW) which is expected to take

[1] Final sound and sonority are also known as the phonotactics of word stem (Rispens et al, 2011).

an –s plural (*aardbeis), as the word is already a trochee. Instead, the plural becomes *aardbeien* 'strawberries' (SWW). The stem of this word is influenced by the factor final sound with the diphthong demanding the suffix [-@n]. This example indicates that the phonological factors (stress pattern and phonotactics of word stem) interact and that they are not always congruent. In some words both phonological factors predict the same suffix (e.g. *foto* 'photo' – *foto's* 'photos'), as both stress pattern (SW) and the vowel as final sound (high sonority) predict the suffix [-s]. In other words the phonological factors disagree (e.g. bureau 'desk' – bureaus [byros] 'desks'), as in this example stress pattern (WS) predicts the suffix [-@n] (**bureauen* **[byro@n]*) and the vowel as final sound predicts the suffix [-s] (*bureaus [byros]*. Moreover, in some words the factor phonotactics of word stem have the most influence and sometimes the factor stress determines the suffix. In these conflict environments it is not always the same factor that takes precedence over the other. Van Wijk (2007) described that the weakest preferences for a suffix are found for words ending in a sonorant (e.g. *appel* 'apple'; *appelen* vs. *appels* 'apples'), as the sonority factor does not make a clear prediction. The suffix [-s] is used, but is not obligatory and that is why both suffixes can be used in some words (see example apples). All Dutch words, including plural inflection, are stored in the van Dale Corpus (see van Wijk, 2007). Kooij & van Oostendorp (2003) claim that there is only 1 category in which pluralisation always contains the suffix [–s] and therefore has no conflict situations, namely plural diminutives (e.g. *konijn* 'rabbit'- *konijntjes* 'little rabbits').

In sum, Dutch regular pluralisation contains two suffixes ([-@n] and [-s]) which are defined by the factor stress and the factor phototactics of word stem. The two interacting factors make partly conflicting and partly congruent suffix predictions. Weaker preferences for a certain suffix in a conflict environment than in a congruent environment result in flexibility in suffix choice.

In addition, the Dutch language contains a few exceptional categories in plural inflection which are known as irregular forms, for example suffix [-@r@n] *stapelmeervoud* 'the stacking plural' (e.g. *kind* 'child'– *kinderen* 'children'). This irregular inflection is uncommon in Dutch as it covers only a limited number of words. Moreover, in merge words the form is used without [-@n] (e.g. *eieren* 'eggs' – *eierdop* 'egg-shell') unlike regular inflections (e.g. *dop* 'cap' – *doppen* 'caps')(Booij & van Santen, 1998). Another exceptional category are the words with an alternation in vowel length. The stem of these words contain a short, closed vowel (e.g. *[pat]* 'path') and

during pluralisation this vowel alternates to a long, open vowel (e.g. *[pAd@n]* 'paths'. This alternation is uncommon in Dutch, while there are many pluralisations which do not contain an alternation in vowel length, for example the plural form of *[pat]* 'toad' is *[pad@n]* 'toads' and *[mok]* 'mug' becomes *[mok@n]* 'mugs' (de Haas & Trommelen, 1993). Dutch also contains a few words which undergo the alternation in vowel length and contain the suffix [-@r@n], for example *blad* 'leave' – *bladeren* 'leaves' or *rad* 'wheel' – *raderen* 'wheels' (van Wijk, 2007).

Finally there are words which are derived from Latin, for example *podium* 'stage' inflects to *podia* 'stages'. Even though there is an influence of Latin some plurals are already denigrated into Dutch, for example the plural of *museum* 'museum' may be *musea* but also *museums* 'museums'.

In the past decade several studies have assessed the pluralisation in Dutch to understand the morpho-phonological nature of plural words. The phonological factors phonotactics of words stem and stress influence the suffix selection in children with reading impairments and typically developing (henceforth TD) children ages 5 and 8 years (e.g. Rispens et al., 2011). The question arises whether the influence of these factors are similar in both children with a typical development and in children with a disordered development. Rispens et al. (2011) argued that incorporation of the developmental track of the influence of the phonological factors is necessary. In this study the morpho-phonological features of pluralisation in disordered children are assessed and compared to TD-children.

1.1. Morpho-phonological features of pluralisation/Dutch plural realisation

As described earlier, pluralisation is a morpho-phonological process, as the suffix inflection (morphology) is influenced by phonological factors (Rispens et al., 2011). By definition, novel words have zero frequency occurrence in Dutch, but different studies claim that besides phonological factors frequency factors (lexical frequency and phonotactic probability also have an effect on pluralisation of words and novel words (Storkel, 2001; Rispens et al., 2011; van Arkel, 2010). Pluralisation (patterns) which occur at a higher frequency have stronger connections and will therefore be produced more quickly than low frequency plurals (Jusczyk, Luce & Charles-Luce, 1994; van Wijk, 2007). The novel words differ in terms of their phonotactic probabilities, according to Leonard, Davis, Deevy (2007), "that is in terms of frequency with which the adjacent phonemes of the novel words appear together in actual words of the language" (p.749).

Van Arkel (2010) investigated whether TD-8 and TD-5yr children used phonological restrictions in plural inflection. In this study 2 types of stimuli, Dutch words and novel words, were used, as only the pluralisation of novel words is influenced by morpho-phonological cues. The Dutch plural words may be stored in the mental lexicon and therefore are not influenced by morpho-phonological cues, as the novel words are not stored in the mental lexicon and therefore are influenced by these factors. Therefore the suffix selection in novel words gives crucial information about the used cues.

The stimuli were also divided in neutral (e.g. nuirem [nœyr@m]), no conflict (e.g. dasau [dAsɑu]) and conflict environments (e.g. niesau [nIsɑu]) and were manipulated/divided by phonological factors stress pattern and final sound as well as the frequency factors phonotactic probability and lexical frequency. The results indicated that the children used the phonological cues stress pattern and phonotactics in novel pluralisation. Furthermore, more errors were made in conflict environments than neutral situations. Suffixes were more often based on stress pattern than based on phonotactics of word stem (i.e. analogy to existing words). An influence of lexical frequency was found, as children added the expected suffix more frequently in high frequency words than in low frequency words. The expected suffix was the predicted plural based on neighbourhood type frequency (van Wijk, 2007). Moreover, an influence of the phonotactic probability was only found in the preschool group (5 yrs). The study showed a preference for the suffix [-@n], as it was used more often in overgeneralization errors than the suffix [-s] (e.g. **clownen* 'clowns'). This result was also obtained by van Wijk (2007). Furthermore, the TD-children in the age of 5 frequently did not inflect the word stem (e.g. [staum] – [*staum]), which indicated an incompletely morpho-phonological development in preschool children.

In this study, the pluralisation will be investigated in children with dyslexia, SLI and comorbid dyslexia and SLI, as the question still arises whether SLI and dyslexia have similar phonological deficits. There is still much to discover in the developmental track of the influence of phonological and frequency factors in disordered development.

1.2. Language-disorders

This study aimed at the morpho-phonological process in language-disordered children, as the outcomes may provide information about non-typical language acquisition.

Dyslexia and specific language impairment[2] (henceforth SLI) are both language-based disorders and show similarities in reading difficulties, as dyslexia[3] is characterized by severe problems in written language and spelling caused by major difficulties in underlying phonological processing deficit (Ramus et al., 2003) and reading difficulties have also been reported to exist in children with specific language impairment (Catts, Adlof, Hogan & Ellis Weismer, 2005; Nathan, Stackhouse, Goulandris, & Snowling, 2004).

Children with SLI have difficulties in different multiple language domains (e.g. word finding, semantics, morphology, syntax, and discourse) and is characterized by severe restrictions in oral language (Parisse & Maillart, 2009; Leonard, 1998; Marshall & van der Lely, 2010; McArthur, Hogben, Edwards, Heath & Mengler, 2000). Next to significant deficits in literacy skills, language problems are also assessed in children with dyslexia (Snowling, Gallagher, & Frith, 2003). Dyslexia is, according to the deficit hypothesis, the result of an underlying phonological deficit and problems arise in the acquisition of phonology (Snowling, 2001).

SLI and dyslexia are common language-disorders which have similar prevalence levels; between 3 and 10 % (Tomblin, Records, Buckwalter, Zhang, Smith & O'Brien, 1997; Bishop & Snowling, 2004; Shaywitz, 1998). According to Bishop and Snowling (2004), "In both SLI and dyslexia, the diagnostic criteria specify that the child has to have adequate hearing and no major handicapping condition that might interfere with learning" (p. 858).

The similarity in literacy skills and language acquisition indicate a possible overlap between dyslexia and SLI. The last decades many authors have claimed a possible overlap between SLI and dyslexia in phonological restrictions (Bishop & Snowling, 2004; Tallal Allard, Miller & Curtiss, 1997). According to de Bree & Kerkhoff (2010) there are two views on the language-disorders relationship. The first view assumes that reading disorders and developmental language impairment primarily are distinguished based on severity and age (de Bree & Kerkhoff, 2010). SLI and dyslexia have to been seen as one disorder, as SLI is the severe and dyslexia the less severe form (Tallal, Allard, Miller & Curtiss, 1997). A second view claims that the phonological restrictions are a cause for both SLI and dyslexia, but that they differ in

[2] Specific language impairment is also known as 'developmental dysphasia', 'developmental language disorder'or 'language-learning impairment' (Parisse & Maillart, 2009) or 'oral language problem' (Bishop & Snowling, 2004).

[3] Dyslexia is also known as a 'specific reading disability' (SRD) or reading impairment (RI) (Bishop & Snowling, 2004).

other qualitative non-phonological language modalities (e.g. semantics, syntax and discourse) (Bishop & Snowling, 2004; Marshall & van der Lely, 2009).

In this study the morphology in children with dyslexia and children with SLI was compared, as morphological deficits are the core problem in SLI. By investigating the morpho-phonological process a possible underlying phonological deficit could be determined. A similarity in dyslexia and SLI can be assessed, by adding a comorbid group.

1.3. Research questions

The main research question of this study is whether language-disordered children (i.e. dyslexic children, children with SLI and children with comorbidity) differ on a plural task in pluralisation (morphology) and differ in correct suffix choice (morpho-phonology). We expect that children with SLI and children with comborbidity (SLI and dyslexia) will experience more problems in plural realisation (morphology) than dyslexic children, as morphology is a core problem in SLI. The results of the dyslexic, SLI and comorb children will also be compared with the results of typically developing children aged 8, to determine to what extent language-disordered children lag behind their age-matched peers. Furthermore, the groups will be compared to typically developing children aged 5, who are at an early stage of morpho-phonological development.

Plural formation will be investigated for both words and novel words. Plural words may be stored in the mental lexicon and can therefore be retrieved, in contrast to novel plurals, which need to be based on productive knowledge of plural inflection. We assume that the performance of all groups is better for words than novel words. However, the disordered children may have more problems with the novel words than the TD-children, as they have problems in productive morpho-phonological processes.

The second question is whether there are effects of frequency on children's plural formation, including lexical frequency (LF) for words and phonotactic probability (PP) for non-words, and whether frequency affects the groups of children differently. Frequency has an important influence in the early stages of development, which leads to the expectation that it may especially affect both the disordered group and the 5-year-old typically developing (TD) children. However, the disordered groups may be more adversely affected by low frequency items than their typically developing peers.

2. METHOD

2.1. Participants

In total, 129 children participated in the study, see tables 1 and 2. Only monolingual Dutch speaking children with a normal or corrected to normal visual ability and an absence of hearing impairments were included in this study. Children with autism or speech output problems, such as dyspraxia, were excluded from this study. Permission of the parents/caretakers was asked by a letter which was handed out in advance.

Group	N	Gender	Age in months			Attention disorder	IQ
		females/ males	Mean	Sd	Range	ADHD/ADD	
5 yrs (TD)	40	26 / 14	65.20	8.33	4;3 – 6;7	-	-
8 yrs (TD)	38	20 / 18	97.21	4.53	7;5 – 8;10	-	-
Dysl	12	9 / 3	91.90	6.54	6;7 – 8;8	5	(> 84 < 116)
SLI	24	4 / 20	95.50	8.49	6;8 – 9;11	5	(> 84 < 116)
COMORB	15	6 / 9	95.53	4.72	7;11 – 8;6	-	(> 84 < 116)

Table 1. Overview of the 5 different groups: sample sizes (N), Gender (females vs. males), attention disorders and age in months; means(M) standard deviations(SD) and range.

Twelve children, 9 girls and 3 boys, had a official declaration of dyslexia based on extensive psychological testing (n = 7) or were suspected to have dyslexia (n = 5), but had not been diagnosed yet. The division in gender is unequal and is not representative, as dyslexia is more likely to be found in males than in females (Leonard, 1998). Ages ranged from 6;7 to 8;8 and had a mean age of 7;7. This age group was selected because the development of reading and writing starts around the seventh year of life. These children received extra help (remedial teaching) in reading, but did not receive any form of language therapy. The children were randomly selected from primary schools in Utrecht and Spijkenisse[4]. Children with the attention disorders ADHD and ADD were included in this study (n = 5), as comorbidity between dyslexia and attention disorders is high (Willcut & Pennington, 2000). Hereafter, these children will be referred as the dyslexic group.

Another 24 children, 4 girls and 20 boys, had been diagnosed as language impaired. The division is unequal, but representative. After all, SLI is more likely to be found in males than in females (Leonard, 1998). They were similar to the dyslexic group in chronological age, as ages ranged from 6;8 to 9;11 and had a mean age of 7;9. None of these children was dyslexic, as they had no official declaration of dyslexia or were suspected to have dyslexia. They were randomly selected via the special primary

[4] Spijkenisse is located in the West of the Netherlands (in the province Zuid-Holland).

schools in Amersfoort, Goes, Gouda and Utrecht[5] of 'Koninklijke Auris Groep' (Royal Auris Group), a professional organisation which provides education, help, and care to people with communication disorders, including hearing disorders, speech- and/or language disorders or autism (AURIS, 2010). Hereafter, these children will be referred to as the SLI-group.

Fifteen children, 6 girls and 9 boys, had been diagnosed as language impaired and dyslexic. They were similar to the children in the dyslexic, and SLI group in chronological age. Ages ranged from 7;11-8;6, with a mean age of 95.53 months. These children attended special primary schools of Koninklijke Auris Groep in Amersfoort, Goes, Gouda, and Utrecht. Hereafter, these children are referred as the comorb group.

The remaining 78 children were typically developing and divided into 2 control groups. None of these children were diagnosed with a language or reading disorder or other cognitive disorders. The first group consisted of 40 children, 26 girls and 24 boys, and on average, were 3 years younger than the disordered groups. Ages ranged from 4;3 to 6;7, with a mean age of 5;4. These children attended primary schools in Nieuw Vennep[6] and hereafter will be referred to as the TD-5yr group.

The second group consisted of 38 children, 20 girls and 18 boys, and were similar to the children in the dyslexic, SLI and comorb group in chronological age. The children in this group ranged in age from 7;5 to 8;10, with a mean age of 8;1. Hereafter, these children are referred to as the TD-8yr group. These children attended primary schools in Nieuwegein and Houten[1o]. The outcome of a One-Way ANOVA with age as dependent variable and group as between subjects variable showed a significant main effect of age ($F(3, 129)=137,49$ $p<.01$) as a Bonferroni showed only a significant difference between 5yrs TD-children and the other 8 year groups ($p<.05$). Since the two control groups showed a significant difference on mean age it is possible to distinguish expected language abilities and language abilities based on calendar age (see §2.1.1).

A standardized language task (Peabody Picture Vocabulary Test; Schlichting, 2005) was used to determine the vocabulary size of all groups, as it is used by clinical linguists and speech therapists to test knowledge of the receptive lexicon (Pearson, 2005). The results of the TD-groups were obtained by van Arkel (2010) and the SLI-,

[5] Amersfoort is located in the centre of the Netherlands (Utrecht), Gouda is located in the West (Zuid-Holland) and Goes is located in the South-West (Zeeland).

[6] Nieuw Vennep is located in the West of the Netherlands (Noord-Holland) and Nieuwegein and Houten are located in the centre of the Netherlands (near Utrecht), all part of the Randstad, the greater urban area of the Netherlands.

dyslexic, and comorb group were tested by speech therapists[7] with the same version and similar instruction of the Peabody Picture Vocabulary test (henceforth PPVT-II-NL). The results of the PPVT-II-NL can be calculated to a WBQ, raw score and percentile score. The raw score was not used in this study, as shown by table 2, because it is highly influenced by age and thus comparison between the different age groups would be unreliable.

Only the SLI and comorb children received language intervention. An Univariate ANOVA with WBQ as dependent variable and group as between-subjects variable showed a significant effect of group (F(4,128)=16,485, p=.00). With respect to group, a Games-Howell post-hoc analysis showed that the TD-5yr group performed significantly better on the vocabulary task than all other groups (TD-8yr p=.001, SLI, comorb: p=.000) with exception to the dyslexic group (p=.110). The disordered groups did not differ significantly from each other (p>.05).

		Vocabulary	Literacy			
Group		**PPVT-II-NL**	**EMT[a]**	**Klepel[a]**	**EMT[b]**	**Klepel[b]**
5 yrs (TD)	40	111.20 (11.87)				
8 yrs (TD)	38	100.82 (9.82)	52.03 (13.46)	45.80 (16.21)	11.3 (2.71)	11.62 (2.62)
Dysl	12	100.00 (13.25)	13.67 (6.75)	9.92 (7.03)	4.67 (2.67)	3.67 (2.57)
SLI	24	89.83 (12.80)	27.50 (21.30)	21.88 (19.09)	8.21 (3.34)	6.46 (3.35)
COMORB	15	90.73 (11.58)	11.56 (11.13)	7.40 (6.97)	4.93 (2.92)	3.53 (2.62)

Table 2. Standardized language results (standard deviation) and literacy results (standard deviation) per group. [a] results of the standard score. [b] results of the raw score.

The group of typically developing children age 8 consisted of children without reading difficulties. Technical reading skills were assessed through a timed word (Eén Minuut Test, Brus &Voeten, 1973) and a timed novel word reading task (de Klepel, van den Bos, Spelberg, Scheepstra & de Vries, 1994). To be excluded from the group of typically developing children, children had to show a weak performance (standard score <7) on both tasks. In total, 7 TD-8yr children were excluded (van Arkel, 2010). A weak performance on both literacy tasks may indicate dyslexia, but the data of these 7 children was not included in the dyslexia group, as the children first have to be further investigated by a professional (psychologist).

The literacy skills of the other 8 year old children were also assessed (see table 2.). An one-way ANOVA with EMT standard score as dependent variable and group as between-subjects variable showed a main effect of group (F(3,89)=26.499, p=.000), post-hoc testing showed that the control group outperformed the other groups (p<.05).

[7] The children attending special primary schools are tested yearly with a speech test battery which includes the PPVT-II-NL.

The SLI group performed better than the dyslexic (p=.01) and the comorb group (p=.014) who did not differ from each other (p=.999). This pattern was also displayed in the Klepel, as a one-way ANOVA with Klepel standard score as dependent variable and group as between-subjects variable showed a main effect of group (F(3,89)=45.298, p=.000). Post-hoc testing showed that the TD-8yr group performed better than all other groups (p<.05). The SLI group performed better than both the dyslexic and comorb group (p<.05) who did not differ from each other (p=.999).

In sum, the highest standard score in both reading tasks was achieved by the control group followed by the SLI group. The dyslexic and comorb group achieved the lowest performance.

2.2. Plural task

The experiment of this study was the plural elicitation task which was also used by van Arkel (2010). The original 'Wug test' (Berko, 1985) was designed to investigate children's productive knowledge of morphology, by asking them to inflect novel words. The current task contained 30 stimuli (singular form), of which 12 were exisiting Dutch words (e.g. *trui*; 'sweater') and 18 were novel words (e.g. [dra]) that are in accordance with Dutch phonotactics The selection of words and novel words was based on several factors. First, the words were divided in high and low lexical frequency (LF) and the novel words were divided in high and low phonotactic probability (PP). The variance in frequency of words was based on the CELEX database (Baayen, et al., 1995), which contains different kind of lexical information of Dutch words, and a target word list, which contains information about the words which belong to passive language acquisition of children in the end of class 2 (Kohnstamm, et al., 1981). In total 7 words consisted of a high frequency (e.g. *slang* 'snake') and 5 words consisted of a low frequency (e.g. *toekan* 'toucan'). The novel words were divided into phonotactic probability of the phoneme sequence. As described by van Arkel (2010), the phonotactic probability was determined based on the Dutch phonotactic frequence database and Corpus Dutch. Nine of the novel words were classified with high phonotactic probabilities (e.g. [meron]), based on their summed phoneme frequency,

Figure 2. An example of pictures which refer to novel words (adapted from van Arkel, 2010).

and the other 9 novel words were classified with low phonotactic probabilities (e.g. [ryveim]).

Furthermore, both novel words and words differed with respect to the phonological variables in 'stress' and 'sonority'(see also appendix A.1.). Based on these variables, an expected suffix could be established. For example, the word *ballon* 'balloon'(WS) should be inflected by the suffix [-@n] in case of a nasal [n] as final sound and stress on the second variable.

In some cases, both stress and final sound lead to the same suffix, in which case novel words were considered 'non conflicting', as in the *ballon* example above. However, other novel words were considered 'conflicting' (see also appendix A.2.; §.1.), as these variables lead to a conflict in suffix choice. For instance, in the non-word [wyzu], the stress cue leads to the [-@n] suffix (*[wyzu@n]), whereas the final sound (based on analogy to similar Dutch words) would lead to the [-s] suffix ([wyzus]). The novel words with a conflict environment were added to determine whether children show a preference for either cue (i.e. phonological or stress-based vs. lexical). The expected suffix was based on the type frequency of similar words in Dutch, based on the van Dale Corpus (van Wijk, 2007). Besides the "no conflict" and "conflict" environments, also "neutral" was presented in this study. A novel word was considered neutral when the variables lead to a different suffix choice where stress is similar to the expected suffix, as in final sound sonorant's both [-s] and [-@n] is possible. For example, in [nœyr@m] the expected suffix based on stress is [-s] and based on final sound [-s], due to the fact that stress is the determent factor the plural form contains a [-sn], [nœyr@ms].

As the novel word items used by Van Arkel (2010) were not equally distributed with regard to stress (S/WS vs. SW) and type (conflict vs. neutral), 8 new novel words were added to the experiment (see shaded items in appendix A.2). Since stress was a relevant factor in this study, new novel words were added to the experiment, increasing the number of conflicting items. The adapted version of the experiment contained 12 words, similar to the study of van Arkel (2010), and 26 novel words (see also appendix A.2. and A.3). The added stimuli contained 4 conflict situations (e.g. [dafOt]) in case of expected suffix.

To exclude elicitation 'order as experimental confound, the experiment was divided into 2 versions (version A and version B) with opposite orders. The groups were randomly distributed in order to construct an equal division among the 2 versions (see table 3).

Version	N	Group				
		TD-5yr	TD-8yr	dyslexia	SLI	comorb
A	36	-	-	6	12	8
B	123	40[8]	38	6	12	7

Table 3. Overview of the division in order.

2.3 Procedure

The pluralisation was elicited by stimuli which were presented auditorily and visually in a PowerPoint presentation which was displayed on a digital notebook. The singular was repeated by the experimenter in case of a repeatedly incorrect repetition. The participant perceived a singular item accompanied by the experimenter's utterance (e.g. "this is a wuuzoe". Shortly after, two items were showed accompanied by the experimenter's utterance "Now there is another one. There are two of them. There are two…". The items were pre-recorded by a Dutch female speaker.

The majority of the children, especially the language disordered children, had difficulties with the phonological complexity - mainly syllable length and consonant clusters - of the novel words (e.g. [wøjɪrp]) in the plural task. They had difficulties in repeating the singular form even before they were asked to inflect the items. To prevent 'incorrect singular' to be an experimental confound, the items were iterated[9] as often as necessary and written down for 39 children. This approach was not used in the study from van Arkel (2010).

Figure 3. Example design experiment.

2.4. Qualitative error analysis

Not only the total number of correct responses (i.e. correct suffix in case of words and expected suffix in case of novel words) but also the total number of plural inflections were analyzed in this study. Due to this division, not only an impression of the

[8] The study of van Arkel (2010) contained only 1 stimulus sequence which corresponded to basic version B (excl. Added Non Words) of this experiment.

[9] The experimenter only stopped with novel word repetition in case of a visible frustration of the participant (e.g. moaning, verbal responses or a dissatisfied facial expression).

pluralisation in general could be made but also an impression of the difficulty in using the expected suffix. For example, an utterance was scored as a plural form (category others) in case of a response which consisted of a suffix, which was not necessarily similar to the expected suffix and could occur in Dutch language. All correct responses and all plural forms were counted separately to use in a quantitative analysis. Furthermore, a qualitative analysis was made by dividing responses into 4 categories/scores (see table 4).

CODE	EXPERIMENT
01	Correct; matched with expected plural form.
02	Wrong suffix; the plural form differed in suffix (e.g. [zetkœys]).
03	Singular; zero marking (e.g. [nisɑu]) including final sound deletion (e.g. [nœyr@]) or substitution (e.g. [stɑut]).
04	Others; decompositions (e.g [bios] for [byrOs] 'desks'.), diminutive (e.g. *konijn - konijntje* 'little rabbit') and no response.

Table 4. Overview of the used coding in responses.

During the scoring of the responses the main focus lies on the used suffix, which was assessed as correct (code 1) in the following cases: (1) when the sound of the first syllable or vowel of the second syllable was substituted (e.g. [dAsau] -[dAsOs] and [dAsau] -[tAsaus], whereas this did not influence the choice in suffix. Or (2) in case of an insertion of a glide (e.g. [zekœy] - [zekœyw@n]); [grœ] – [grœj@n])[10] or (3) when a voicing alternation of the final sound took place (e.g. [sipAnt] - [sipɑnd@n]), due to the fact that both conversions can occur in Dutch (e.g. *hand* 'hand-hands' [hant] – [hand©n]; *koe* 'cow-cows' [koe] – [koej@n]).

Furthermore, the responses with a syllable reduction (e.g. [gylop] – [gyl@n] were scored as incorrect in case of the variable deletion (stress), just like the responses which could no longer be referred to the target stimulus (decompositions). Nevertheless, both situations were scored as plural forms, for example, [grœy] – [grœn] was scored correct, as this pattern, addition of the [-n], exists in Dutch (*trede* 'stair'- *treden* 'stairs' [trEd@] – [trEd@n]).

Responses which contained lexicalization (e.g. [sten©n] instead of [stin©n] 'rocks') were also categorized as decompositions. These responses, which were not identical to the expected suffix, gave information about possible associations with the lexicon. The last category also contained responses that ended in [-@(n)s], [-ns] or [-

[10] In the study from van Arkel (2010) responses with an insertion were not scored as correct. Because of this difference, all scores of the former study were adjusted.

s@(n)], and were considered to have double marking (e.g. [pøgu] - [pøgOn@s] and [nisau] – [nɪsɑu@ns]). As shown in table 6, the score 'incorrect suffix' is distributed into 3 categories. This rating provided information about the ability of plural inflection (a morpho-phonological process). Participants also changed the final sound, which might indicate an attempt to plural inflection (e.g. [naugr@n] instead of [nœyr@ms]). All responses with zero marking belonged to category 'singular'.

The study from van Arkel (2010) did not include the division as mentioned above, as she assessed all responses which included a suffix correct. Due to the limited number of categories, the use of strategies (e.g. double marking) was difficult to understand. When more categories were used more different morpho-phonological strategies can be assessed. Due to the fact that this study compared the performance in both disordered groups to their typically developing peers, only the qualitative analysis, as defined by van Arkel (2010), was used.

2.5. Statistical analysis

The statistical data analyses used in this study were mainly based on multiple group comparison (TD-5yr, TD-8yr, dyslexia, SLI and comorb). In general, a significance level of $p<.05$ was used. A repeated measures ANOVA (Analysis of variance) was performed on all responses which contained an inflection (Plur) to see whether the control groups and the disordered groups differed significantly in pluralisation. Furthermore, an repeated measures ANOVA was performed on only the correct inflections (Corr) to see whether the group differed significantly in correct suffix choice. The effects of the following independent variables were tested: stimulus type (novel word vs. word), phonotactic probability for novel words and lexical frequency for words (high vs. low), suffix choice ([-s] vs. [–ən]) and conflict situation (neutral vs. conflict). Both main and interaction effects were tested. Post-hoc testing depended on the homogeneity of variance (Games-Howell or Bonferroni) was used in case of multiple comparisons. Finally, the correlation coefficient Pearson's R was calculated to determine a possible linear relationship between the total correct responses and vocabulary size (WBQ) and reading ability.

3. RESULTS

In the following section, the results are presented for mean plural inflection (§ 3.1) and *correct* plural selection (§ 3.2.) including possible influence of the phonological factors stress and/or phonotactics of word stem (§ 3.3.) and the frequency factors (§ 3.4.).

Furthermore, the results of a possible correlation between plural realisation and vocabulary or reading achievement (§ 3.5.) will be presented. The results for the added novel words (see § 2.3) were not used for the comparison between the 5 groups (TD-8yr, TD-5yr, dyslexia, SLI, comorb), as the control groups only received a subset of these stimuli.

3.1. Plural inflection

Figure 4 presents the mean number of plurals produced by each group for words and novel words, including incorrect plurals. A repeated measures ANOVA was performed on the mean number of plurals (plur.) with stimulus type (word and novel word) as within-subjects factor and group (TD-8yr, TD-5-yr, dyslexia, SLI, comorb) as between-subjects factor showed a main effect of stimulus type ($F(1,125)=119.165$, $p<.01$), and a main effect of group ($F(4,125)=10.49$, $p<.001$). A post-hoc analysis (Bonferroni) showed a significantly higher plural score for the TD-8yr group compared to all other groups (all $p<.001$). There was no significant difference between the TD-5yr, dyslexic, SLI and comorb-group (all $p>.05$).

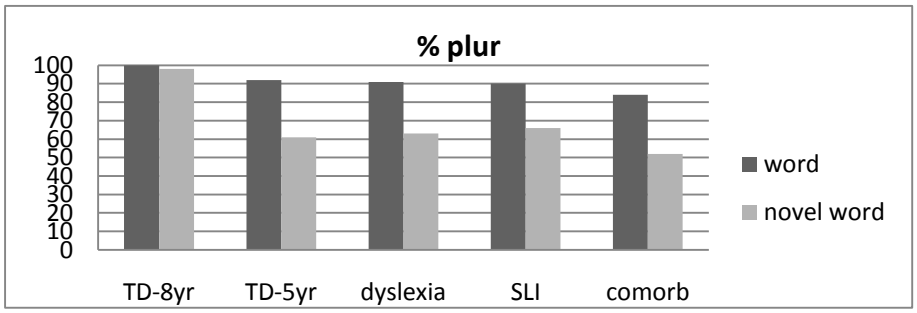

Figure 4. Percentage of plural responses(plur.) for the 2 types of stimuli (word and novel word) in the TD-8yr, TD-5yr, dyslexic, SLI and comorb-group.

Furthermore, a significant interaction between stimulus type and group was found ($F(4,125)=10.741$, $p<.001$) (see appendix B.1.), as the effect of stimulus type was smaller for the TD-8yr children. The outcome of a paired samples t-test showed a significant difference between the number of plurals in words and novel words in all groups (TD-5yr, SLI, comorb: $p<.01$, dyslexia $p=.018$, TD-8yr $p=.003$).

In sum, the results showed plural realisation is the easiest for TD-8yr children, but more difficult for TD-5yr children and the disordered groups. This indicates that the ability to form plural novel words is not sufficiently developed in children at an early stage of phonological development and children with (subtle) language based disorders.

3.1. Correct suffix selection

Next to plural inflection, an analysis was conducted on the mean percentages correct suffix selection (see figure 5). A repeated measures ANOVA was performed on the number of *correct* plurals (corr.) with stimulus type (word, novel word) as within-subjects factor and group (TD-8yr, TD-5yr, dyslexia, SLI and comorb) as between-subjects factor. Results showed a main effect of stimulus type ($F(1,125)=551.43$, $p<.01$), a main effect of group ($F(4,125)=14.386$, $p<.01$), and a significant interaction effect between stimulus type and group ($F(4,125)=8.627$, $p<.01$) (see appendix B.2.). These results show that words were more often correctly inflected than novel words. With respect to group, Bonferroni analyses showed that the TD-8yr group differed from the TD-5yr and comorb-group ($p<.001$), as well as the dyslexic group ($p=.019$). There was also a difference between TD-5yr and comorb-group ($p=.005$). Results showed no significant difference between the three language-disordered groups (all $p>.05$).

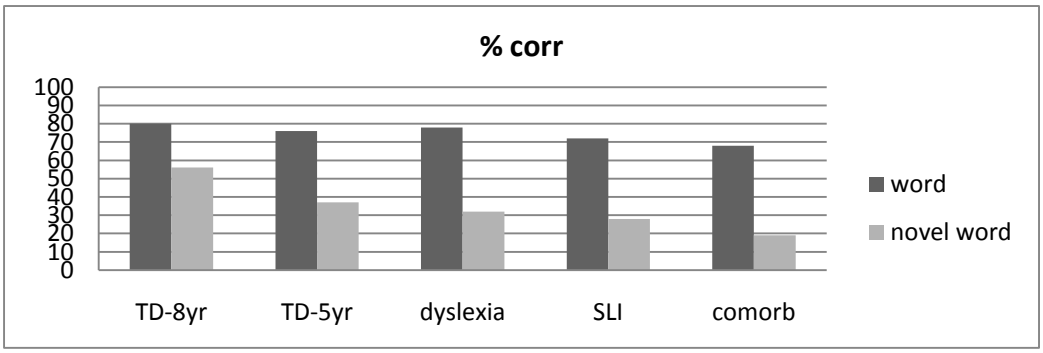

Figure 5. Percentage of correct suffix(corr.) for the 2 types of stimuli (word and novel word) in the TD-5yr, TD-8yr, dyslexic, SLI and comorb group.

3.2.1. Qualitative errors

A qualitative error analysis was made to further investigate the type of responses produced in the plural morphology experiment. In total 3 categories were used, divided into the correct "singular" and incorrect responses (error) "others" and "suffix"[11] (see § 2.4.). Results are presented in figure 6. The most common error in all groups was 'zero marking'. This error was most common in the comorb-group 43.3% (117/270) followed by the TD-5yr group 35.29% (254/720), dyslexic group 34.2% (74/216) and the SLI group 33.6% (145/432).

[11] This includes all responses with a suffix, for example both *[wyzu©n] and [wyzus].

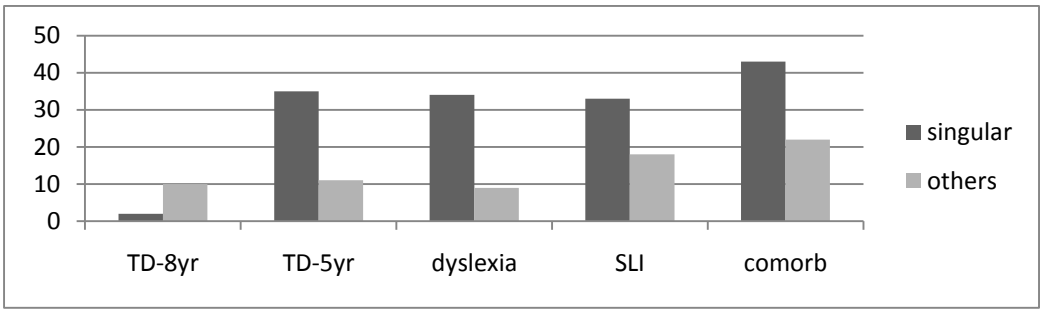

Figure 6. Percentages of the different errors in novel words.

3.3. Suffix selection in correct plural realisation

The words and novel words could be inflected with either suffix [-@(n)] or [-s]. The influence of this variable was determined for the number of plurals produced and the number of correct plurals produced. The results for words are presented in figure 7, of novel words in figure 8. A repeated measures ANOVA looked at the number of *correct* plurals in words with suffix ([-@n] or [-s]) as within-subjects factor and group as between-subjects factor (see figure 9). This analysis showed a main effect of suffix $F(1,125)=95.668$, $p<.01$, as words taking [–@n] suffixes were inflected correctly more often than those taking [–s]. There was again a main effect of group ($F(4,125)=3.0$, $p=.021$), with a post-hoc Bonferroni analysis showing that only the comorb-group performed significantly worse on *correct* plurals in words than the TD-8yr group ($p=.045$). None of the other groups differed significantly from each other ($p>.05$). There was no significant interaction between suffix and group ($F(4,125)=.870$, $p=.484$), as all groups performed better on plurals with [-@n] than [-s].

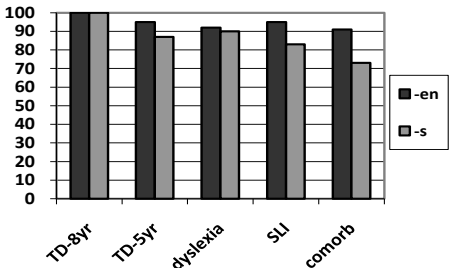

Figure 7. Percentages correct plurals in words divided into suffix ([-@n]; [-s].

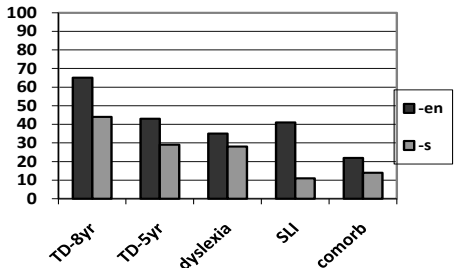

Figure 8. Percentages correct plurals in novel words divided into suffix ([-@n]; [-s].

A repeated measures ANOVA was also performed on the number of *correct* plurals in novel words, yielding a main effect of suffix ($F(1,125)=11.455$, $p=.001$) and group ($F(4,125)=17.978$, $p<.01$), but no significant interaction between suffix and group $F=(4,125)=0.837$, $p=.504$, as all groups showed a preference for [-@n]. The outcome of

a post-hoc test (Bonferroni) showed a significant difference between the TD8-yr group and all other groups ($p<.01$) and between the TD-5yr and comorb group ($p=.006$).

To summarize, in both words as novel words a higher number of *correct* plurals was made for [-@n] over [-s] in all 5 groups. A difference in the number of *correct* plurals in words related to frequency was found, as TD-8yr children were not influenced by suffix.

3.3. Effect of phonological factors on suffix selection

Pluralisation is influenced by the phonological factors metrical stress and final sound of the word stem, but these are not always congruent (see §1). The data was divided into "no conflict", "conflict", and "neutral" targets. In conflicting targets, the expectation based on stress is in conflict with the expectation based on the final sound (as reflected in a corpus of Dutch). Due to the fact that words already have an existing plural (see §1), only the environment of the novel words was tested. The analysis was performed on a balanced dataset of 8 different stimuli, taking into account the difference in stress and equal distribution in suffix ([-@n] and [-s]). Monosyllabic words were excluded from this dataset. The included data is shown in table 5.

Novel-word	**STRESS**	**FINAL SOUND**	**PP**	**Expected suffix based on STRESS**	**Expected suffix based on FINAL SOUND**	**Conflict**
dasau [dasɑu]	WS	diphthong	high	en	en	no conflict
zekui [zekœy]	WS	diphthong	low	en	en	no conflict
mooka [mOka]	SW	vowel	high	s	s	no conflict
peugoe [pøgu]	SW	vowel	low	s	s	no conflict
niesau [nisɑu]	SW	diphthong	high	s	en	conflict
luumui [lymœy]	SW	diphthong	low	s	en	conflict
bema [bcma]	WS	vowel	high	en	s	conflict
wuuzoe [wyzu]	WS	vowel	low	en	s	conflict

Table 5. Overview of the characteristics in data distributed into an equal number of conflict and no conflict environments.

The outcome of a repeated measures ANOVA on the mean number of plurals (see figure 9) produced for novel words with environment (conflict and no conflict) as within-subjects factor and group as between-subjects factor, showed no main effect of environment ($F(1,125)=.624$, $p=.431$), suggesting that suffix selection was not more difficult for either the no conflict or conflict targets/environments. A main effect for group was found ($F(4,125)=10.382$), $p<.01$, with Bonferroni testing showing that the

TD-8yr group performed significantly better than all other groups (p<.05). The TD-5yr group and disordered groups did not show any significant difference (dyslexia, SLI, comorb: p=1). Furthermore, a significant interaction was found between group and environment (F(4,125)=4.316), p<.01, as environment affected the plural realisation of the groups differently. A follow-up paired samples t-test showed that there was a significant difference between the number of plural novel words in conflict and no conflict items for TD-5yr children (t(39)=-3.25, p=.002), but this difference was not significant in the other groups (TD-8yr p=1, dyslexia p=.166, SLI p=.070, comorb p=.334).

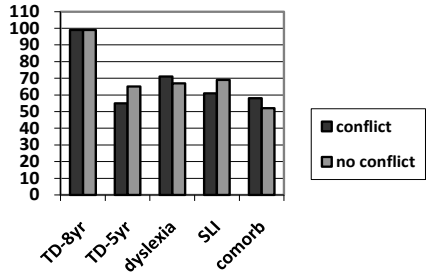

Figure 9. Percentages plural overall in novel words with a conflict or no conflict environment.

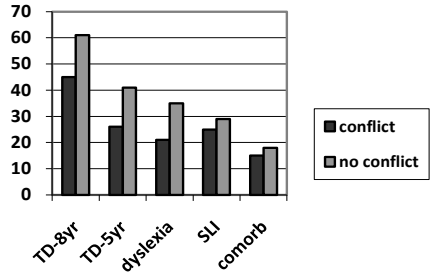

Figure 10. Percentages correct plurals in novel words with a conflict or no conflict environment.

A similar analysis was conducted for the number of *correct* plurals for novel words (see Figure 10). The outcome of a repeated measures ANOVA on the number of *correct* plurals in novel words with environment (conflict and no conflict) as within-subjects factor and group as between-subjects factor showed a main effect of environment (F(1,125)=25.153, p<.01), as no conflict items were inflected correctly more often than conflict items. Moreover, a main effect was found for group (F(4,125)=12.618, p<.01), with Bonferroni testing showing a significant difference between the TD-8yr group and all other groups (dyslexia, SLI, comorb: p<.01), with the TD-8yr group outperforming all other groups. Furthermore, the TD-5yr group showed a higher number of correct plurals than the comorb-group (p=.049). No significant difference was found between the disordered groups (p>.05). Furthermore, no significant interaction effect was found between group and conflict (F(4,125)=1.983, p=.101), as all groups performed better in no conflict than in conflict environments.

Due to the limited number of stimuli (4 conflict and 4 no conflict) a significant effect of environment within all separate groups difficult to obtain. When more stimuli are used, as in the balanced dataset which was added in the plural task of the disordered groups, the pattern of significance might become more evident. However, as this study

compared the performance of the disordered groups to their typically developing peers, only the original subset was used.

In sum, all groups differed in both the number of plurals produced and the number of *correct* plurals produced. Only the number of *correct* plurals was influenced by the environment/target, as more correct suffixes were used in no conflict targets.

3.4. Effect of frequency on suffix selection

One of the main variables in this study was lexical frequency in case of the words (figure 11) and phonotactic probability in case of novel words (figure 12). A repeated measures ANOVA carried out on the number of c*orrect* plurals in words (figure 11) with lexical frequency (high and low) as within-subjects factor and group as between-subjects factor showed a main effect of both frequency ($F(1,125)=95.054$, $p<.01$), and group ($F(4,125)=3.169$, $p=.016$). With respect to group, Bonferroni analysis showed a significant difference between the TD-8yr and comorb-group ($p=.03$). All other groups, including the TD-8yr group, did not differ significantly from each other ($p>.05$). No significant interaction was found between frequency and group ($F(4,125)=2.08$, $p=.087$), as all groups performed better on high frequency than low frequency words (see figure 11). A paired samples t-test showed a significant difference between high and low frequent words in *correct* plurals in words in all groups ($p<.01$), except for the dyslexic group ($t(11)=1.862$, $p=.089$).

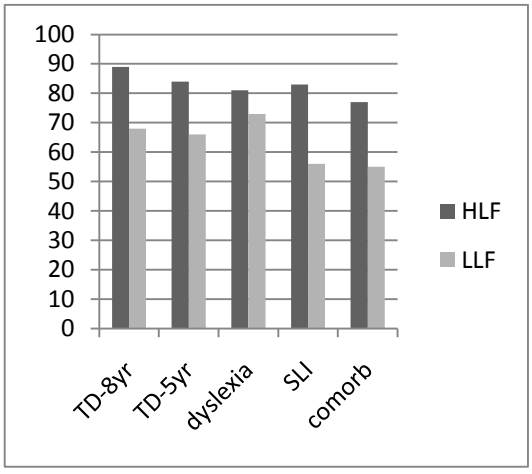

Figure 11. Percentage correct plurals in words with a high(HLF) or low lexical frequency (LLF)

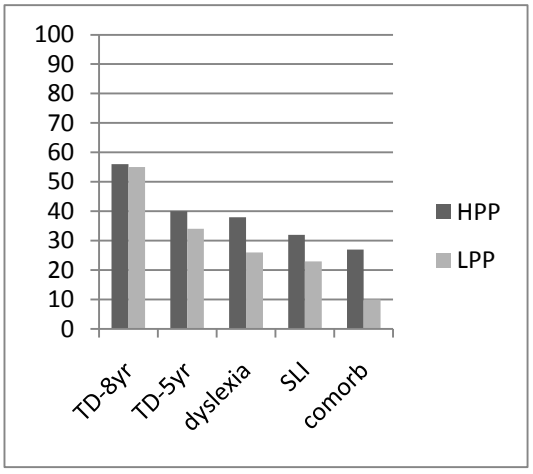

Figure 12. Percentage correct plurals in novel words with a high (HPP) or low (LPP) phonotactic probability

Another repeated measures ANOVA was performed on the total number of *correct* plurals in novel words (figure 12), with phonotactic probability (high and low) as within-subjects factor and group as between-subjects factor. Results showed a main

effect of both phonotactic probability ($F(1,125)=23.102$), $p<.01$ and group $F(4,125)=17.393$, $p<.01$. With respect to group, Bonferonni analysis showed a significant difference between the TD-8yr group and the other 4 groups ($p<.01$). The TD-5yr group differed significantly from the comorb-group ($p<.01$), but the language-disordered groups did not differ significantly from each other ($p>.05$). No significant interaction effect was found between group and phonotactic probability ($F(4,125)=1.856$, $p=.122$), as all groups performed better on novel words with high than low phonotactic probability (see figure 12). A paired samples t-test showed a significant difference between the number of correct plurals for novel words with high and low phonotactic probability in the comorb-group ($t(14)=3.659$, $p=.003$) and the SLI group, $t(23)=4.413$, $p=.000$. This was also found in the dyslexic group ($t(11)=2.60$, $p=.025$).

To summarize, in both words and novel words, a higher number of *correct* plurals was produced for high frequency over low frequency targets in all five groups. The influence of phonotactic probability in plural novel words was most present in the three language-disordered groups.

3.5. Literacy, Vocabulary size and plural realisation

In order to assess the impact of literacy skills on pluralisation, the technical literacy tasks (EMT and the Klepel) were compared with the number of plurals overall in words and novel words, as well as the number of *correct* plurals (table 6) using a Pearson's correlation coefficient (r).

CORRELATION CONDITIONS	**r**				
	Overall	**TD-8yr**	**dyslexia**	**SLI**	**COMORB**
EMT st.sc. * words plur.	.333*	[a]	-.088	-.009	.258
EMT st.sc. * novel words plur.	.394*	.164	-.418	.127	.315
Klepel st.sc. * words plur.	.378*	[a]	.098	.115	-.151
Klepel st.sc. * novel words plur.	.407*	.124	-.449	.127	-.138

Table 6. Correlation between the variables EMT standard score (st.sc.), Klepel standard score (st.sc.) and plural realisation(plur.) of words and novel words. [a]. Cannot be computed as at least one of the variables is constant. *. Correlation is significant at the 0.05 level (2-tailed).

A weak significant correlation between the technical reading tasks (EMT and Klepel), standard score and the plural realisation in words and novel words ($p<.05$) was found (see table 6). No correlation in groups was found between literacy skills and number of plurals in both words and novel words was found (TD-8yr, dyslexia, SLI, comorb: $p<.05$).

CORRELATION CONDITIONS	r				
	Overall	**TD-8yr**	**Dysl**	**SLI**	**COMORB**
EMT st.sc. * words corr.	.199	.419*	-.376	-.097	-.117
EMT st.sc. * novel words corr.	.507*	.499*	-.426	.195	.203
Klepel st.sc. * words corr.	.264*	.408*	-.233	.053	-.251
Klepel st.sc. * novel words corr.	.537*	.288	-.509	.249	-.249

Table 7. Correlation between the variables EMT standard score (st.sc.), Klepel standard score (st.sc.) and correct suffix (corr) of words and novel words. [a]. Cannot be computed as at least one of the variables is constant. *. Correlation is significant at the 0.05 level (2-tailed).

The correlation of the different groups demonstrated a weak significant correlation for the TD-8yr children between the technical reading tasks and the number of *correct* plurals in both words and novel words ($p<.01$), with exception to the Klepel and the number of *correct* plurals in novel words ($p=.288$). No correlation between literacy skills and number of correct plurals was found in TD-5yr and the language-disordered groups ($p<.05$).

Secondly, a Pearson's correlation coefficient (r) was used to test a possible correlation between vocabulary and the performance on the plural task (see table 7). The analysis showed no significant correlation between the number of plurals overall in words and WBQ (Pearson's $r=.172$, $p=.51$) or in novel words and WBQ (Pearson's $r=-.009$, $p=.916$). Only a weak significant correlation between the number of correct suffixes in words and WBQ was found (Pearson's $r=.204$, $p=.20$), as no significant correlation was found in novel words and WBQ (Pearson's $r=.147$, $p=.097$).

In sum, a weak correlation was found between literacy and *correct* plural realisation in novel words. No correlation was found between vocabulary and plural realisation or the number of correct suffixes.

4. DISCUSSION

This study examined the morpho-phonological process of pluralisation in children with dyslexia and / or specific language impairment (SLI), and compared their results with their typically developing peers, using a plural elicitation task. The main purpose of the study was to gain further insight into the relationship between SLI and dyslexia by examining the effects of frequency and phonological factors on plural inflection.

The results showed that pluralisation (morphology) in novel words and words was problematic for both TD-5yr and language-disordered children, as they inflected fewer plurals than the 8-year-old control group. The disordered groups performed equal to the 5-year-olds in the number of plurals produced for novel words (whether correct or

incorrect), which indicated that the ability to form plurals is not yet fully developed in children at an early stage of phonological development and children with (subtle) language-disorders. Results also showed that the TD-5yr and TD-8yr children performed better on *correct* pluralisation (using morpho-phonological cues to choose the right suffix) than the language-disordered groups. The percentage of *correct* plurals decreased when more multiple language deficits were present, as the TD-5yr children produced a *correct* plural more often than the children with dyslexia, followed by the children with SLI and comorbidity. The most common error in the disordered groups was "zero marking". Furthermore, the results showed evidence that all groups had more difficulties with pluralisation and *correct* pluralisation in novel words than words.

The results showed that the number of *correct* plurals increased in TD-8yr children in case of a higher literacy performance. This was not the case in the language-disordered groups. The number of correct pluralisation in novel words in the TD-8yr and language-disordered children was not correlated to the literacy skills.

The plural task results also showed that all groups preferred the use of suffix [-@n] over [-s] in *correct* pluralisation. The finding of overuse of this suffix in de language-disordered children and their language-matched peers corresponds to Baayen, Schreuder, de Jong & Krott (2002) and van Wijk (2007) who showed that children in a early stage of development have preference to the use of [-@n]. The current results also show that all groups were sensitive to stress in *correct* plural novel words, as they all performed better in congruent than conflict targets.

This study also investigated whether children were sensitive to frequency factors in morpho-phonological processes. All groups, with exception to children with dyslexia, were sensitive to lexical frequency in words, as they performed better on correct plural words with a high frequency than a low frequency. This indicates a difference between the dyslexic and the SLI group. Furthermore, results showed an influence of phonotactic probability on correct plural novel words in all three language-disordered groups, as children were better in inflecting a novel word with high phonotactic probability (e.g. [nIsɑu]) than low phonotactic probability (e.g. [wyzu]). However, this effect was not found for their typically developing peers. These results are in line with previous findings by Rispens, de Bree & Kerkhoff, who found that phonotactic probability is used at an early stage of development, whereas lexical frequency becomes more important at later stages. Hence, the current results indicate that high phonotactic probability may be used by language-disordered children to acquire new words and

patterns. Children with dyslexia, SLI and comorbidity are expected to be more limited than TD-5yr in their use of plurals. However, it is nevertheless the case that children with SLI and/or dyslexia are more adversely affected by low frequency novel words than TD-5yr children in pluralisation. These findings were similar between the language-disordered groups. It is assumed that the language-disordered children have more difficulties in pluralisation in general, and therefore are more dependent on the characteristics of new words. These findings correspond to a study by Leonard, et al. (2007) who found an influence of phonotactic probability on past tense formation for children with SLI, but not for a control group of typically developing children.

In sum, this study has shown that both dyslexia and SLI group have difficulties in morpho-phonological processes, as they performed worse on both plural and correct plural inflection than the TD-8yr group. Results showed that both typical developing and language-disordered children seem to use phonological cues in novel word pluralisation, as more errors were found in conflict than in no conflict targets. These findings point towards an underlying phonological deficit in the language-disordered groups. The disordered groups performed equal to the 5-year-olds in the number of plurals produced for novel words (whether correct or incorrect), which also indicates that the ability to form plurals is not yet fully developed in children at an early stage of phonological development and children with (subtle) language-disorders.

Furthermore, only the language-disordered groups were sensitive to phonotactic probability. The dyslexic group was not sensitive to lexical frequency in contrast to the other groups. Differences between the groups which support the view that dyslexia and SLI have to be treated as two separate disorders, need to be further investigated.

4.1. Future research

In this study, Dutch plural formation was investigated and compared between children with language-disorders and their typically developing peers. Even though language-disordered children produced fewer (correct) plurals, children with SLI and / or dyslexia did not differ significantly on the use of phonological cues (stress and final sound of the target word). However, differences may be enhanced when performance is compared on a larger dataset, which includes more words in which these cues are in conflict. In future research, it would be interesting to investigate the added items in the language based disordered groups and compare their results to their typically developed peers (age-matched and language-matched). As the current study was aimed at comparing the disordered group to typically developing peers, this analysis will be left for future work.

It is also interesting to look at the singular form which is repeated by the children. Perhaps, they adjust the stress in the singular form which influences the suffix expectancy based on stress and causes the more common suffix [-@n].

Moreover, the dyslexic group in this study contained 9 females and 3 males. Due to the fact that dyslexia is more common in males than in females (Blomert & Willems, 2010), the used distribution in gender is not really representative. A future study should include more dyslexic children, which may also result in a more representative gender distribution.

Finally, it would also be interesting to investigate in more detail the type of errors which are made in the TD-5 and language-disordered groups (e.g. "zero marking" vs. "incorrect suffix"), as this may reveal qualitative difference between groups.

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Appendix

A. Overview of the stimuli

In the following section the stimuli that were used in the experiment (plural task) are presented in different tables. Each table shows the distributional characteristics of the items (stress, final sound, lexical frequency/ phonotactic probability, suffix based on stress and the expected suffix). Furthermore, a division between conflict, neutral or no conflict is made. In case of a similarity in expected suffix based on stress and final sound

A.1. Characteristics words

word	STRESS	FINAL SOUND	LF	Expected suffix based on STRESS	Expected suffix based on FINAL SOUND	Conflict
been *(leg)*	S	sonorant	high	en	en	neutral
pinguïn *(pinguin)*	SW	sonorant	low	s	s	no conflict
konijn *(rabbit)*	WS	sonorant	high	en	en	neutral
slang *(snake)*	S	sonorant	high	en	en	neutral
toekan *(toucan)*	SW	sonorant	low	s	s	no conflict
ballon *(balloon)*	WS	sonorant	high	en	en	neutral
trui *(sweater)*	S	diphthong	low	en	en	no conflict
aardbei *(strawberry)*	SW	diphthong	low	s	en	conflict
mevrouw *(lady)*	WS	diphthong	high	en	en	no conflict
gnoe *(gnu)*	S	vowel	low	en	s	conflict
foto *(picture)*	SW	vowel	high	s	s	no conflict
bureau *(desk)*	WS	vowel	high	en	s	conflict

Table A.1. Overview of the characteristics in words distributed into an equal number of conflict and no conflict environments.

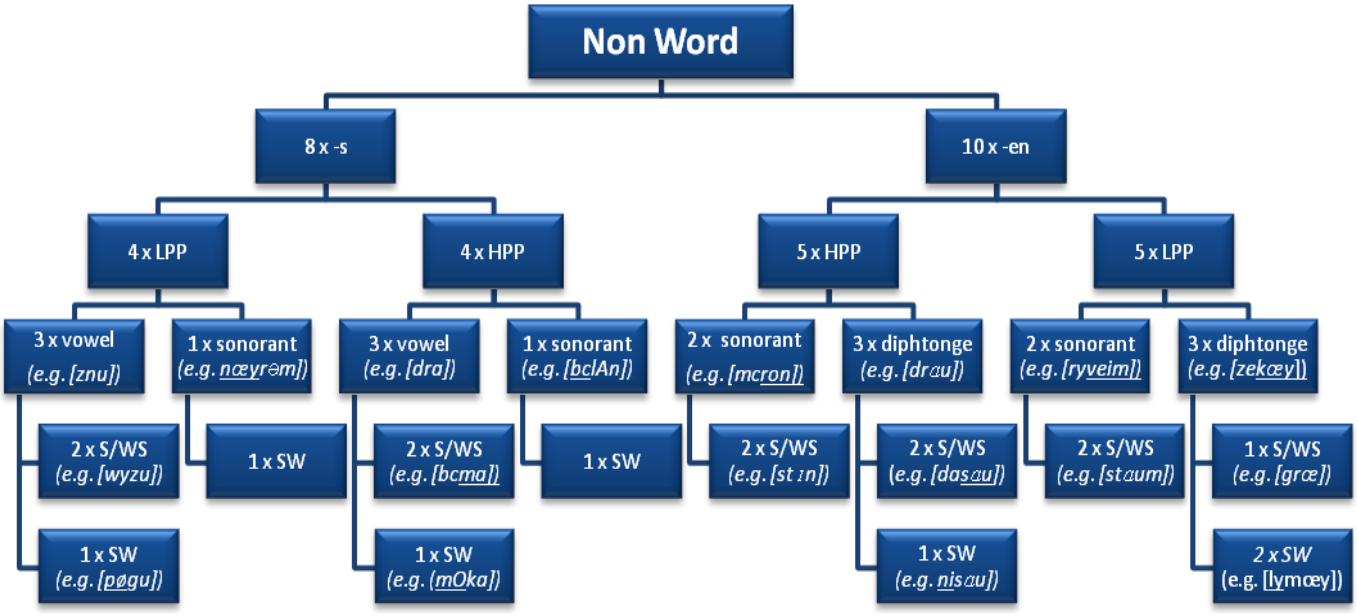
A.2. Characteristics novel words

Novel-word	STRESS	FINAL SOUND	PP	Expected suffix based on STRESS	Expected suffix based on FINAL SOUND	Conflict
stin [stɪn]	S	sonorant	high	en	en	neutral
staum [stɑum]	S	sonorant	low	en	en	neutral
beelan [bclAn]	SW	sonorant	high	s	s	neutral
nuirem [nœyrəm]	SW	sonorant	low	s	s	neutral
meeron [mcron]	WS	sonorant	high	en	en	neutral
ruveim [ryveim]	WS	sonorant	low	en	en	neutral
drau [drɑu]	S	diphthong	high	en	en	no conflict
grui [grœ]	S	diphthong	low	en	en	no conflict

dasau [dasɑu]	WS	diphthong	high	en	en	no conflict
zekui [zekœy]	WS	diphthong	low	en	en	no conflict
niesau [nisɑu]	SW	diphthong	high	s	en	conflict
luumui [lymœy]	SW	diphthong	low	s	en	conflict
draa [dra]	S	vowel	high	en	s	conflict
znoe [znu]	S	vowel	low	en	s	conflict
bema [bcma]	WS	vowel	high	en	s	conflict
wuuzoe [wyzu]	WS	vowel	low	en	s	conflict
mooka [mOka]	SW	vowel	high	s	s	no conflict
peugoe [pøgu]	SW	vowel	low	s	s	no conflict
dafoot [dafOt]	SW	obstruent	high	s	en	conflict
dahee [dahc]	WS	vowel	high	en	s	conflict
giejeu [gijø]	SW	vowel	low	s	s	no conflict
guulop [gylɔp]	SW	obstruent	low	s	en	conflict
nuiweu [nœywø]	WS	vowel	low	en	s	conflict
siepant [sipɑnt]	WS	obstruent	high	en	en	no conflict
waatee [watc]	SW	vowel	high	s	s	no conflict
weujirp [wøjirp]	WS	obstruent	low	en	en	no conflict

Table A.2. Overview of the characteristics in novel words distributed into an equal number of conflict and no conflict environments.

A.3. Distribution novel words.



The distribution of stimuli type novel word; expected suffix ([-s] vs. [-@n]), phonotactic probability (LPP vs. HPP), final sound and stress (S/WS vs. SW).

B. Plots

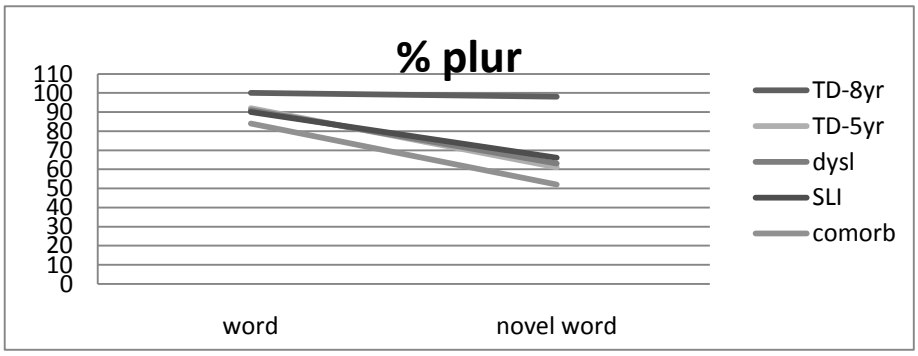


Figure B.1. Percentages of plural realisations in words and novel words

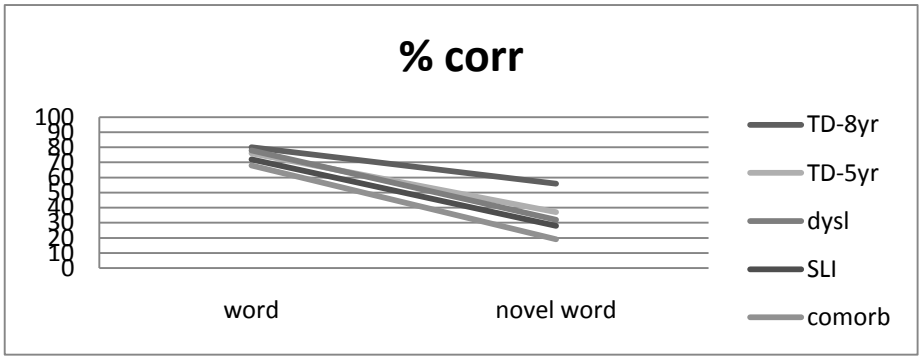


Figure B.2. Percentages of correct plurals in words and novel words.

C. Pluralisation influenced by frequency factors.

plurals	**Word**			**Novel word**		
	HLF	**LLF**	**Total**	**HPP**	**LPP**	**Total**
8 yrs (TD)	100 %	100%	100%	99 %	97%	98 %
5 yrs (TD)	95 %	87 %	91 %	62 %	61 %	61 %
dyslexia	92 %	90 %	91 %	64 %	63 %	63 %
SLI	95 %	84 %	89 %	68 %	65 %	66 %
COMORB	89 %	77 %	83 %	50 %	56 %	53 %

Table.C.1. Percentage of all plural realisations in words and novel words distributed in high and low frequency.

correct	**Word**			**Novel word**		
	HLF	**LLF**	**Total**	**HPP**	**LPP**	**Total**
8 yrs (TD)	89 %	68 %	78 %	56 %	55 %	57 %
5 yrs (TD)	84 %	66 %	75 %	40 %	34 %	37 %
dyslexia	81 %	73 %	77 %	38 %	26 %	32 %
SLI	83 %	56 %	70 %	32 %	23 %	28 %
COMORB	77 %	55 %	66 %	27 %	10 %	19 %

Table C.2. Percentage correct plurals in words and novel words distributed in high and low frequency.