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# Regular and irregular noun plurals in German individuals with Down syndrome

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## 1 Introduction

Individuals with Down syndrome (DS) display marked problems in the acquisition of inflectional morphology (e.g. Eadie et al., 2002). A typical finding in research on inflectional deficits is that regular and irregular inflected forms are affected differently. Dualistic approaches to inflection assume that this difference in vulnerability is due to the fact that the representations and mechanisms involved in the production of regular and irregular inflected forms rely on two independent modules of the human language faculty: a computational (i.e. grammar) component where regular affixation is carried out and regular inflected forms are produced, and a storage component – the mental lexicon – in which learned irregular inflected forms are stored and retrieved (Pinker, 1999). This dualistic view of inflection presupposes that language deficits should be found that selectively affect only one of these components sparing the other. Inflectional deficits in individuals with DS might constitute a case in point (Penke, 2019). If regular inflection requires morphological processing - assumed to be compromised in DS - regular inflection should be impaired in individuals with DS. In contrast, if irregular inflected forms are stored in the mental lexicon they should be less affected since the mental lexicon is typically developed according to or even exceeding mental-age expectations in these individuals (e.g. Næss et al., 2011). Here, I will present data on noun plural inflection in 57 German-speaking individuals (31 with DS, 26 typically-developing children) bearing on this issue.

Other than English, German displays overt regular and irregular inflectional endings on noun plurals. The German plural system consists of four different plural allomorphs. Plural nouns can be marked by /s/, by /e/, by /er/, by /n/ or they can remain unmarked. All German plural nouns other than /s/-inflected nouns are subject to a prosodic constraint that requires the plural form to end in a reduced syllable, i.e. an unstressed syllable with Schwa or a syllabic sonorant (Neef, 1998) (e.g. 1 Bär – 2 Bären ‘bear(s)’, 1 Tisch – 2 Tische ‘table(s)’, 1 Kind – 2 Kinder ‘child(ren)’). The plural ending /n/ is particularly suited to investigate selective deficits of regular or irregular inflected forms as it surfaces on regular as well as on irregular inflected nouns. On feminine nouns ending in /ə/ in the singular form (e.g. [bi:nə] ‘bee’) the ending /n/ is completely predictable and considered to be regular ([bi:nən] ‘bees’). On masculine and neuter nouns that do not end in /ə/ in the singular form (e.g. [bɛ:v] ‘bear’) the /n/ ending (e.g. [bɛrən]) is considered to constitute an irregular ending since it is neither productive for masculine and neuter nouns nor predictable on the basis of the phonological shape of the nouns that take this ending (Wiese, 1999; Penke & Krause, 2002, Bartke et al., 2005). As the phonological complexity of regular and irregular /n/-inflected forms does not differ and as both types of /n/-plurals display a similar type frequency (Bartke et al., 2005), German /n/-plurals constitute an ideal test case to identify selective deficits of regular or irregular inflected forms.

## 2 Method

Noun plurals were elicited from 31 children and adolescents with DS (12 female) aged 4;07 to 19;02 years (*M* 14;05 years). For two of them the parents reported a mild hearing loss of less than 25 dB. For the remaining participants with DS no permanent hearing loss had been diagnosed. Nonverbal mental age (MA) was assessed using the SON-R 2.5-7 (Tellegen et al., 2007). It ranged from 2;11 to 6;05 years (*M* 4;05). Performance of the participants with DS was

compared to a control group of 26 typically-developing (TD) children (13 female) matched in chronological age to the nonverbal mental age of the participants with DS (age TD group 3;04 - 5;07 years,  $M$  4;05) (difference mental age DS group vs. chronological age TD group  $p = .63$ , ns.). All participants were monolingual speakers of German.

Elicitation of noun plurals followed the classical *wug*-test design (Berko, 1958). Participants were first presented with a picture displaying a single object named by the experimenter (e.g. *Look, this is a bee*). Then, a picture displaying three of these objects was presented and the participant was asked to produce a plural form (e.g. *Now there are some more. Now there are \_\_\_ ?*). In total, we elicited 40 noun plurals per participant. Here, I will focus on the 8 items eliciting regular /n/-plurals (henceforth  $n^{fem}$ -plurals) and the 8 items eliciting irregular /n/-plurals (henceforth  $n^{nonfem}$ -plurals). Regular and irregular /n/-items were matched for lemma and plural form frequency according to the CELEX database (Baayen et al. 1993) ( $n^{fem}$ -items: mean lemma frequency 24.4, mean plural frequency 12.6;  $n^{nonfem}$ -items: mean lemma frequency 37.4, mean plural frequency 17.1, difference  $p > .45$  each). To tap into the productive abilities of the participants all tested items were of relatively low frequency.

Participants were tested individually after a short practice phase familiarizing them with the task. During testing, items were presented in the same previously randomized order for all participants and no feedback was given. All experimental sessions were video- and audiotaped. Participants' reactions were transcribed and transcripts were checked against the video files by a second independent researcher.

Produced forms were then evaluated for the correctness of the plural form of the 16 critical items. An inflectional error was counted if a wrong inflectional ending was used instead of the correct ending (e.g.  $*[bi:nəs]$ ,  $*[bεβə]$ ) or if the inflectional ending was omitted (e.g.  $*[bi:nə]$ ,  $*[bεε]$ ). Based on these data, accuracy scores for  $n^{fem}$ - and  $n^{nonfem}$ -plurals were calculated for each participant and compared by a two-factorial, mixed ANOVA. The level of statistical significance was set at  $p < .05$ .

### 3 Results

Figure 1 presents the accuracy scores for the two groups of participants and the two types of /n/-plurals. For both types of /n/-plurals, the group of participants with DS achieved lower mean accuracy scores than the group of TD children. Whereas the group of TD children obtained a mean accuracy score of 91.3% for regular  $n^{fem}$ -plurals, the corresponding score for the group of participants with DS was at only 47%. For irregular  $n^{nonfem}$ -plurals the TD group obtained a mean accuracy score of 46.7%, the mean accuracy score of the participants with DS was 31.4%.

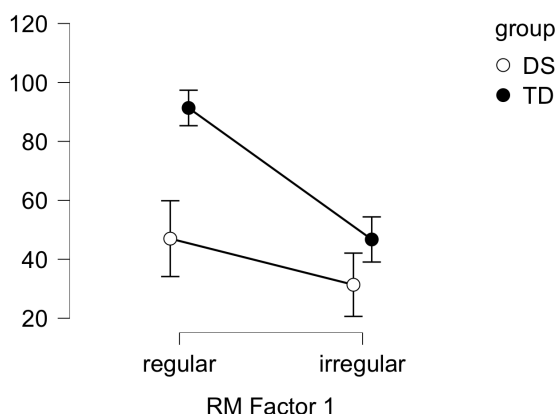


Figure 1: Accuracy scores for regular and irregular /n/-plurals obtained by the two participant groups.

A two-way factorial analysis of variance with SUBJECT GROUP (DS vs. TD) as between-subjects factor and REGULARITY (regular  $n^{fem}$ -plural vs. irregular  $n^{nonfem}$ -plural) as within-subject factor revealed a significant main effect of participant group ( $F(1,55) = 21.2, p < .001, \eta p^2 = .28$ ) with the group of TD children achieving higher accuracy scores than the group of participants with DS. A significant main effect was also obtained for the factor REGULARITY ( $F(1,55) = 119.2, p < .001, \eta p^2 = .68$ ), reflecting that accuracy scores for regular  $n^{fem}$ -plurals were significantly higher than accuracy scores for irregular  $n^{nonfem}$ -plurals in both groups of participants. In addition, the interaction of the factors SUBJECT GROUP X REGULARITY was also significant ( $F(1,55) = 27.5, p < .001, \eta p^2 = .33$ ), indicating that group differences were more pronounced for regular compared to irregular plural forms. Indeed, post-hoc testing (*Bonferroni*) yielded no significant group difference for the accuracy scores obtained for irregular  $n^{nonfem}$ -plurals ( $t = 2.2, p = .19$ ), whereas for regular  $n^{fem}$ -plurals the group of TD children significantly outperformed the group of participants with DS ( $t = 6.3, p < .001$ ). Analyses correlating accuracy scores for both types of /n/-plurals with the chronological and the mental age of the participants with DS, yielded no significant relationships for  $n^{fem}$ -plurals ( $p > .2$  each). For  $n^{nonfem}$ -plurals, accuracy scores displayed a tendency to increase with chronological age ( $p = .061$ ).

Overall, 77.7% of the incorrect forms produced by the participants with DS were unmarked forms where the /n/-marking was missing. As mentioned above, a prosodic constraint requires all native German noun plurals to end in a reduced syllable. An error analysis was conducted to evaluate whether participants adhered to this constraint in their incorrectly produced noun plurals. Only nouns taking the  $n^{nonfem}$ -plural were evaluated in this analysis since nouns taking the  $n^{fem}$ -plural already end in a reduced Schwa-syllable in the singular form. In contrast, nouns taking the  $n^{nonfem}$ -plural typically end in a stressed syllable in the singular form. Leaving these forms unmarked, thus, results in a prosodically illicit plural form. This analysis yielded that a substantial proportion of the incorrectly produced plural forms for  $n^{nonfem}$ -nouns were left unmarked by the participants with DS (61.5%), thus violating the prosodic constraint on plural forms. This proportion was significantly higher than the proportion of unmarked forms produced by group of TD children (27.5%) ( $t(54) = 2.95, p = .005, d = .79$ ). The high proportion of produced plural forms that do not adhere to the prosodic constraint on German plural nouns suggests that this prosodic constraint is not fully operative in the participants with DS. Interestingly, however, the huge majority of the unmarked forms produced by the participants with DS were accompanied by a quantifier (the numeral *three* or the quantifier *many*) (81.3%), suggesting that the concept of plural was expressed by the quantifier instead of the unavailable inflected plural form.

## 4 Discussion

The data indicate that noun plural inflection is impaired in German-speaking individuals with DS. This deficit selectively affects regular  $n^{fem}$ -plural formation. Whereas accuracy scores for regular  $n^{fem}$ -plurals were significantly lower compared to a group of TD children, accuracy scores for  $n^{nonfem}$ -plurals did not differ for the two groups of participants, suggesting that the production of irregular inflected /n/-plurals was at a level expected for the mental age attained by the participants with DS. This finding confirms previous findings on inflectional deficits in DS that have also found regular inflection (English past tense inflection and German past participle inflection) to be selectively affected in individuals with this syndrome (Eadie et al., 2002; Laws & Bishop, 2003; Penke, 2019).

Although regular and irregular /n/-inflected noun plurals display the same plural marker and the tested items were of similar frequency (lemma and word form frequency), participants' behaviour differed significantly with respect to regular and irregular /n/-plurals. TD children

achieved a mean accuracy score for regular *n/em*-plurals of over 90%, indicating that they had acquired the regular *n/em*-plural marking. In contrast, accuracy scores for irregular /n/-plurals were significantly lower. The different development of regular and irregular inflected /n/-plurals in TD children and the finding that regular /n/-plurals were selectively affected in the group of participants with DS are in accordance with a dualistic view to inflection that states a qualitative difference between regular and irregular inflection.

The findings on incorrect, unmarked plural forms indicate that the observed language impairments in the participants with DS are not restricted to regular inflectional processes per se, but encompass prosodic constraints operating on the output of these processes. The observation that most unmarked nouns were produced with a preceding numeral suggests that participants with DS had already grasped the concept of plurality (see Clark & Nikitina, 2009) but had not yet acquired or could not access or produce the inflected plural form expressing this concept.

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