

## RESEARCH

# The mass-count distinction in Dutch-speaking children with specific language impairment

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This study reports experimental data on the acquisition of the mass-count distinction by Dutch-speaking children with specific language impairment (SLI). While verbal morphosyntax is known to be impaired in SLI, nominal morphosyntax has received less attention. The mass-count distinction provides an interesting test ground: count can have a plural morpheme: *bal-en* ('balls'), but mass cannot: *\*deeg-en* ('doughs'). Flexible nouns can easily occur in either mass or count syntax (*pizza/pizza-s*). Finally, object-mass nouns (e.g. *furniture*) are syntactically mass, but quantify over individuals, and are hypothesized to have a lexical [+individual] feature (Bale & Barner 2004). Typically developing (TD) Dutch-acquiring children become sensitive to the mass-count distinction around age 6 (van Witteloostuijn 2013).

Hypothesizing that the primary impairment of SLI is in morphosyntax, and not in lexical-semantics, we predict that Dutch-speaking children with SLI older than 6 have most problems with the interpretation of flexible nouns (relying solely on morphosyntax), some problems interpreting classical count and mass nouns (supported by convention/world knowledge), and least problems interpreting object-mass nouns (relying solely on their lexical [+individual] feature).

Quantity judgments based on count and mass nouns were collected from 28 Dutch children with SLI aged between 6 and 14 years old and 28 individually age-matched TD children. Confirming our predictions, the children with SLI scored significantly lower than their TD controls on flexible nouns, and, albeit to a lesser extent, on classical nouns. This underscores the (nominal) morphological deficit in SLI. In contrast, no difference between groups was found on object-mass nouns.

**Keywords:** mass-count distinction; morphosyntax; specific language impairment; language acquisition

## 1 Introduction

In languages such as Dutch and English, the distinction between mass and count nouns is conveyed through number morphology: mass nouns can only occur in singular form (*dough*, *\*doughs*), whereas count nouns receive a plural morpheme (*ball*, *balls*). We know from previous studies that children with specific language impairment (SLI) have difficulties with the comprehension and production of grammatical morphemes. For example, Dutch-speaking children with SLI have been shown to have problems with subject-verb agreement or finiteness both in judgment (Rispen & Been 2007) and in production (de Jong 1999; Wexler, Schaeffer & Bol 2004). Less is known about the difficulties that children with SLI experience with morphology in the nominal domain (but cf. Rice and Oetting 1993 for English-speaking children with SLI). The aim of the present study is to investigate whether children with SLI are able to use nominal (plural) morphology to distinguish between mass and count nouns in a sample of Dutch-speaking children with

SLI between the ages of 6 and 14 and gender- and age-matched typically developing (TD) children.

## 2 Background

### 2.1 Relevant theories on the mass-count distinction

The distinction between mass nouns, such as *dough*, and count nouns, such as *ball*, is syntactically expressed in many languages, including English and Dutch. Such languages are referred to as number-marking languages. In these languages the mass-count distinction affects the distribution of singular vs. plural morphology. Following Chierchia (1998) and Krifka (2009), we assume that mass nouns in number marking languages have the syntactic properties listed and illustrated for Dutch and English in (1):

- (1)
- (i) cannot be preceded by an indefinite article: \**een deeg* – \**a dough*
  - (ii) cannot be preceded by numerals: \**drie degen* – \**three doughs*
  - (iii) need a classifier or a measure phrase to be quantized: *een hoopje deeg* – *a pile of dough*
  - (iv) cannot be pluralized: \**degen* – \**doughs*

Besides typical mass nouns such as *dough* and typical count nouns such as *ball*, there are so-called flexible nouns, which sometimes behave as mass nouns, and sometimes as count nouns, as illustrated in (2) for Dutch:

- (2)
- a. Voor dit project heb ik twee meter touw nodig.  
for this project have I two meter rope necessary  
'For this project, I need two meters of rope.'
  - b. Het schip zit met drie touwen vast.  
the ship sits with three ropes attached  
'The ship is attached with three ropes.'

The noun *touw* ('rope') is mass if it is quantized by a measure phrase, as in (2a), while it is count if it is preceded by a numeral and followed by a plural morpheme, as in (2b).

There is also a semantic side to mass and count. Quine (1960) introduced the term cumulativity and argued that mass nouns refer cumulatively. The same mass noun can refer to either one (small) amount of substance, or to a combination of several amounts of the same substance. For instance, two amounts of *dough* put together still results in *dough*. Obviously, this does not apply to singular count nouns: the combination of two cars does not result in *car*. A second important notion regarding the semantics of mass and count is divisivity (Cheng 1973). Mass nouns are divisive, but count nouns are not: parts of dough are also referred to as *dough*, but parts of a car are not referred to as *car*. These observations led to the suggestion that the distinction between mass and count is based on individuation: count nouns quantify over individuals, mass nouns do not (Quine 1960; Gordon 1985; Bloom 1994 a.o.).

Nevertheless, such an account does not cover all the facts. There is no one-to-one mapping between, on the one hand, cumulative, divisive (non-individuated) objects/substances and mass nouns, and on the other hand, non-cumulative, non-divisive (individuated) objects and count nouns. For example, mass nouns and plural count nouns are both interpreted as cumulative, and can thus not be distinguished by means of cumulativity (Pelletier 1979; Gillon 1996). Furthermore, nouns such as *furniture*, *cutlery*, and *silverware* quantify over individual items, but are syntactically mass.

Gillon (1996) makes an attempt to solve this problem by proposing that mass nouns are lexically unspecified with respect to individuation. From this perspective, count nouns refer to individual items and are specified as such in the lexicon, whereas world knowledge determines the reference of mass nouns. For example, whereas both *furniture* and *dough* are syntactically mass nouns, and therefore lexically unspecified, our experience tells us that *furniture* refers to distinguishable, individual items, but *dough* does not. Chierchia (1998) elaborates on this lexical account by claiming that all mass nouns actually refer to individuals but that it is the plurality value of the noun that distinguishes between count and mass.

Although lexical accounts such as the ones described above may be empirically adequate, we believe they are not the most elegant, as the relevant distinctions are merely stipulated in the lexicon. Furthermore, it is not always the case that a typical count noun such as *table* gets a count interpretation (see (3a) below), or that a typical mass noun such as *water* receives a mass interpretation (see (3b) below). Making use of the observed syntactic differences between mass and count, Borer (2005) proposes that the interpretation of a noun as mass or as count follows from its syntactic environment: count syntax (such as an indefinite determiner or a plural morpheme) renders a count interpretation, while the absence of such syntax yields a mass interpretation. In other words, all nouns can be either count or mass, even nouns that are conventionally referred to as count (such as *table*), and nouns that are conventionally referred to as mass (such as *water*). This is illustrated in (3):

- (3) a. You get more **table** for your money at IKEA.  
b. The territorial **waters** of Indonesia are quite polluted.

According to Borer (2005), the fact that some nouns are more often referred to as mass nouns and other nouns as count nouns is due to convention. In this sense, all nouns are flexible between mass and count, because each noun has a “bare” entry in the lexicon, unmarked for the mass-count distinction. This bare entry receives the correct mass or count value structurally. Nouns become count nouns when they are embedded in count syntax. In all other cases, nouns have a mass interpretation. Nonetheless, it is not clear in this account how nouns such as *furniture*, that are syntactically mass (*This store has many different types of furniture*), receive an interpretation based on individuation.

Experimental evidence for the hypothesis that nouns become mass or count only by virtue of their syntactic environment comes from a study by Barner & Snedeker (2005), who show that for flexible nouns (such as *rope* and *chocolate*), it is not world knowledge, but the syntactic context of nouns (mass: *a piece of rope* or count syntax: *three ropes*) that yields a mass or a count interpretation. The results of Barner & Snedeker’s (2005) study leads them to propose that the distinction between mass and count is due to the individuation entailments of the noun phrase. A feature [+individual] licenses this individuation. The [+individual] feature is invoked either syntactically, by means of articles, plural morphology, numerals, etc. (i.e. count syntax), or lexically, as in nouns such as *furniture*, for which the [+individual] feature is part of their lexical denotation. From this perspective, regular mass nouns cannot individuate because the [+individual] feature is available neither syntactically, nor lexically. Barner & Snedeker’s analysis regards the mass-count distinction as a phenomenon mainly determined by syntax, except for object-mass nouns such as *furniture*, which are lexically specified for individuation. The suggestion that mass is distinguished from count through syntax was also developed in Bale & Barner (2004), who, similar to Borer (2005), argue that root nouns are underspecified with respect to

mass-count (or “countability”). Root nouns then receive their mass or count specification when they combine with a functional head via a syntactic operation.

In this study we follow Borer (2005), Barner & Snedeker (2005) and Bale & Barner (2004) in assuming that nouns become mass or count via morphosyntactic means. The syntactic switch from mass to count and vice versa is easiest for flexible nouns such as *rope*, or *chocolate*, because our world knowledge or convention does not push them into a particular direction. Classical count nouns such as *ball*, and classical mass nouns such as *dough* “suffer” from convention and/or world knowledge, as *ball* is usually used with count syntax and refers to an individual item, whereas this is not the case for *dough*. Finally, for object-mass nouns such as *furniture*, we adopt Barner & Snedeker’s (2005) and Bale & Barner’s (2004) account that such nouns carry a lexical [+individual] feature. Our approach is schematized in Table 1.

In the next section we discuss some previous studies on the acquisition of the mass-count distinction in other languages than Dutch.

## 2.2 Previous acquisition studies on the mass-count distinction – children with typical development

English-acquiring TD children have been shown to be sensitive to the mass-count distinction relatively early. For instance, Gordon (1985; 1988) reports that 2–3-year-old children acquiring English apply the plural morpheme only to count nouns, thus obeying pluralization restrictions. Gathercole, Cramer, Somerville & Jansen Op De Haar (1995) showed 3 and 4-year-olds children unfamiliar objects and gave these objects novel names. They found that if the object was used in count syntax, the children also used the novel noun for new items of the same shape (but different material) (*a blicket* → *blickets*). In contrast, if the item appeared in mass syntax, the children extended the noun to a new item consisting of similar material (but a different shape), i.e. *some blicket* → *blicket*. Soja (1992), Soja, Carey & Spelke (1991; 1992) report similar results for even younger children acquiring English, namely between the ages of 2;0–2;6. However, these studies did not test the full range of mass and count nouns as presented in Table 1.

A more recent study by Barner & Snedeker (2005) fills this gap by experimentally investigating classical count and mass nouns as well as flexible and object-mass nouns. Basing themselves on Gathercole (1985), Barner & Snedeker developed a Quantity Judgment Task (QJT) to evaluate 4-year-old children’s knowledge regarding the mass-count distinction in English.

In their first experiment, Barner & Snedeker (2005) tested object-mass nouns (*furniture*,  $N = 4$ ), and compared these to classical mass nouns (*toothpaste*,  $N = 4$ ) and classical count nouns (*shoes*,  $N = 4$ ). The experimenter showed the participant two pictures of two characters each having a certain amount of items or substance, and then asked which

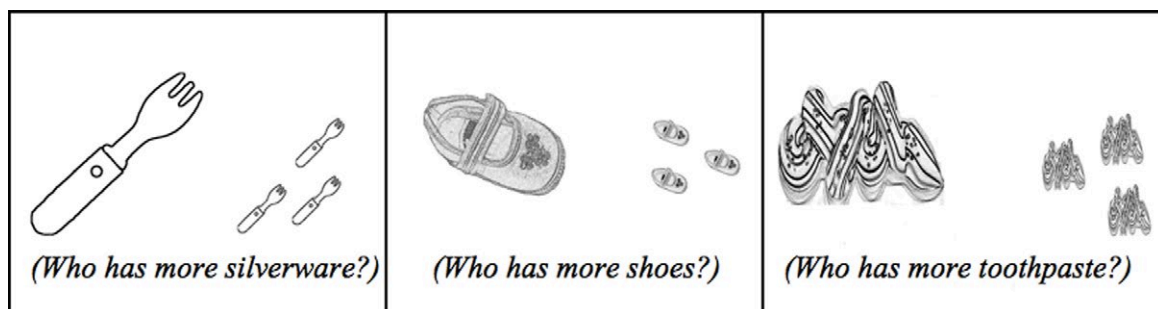
**Table 1:** Overview of the ways in which the interpretation of different noun types is determined.

Noun type	Example	Interpretation determined by		
		Morphosyntax alone	Morphosyntax and convention	Lexicon
Classical count	A ball/three balls		×	
Classical mass	A pile of dough		×	
Flexible count	A rope/three ropes	×		
Flexible mass	A piece of rope	×		
Object-mass	A set of furniture			×

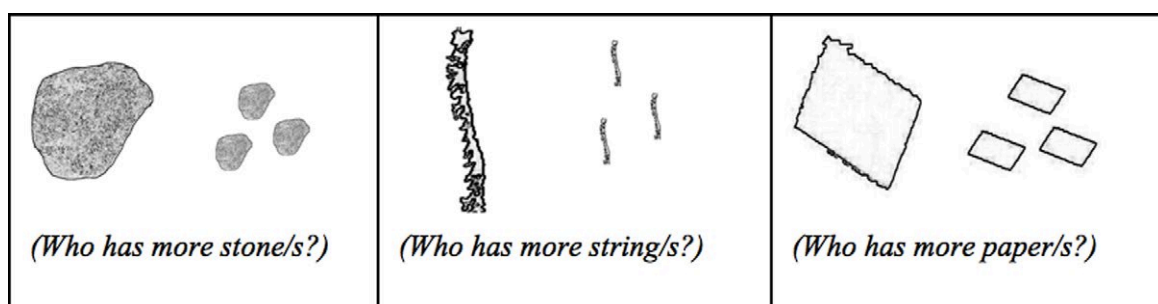
character had more. It is important to note here that one character had more of the relevant noun in terms of number of individual items, whereas the other character had more of the noun when regarding overall volume. For instance, in the experimental item testing the object-mass noun *silverware*, one character had two small forks and two small knives while the other character was portrayed with one large fork and one large knife. Moreover, in all experimental items the overall volume of the two large objects together was larger than the overall volume of the higher number of small items of the same kind. The object-mass, the classical count and the classical mass conditions are illustrated in Figure 1.

Barner & Snedeker (2005) tested 12 English-acquiring children (age 4;0–4;6,  $M = 4;3$ ) and 16 English-speaking adults. Their results show that in the classical count (*shoes*) and object-mass conditions (*furniture*), adults virtually always correctly base their judgments on number, namely 94% and 98%, respectively. In contrast, number-based judgments were never encountered in the classical mass condition (i.e. 100% of judgments were correctly based on overall volume). The children performed adultlike on the classical count and object-mass conditions: they correctly gave number-based judgments at 98% and 92%, respectively. In the classical mass condition they (incorrectly) judged classical mass nouns based on number at a rate of 40%, resulting in an accuracy rate of 60%. Although this is a substantial amount of non-adultlike responses, Barner & Snedeker do not elaborate on this. Instead, they focus on the significantly higher proportions of number-based judgments in the object mass and classical count conditions than in the classical mass conditions, and conclude that English-acquiring 4-year-olds are sensitive to the mass-count distinction.

Barner & Snedeker's (2005) second experiment assessed quantity interpretations of flexible nouns (e.g. *string(s)*, *stone(s)*) in both count and mass syntax. In this experiment, one character had one large item while the other character had three small objects of the same kind. This is illustrated in Figure 2.



**Figure 1:** Illustration of Barner & Snedeker's (2005) first experiment on object-mass, classical count and classical mass conditions, respectively (Figure 1 in Barner & Snedeker 2005: 50).



**Figure 2:** Illustration of Barner & Snedeker's (2005) second experiment, on flexible nouns (Figure 4 in Barner & Snedeker 2005: 54).

Two new groups of participants were tested, comparable in size and age to the participants of the first experiment: 12 English speaking children (age 4;0–4;5,  $M = 4;2$ ) and 16 adults. The adult and child participant groups were each split into two, such that one subgroup received all flexible nouns in mass syntax (i.e. *stones, strings, papers*) and the other subgroup was presented with all items in count syntax (i.e. *stone, string, paper*).

The results of the second experiment show that in the count syntax condition, the adults virtually always based their judgments on number of individual items (97%), but rarely if the noun was presented in mass syntax (3%). The child results show a similar distinction: when flexible nouns appear in count syntax (i.e. with a plural morpheme), the children correctly base their judgments on number 95% of the time, vs. 25% of judgments incorrectly based on number when the flexible noun appears in mass syntax (i.e. without a plural morpheme). Thus, the children reach only an accuracy rate of 75% versus 97% of judgments accurately based on overall volume in adults. Again, Barner & Snedeker do not comment on this substantial (non-adultlike) rate of number-based judgments of flexible nouns in mass syntax by the children.

Overall, Barner & Snedeker's (2005) study shows that English-acquiring 4-year-old children are sensitive to the mass-count distinction. However, note that Barner & Snedeker did not test children older than age 4, and that the 4-year-olds did not perform adultlike yet in all conditions. As noted above, they incorrectly base almost 40% of their quantity judgments on number in the classical mass condition (vs. 0% for the adults), and 25% in the flexible mass condition (vs. 3% for the adults). These results suggest that the acquisition of mass noun syntax takes more time than the acquisition of count noun syntax, leaving open the developmental question as to when exactly English-acquiring children become adult like in their mass-count interpretations. In contrast, the 4;0–4;6-year-old English-acquiring children do perform adultlike on the object mass nouns. Barner & Snedeker explain this by assuming that object mass nouns are already specified with a [+individual] feature in the lexicon. As for Barner & Snedeker's methods, we would like to point out that the number of participants was low, and that the participant groups for the two experiments were not the same. Moreover, the participants were split across conditions in their second experiment (on the flexible nouns), making the participant groups even smaller, and rendering it impossible to compare the interpretation of flexible nouns in count and mass syntax within subjects, and to the classical conditions. In addition, Barner & Snedeker's visual materials are potentially ambiguous: the items that are intended to be smaller are identical to the large objects, and may therefore be interpreted as just being farther away, causing the participant to think that the picture with the higher number of items is always more. We should therefore interpret their results with caution.

Hacohen (2009) improved Barner & Snedeker's materials for her study on the mass-count distinction in Hebrew-acquiring children. She manipulated the pictures such that all small objects not only differed from the large objects in size, but also in some other property, preventing the smaller objects from being interpreted as identical to the larger objects but farther away. Moreover, objects were presented on a plate, providing depth and perspective to the objects. In addition, the drawings were replaced by photos, making the objects clearer. Subsequently, Van Witteloostuijn (2013) and Van Witteloostuijn & Schaeffer (2014) further developed Hacohen's QJT, by adjusting some problematic items from Hacohen's task (as witnessed by a pilot study with Dutch adults) and adding more experimental items. This renewed QJT had the same conditions as Barner & Snedeker (2005), but now with 4 items per condition (except for the flexible mass and count nouns, which had 12 items each). All items were randomized in one experiment and administered to one and the same group of Dutch acquiring children of different ages ( $N = 88$ , aged 4;1–12;8), making it possible to examine performance across ages, determine age

of acquisition, and compare the interpretation of the different types of nouns within the same participants. Table 2 presents an overview of Van Witteloostuijn’s (2013) and Van Witteloostuijn & Schaeffer’s (2014) results (columns 2 through 6) and compares them to Barner & Snedeker’s (2004) results for English-speaking children in the first column. Although Van Witteloostuijn (2013) and Van Witteloostuijn & Schaeffer (2014) originally grouped all kindergarten-level children together (4;1–5;10), we split this group into two, so as to obtain a better comparison to the English data. Note, however, that the youngest age-group (4;1–4;6) only contains three children, which is why we also added a column with the original data of all the Dutch kindergarten-level children collapsed (4;1–5;10).

Van Witteloostuijn’s (2013) and Van Witteloostuijn & Schaeffer’s (2014) results show that Dutch-speaking TD children from age 6 onwards make a clear distinction between judgments based on volume in the classical and flexible mass conditions (21% and 23% of judgments incorrectly based on number, respectively) and judgments based on number in the classical and flexible count conditions (93% and 82% of judgments correctly based on number, respectively). As for the younger children, examining first the data of the entire kindergarten group, the Dutch 4;1–5;10-year-olds perform randomly on the flexible count and mass and classical mass conditions (flexible count: 58%, flexible mass: 54%, and classical mass: 52% of judgments based on number), but well above chance on classical count and object mass nouns (81% of judgments correctly based on number in both conditions). A priori, the numbers in Table 2 may suggest that English-speaking children acquire the mass-count distinction earlier than Dutch-speaking children. However, some caution is in place here. If we compare the youngest Dutch-speaking children (4;1–4;6, but, N = 3!) to their English-speaking age-mates, we see that they perform more similarly

**Table 2:** Summary of results of previous studies, expressed as percentages of accuracy.

Noun type	Barner & Snedeker (2005) English	Van Witteloostuijn (2013) and Van Witteloostuijn & Schaeffer (2014) Dutch					
	4;0–4;6 N = 12	4;1–4;6 N = 3	4;7–5;10 N = 14	4;1–5;10 N = 17	6;2–7;11 N = 26	8;0–9;11 N = 22	10;0–12;6 N = 25
<b>Flexible count</b> <sup>1</sup> (e.g. rope)	95	56	58	58	82	95	94
<b>Flexible mass</b> (e.g. rope)	75	61	43	46	73	86	90
<b>Classical count</b> (e.g. ball)	98	92	79	81	93	100	100
<b>Classical mass</b> (e.g. dough)	60	75	43	48	79	92	96
<b>Object mass</b> (e.g. furniture)	92	92	79	81	85	94	97

*Note.* Judgments based on number for flexible count, classical count, object mass; judgments based on overall volume for flexible mass, classical mass.<sup>2</sup>

<sup>1</sup> Recall that in Barner & Snedeker’s (2005) experiment the two flexible conditions were administered to two different groups of merely 6 children each: one group of 6 received the flexible nouns only in count syntax, whereas the other group of 6 received the same flexible nouns only in mass syntax. This methodology may have facilitated a consistent count or mass interpretation strategy in the flexible conditions, boosting accuracy. Moreover, none of these children took part in Barner & Snedeker’s experiment testing classical nouns. Both issues make a comparison between the response accuracies of the classical and the flexible conditions questionable.

<sup>2</sup> By chance, no children aged 5;11–6;1 were tested in van Witteloostuijn (2013).

to the English-speaking 4;0–4;6-year-olds than the 4;7–5;10-year-old Dutch-speaking children. This may indicate a U-shaped learning pattern which occurs when lexical and rule-based knowledge interact, something that may well be the case in the acquisition of the mass-count distinction. If this U-shaped pattern turns out to be real, older English-acquiring children may also perform slightly more poorly than the young English-acquiring group tested by Barner & Snedeker (2005), and not be so different from the Dutch-acquiring children after all. However, note that the youngest Dutch-speaking group (4;1–4;6) consist of only three children, implying that we really cannot draw any firm conclusions from their scores. Recall furthermore our reservations regarding Barner & Snedeker's original materials, small numbers of participants, and limited age groups, and that the English-acquiring 4-year-olds in Barner & Snedeker's study were not adultlike in their mass noun interpretations. More research on 4;1–4;6-year-old Dutch-acquiring children and on 4;6–6-year-old English-acquiring children is clearly needed. If such research showed that English-speaking children acquire the mass-count distinction earlier than Dutch-speaking children, an explanation could be that syntactic cues that potentially distinguish mass from count are more ambiguous and rarer in Dutch. For example, Dutch has fewer quantifiers than English that differentiate between mass and count nouns (e.g. *veel* ('much/many'), *weinig* ('little/few'), and *minder* ('less/fewer')). Moreover, it is not unusual to combine a Dutch mass noun in mass syntax (so without a plural morpheme) with a numeral in Dutch (e.g. *twee melk* (lit. 'two milk')). For a more detailed analysis of the cross-linguistic differences in (the acquisition of) the mass-count distinction see Van Witteloostuijn (2013).

One clear conclusion that can be drawn from the data in Table 2 is that both English and Dutch-speaking children acquire count nouns before mass nouns. Van Witteloostuijn (2013) and Van Witteloostuijn & Schaeffer (2014) argue that it is the overt (plural) morphology that accelerates the acquisition of count nouns, as opposed to mass nouns, which have no such overt morphosyntax. The more overt triggers there are in the input, the earlier the type of noun is acquired. Although the acquisition of number morphology (which is acquired around age 3, see Schaerlaekens 1980; van Wijk 2007) is a necessary requirement for the acquisition of the mass-count distinction, it is not sufficient. Children also need to learn that count nouns can have an indefinite determiner, while mass nouns cannot, and that count nouns can be directly preceded by a number, while mass nouns need a measure phrase to quantify over them. Furthermore, as Barner & Snedeker (2005) point out, they need to know what specificity is: whereas the use of a noun in count syntax (i.e., in the presence of a plural marker) clearly entails a reference to individuals, the use of a noun in mass syntax (i.e., in the absence of a plural marker) is unspecified regarding individuation. Thus, to correctly differentiate mass from count nouns, children need different pieces of knowledge. All these properties of count and mass nouns need to be properly clustered and mapped to the correct interpretation, which is why it may take some time to fully acquire the mass-count distinction. The fact that count nouns have many more overt cues in the input (plural morphology, indefinite determiners, numbers) than mass nouns may explain why, overall, count nouns are acquired before mass nouns.

For the Dutch-acquiring children, the distinction between classical count and mass nouns kicks in earlier than the distinction between the flexible count and mass nouns. For the English-acquiring children this is hard to tell, as the children participating in Barner & Snedeker's (2005) classical mass-count experiment were not the same as the ones participating in the flexible mass-count experiment. Van Witteloostuijn (2013) and Van Witteloostuijn & Schaeffer (2014) argue that the earlier acquisition of the classical mass-count distinction is due to the additional, converging evidence from convention (Borer 2005) in the input, which distinguishes classical count from mass nouns (*dog* is usually



and most frequently used in count syntax, whereas *dough* is usually and most frequently used in mass syntax). Crucially, the notion of convention relates to frequency of use and world knowledge, but not to lexical meaning. If nouns such as *dog* were lexically marked for a number-based meaning, they should always be used as a count noun, which is clearly not the case (see Borer's 2005 example *There is dog in the soup*).

Finally, object-mass nouns are acquired early by both English and Dutch-speaking children. Van Witteloostuijn (2013) and Van Witteloostuijn & Schaeffer (2014) adopt Bale & Barner's (2004) claim that object-mass nouns have a lexical [+individual] feature. They propose that as soon as the relevant noun is acquired, this lexical feature is in place and gives rise to a correct number-based interpretation from early on.

Overall, we propose the following acquisition pattern for TD children in English as well as in Dutch. Initially, all nouns can be interpreted as either referring to individual items or to unbounded volumes or substances. By attending to the input, children collect evidence from syntax, lexicon and convention/world knowledge to learn that some nouns are more likely to be interpreted as referring to individual items with boundaries (count) or as referring to unbounded volumes or substances (mass). Classical count nouns are acquired first, because overt syntax and convention/world knowledge provide strong, converging evidence. Object mass nouns are acquired early, too, because the input is non-ambiguous: they virtually never come with overt count syntax, and always refer to a collection of individual items, reflecting their lexical [+individual] feature. The input provides less direct evidence for (classical) mass nouns, because of the lack of overt morphosyntax, causing a delay in acquisition. Finally, the flexible mass-count distinction is acquired after the classical mass-count distinction because the morphosyntactic evidence in the input is not strengthened by evidence from convention.

Most important to the present discussion, the studies described above demonstrate that by the age of 6, TD children are sensitive to the mass-count distinction and are able to interpret the morphosyntax determining this distinction, at least in English and Dutch. Nevertheless, performance on the QJT, and thus sensitivity to the mass-count distinction continues to develop in later childhood. The question is what sort of knowledge children age 6 and up with SLI have of the mass-count distinction. Before we continue to our hypotheses and predictions regarding the mass-count distinction in children with SLI, let us briefly describe the relevant details of SLI.

### **2.3 Specific language impairment**

Specific language impairment is a developmental language disorder that affects around 5–7% of children (Tomblin et al. 1997). Children with SLI do not form a homogeneous group: the disorder can affect different subdomains of language and these effects can be of varying severity (Leonard 2014; Novogrodsky 2015). One area that is typically influenced by the impairment is morphosyntax and the ability to comprehend and produce grammatical morphemes. These grammatical morphemes include those that indicate tense, number marking and subject-verb agreement (Rice, Wexler & Cleave 1995; Clahsen, Bartke & Göllner 1997; de Jong 1999; Wexler, Schaeffer & Bol 2004; Rispens & Been 2007; Spoelman & Bol 2012). For example, Clahsen et al. (1997) compare 9 English-speaking children with SLI to 6 German-speaking children with SLI aged between 5 and 8 years old on subject-verb agreement and tense. To explain the children's problems with these verbal morphological features they formulate the Agreement Deficit Hypothesis: "Formal features which do not have a semantic interpretation, specifically phi-features of verbs, cause acquisition problems for children with SLI" (Clahsen et al. 1997: 151). Spoelman & Bol (2012) state that verbal morphology, including subject-verb agreement, is most affected in children with SLI, at least in morphologically poor languages such as

English and Dutch. In their study, they collected audio-recordings from 10 children with SLI (aged 4–7) and compared them to 10 age-matched TD children and found impairments in subject-verb agreement and in verb argument structure. For instance, children with SLI often omit the past tense morpheme (*-ed* in English, *-te/-de* in Dutch) at ages at which TD children no longer do this.

Although the impairment in morphosyntax in children with SLI has been well-documented in the verbal domain (e.g. tense and subject-verb agreement), less is known about the nominal domain. Nominal morphology includes, for instance, grammatical gender in Dutch (neuter definite article *het* ('the') vs. common definite article *de* ('the')), adjectival inflection in Dutch noun phrases such as *het mooie huis* ('the beautiful house') vs. *een mooi huis* ('a beautiful house'), and the plural morpheme (*-s* in English, *-s* or *-(e)n* in Dutch), one of the foci of the current study. Nevertheless, there are a few studies on nominal morphology in SLI. For example, Rice & Oetting (1993) investigated spontaneous language samples of 81 5-year-old English-speaking children with SLI and found that they produced the plural inflection in obligatory contexts less often as compared to a control group of 92 MLU-matched TD children, suggesting difficulties in the area of nominal morphosyntax. Furthermore, in a sentence completion study by Novogrodsky & Kreiser (2015), 15 Hebrew-speaking children with SLI (aged 8–14) were compared to a group of language-matched and a group of age-matched controls on their ability to complete sentences with the morphologically correct noun. Although the results show no differences between the SLI group and the language-matched TD group, the SLI group performed more poorly than the age-matched TD group. In addition, error analyses reveal that, even though no group differences between TD language-matched and SLI were found, children with SLI produced more morphological errors as compared to other error types (e.g. semantic or phonological errors). Thus, according to the authors, children with SLI in this study “presented incomplete morphological knowledge” of nouns (Novogrodsky & Kreiser 2015: 821).

As for the lexicon, many studies report smaller vocabularies than TD age-mates for children with SLI (e.g. Rice 1991; Conti-Ramsden & Jones 1997; Leonard 1998; Hick et al. 2002). Furthermore, some studies show that lexical access can be slower in children with SLI (Seiger-Gardner & Schwartz 2008). Nevertheless, it is not clear whether children with SLI have difficulties with the lexical-semantics and the features of the words that they have acquired. As storing of features on words is quite different from grammatical computation, this may not be as impaired as morphosyntax in SLI.

#### **2.4 Previous acquisition studies on the mass-count distinction in children with specific language impairment**

Rice, Cleave & Oetting (2000) investigated the interpretation of syntactic cues in a group of 20 children with SLI (aged approximately 5 years) to two groups of TD children, one matched on mean length of utterance (approximately 3 years) and one matched on chronological age on a naming task. Participants watched a video containing a story in which a total of sixteen novel count and mass nouns were introduced, together with sixteen unfamiliar objects that served as potential referents for the novel nouns. There were two versions of the video, rendering two conditions: one with syntactic cues (e.g. *Look, I found a keelwug and some blick*) and one with neutral syntax (e.g. *Look, I found the keelwug and the blick*). After viewing the video, participants were required to map the novel words to the unfamiliar objects. Results revealed that only the 5-year-old TD children were able to pick up on the syntactic cues, reflected by significantly higher

performance in the cued condition than in the neutral condition, whereas the 5-year-old children with SLI (and the 3-year-old TD children) were not. This raises the question as to whether older children with SLI are better at using syntactic cues to distinguish between mass and count.

Older children were investigated in Froud & Van Der Lely (2008), who explored the mass-count distinction in 17 English-speaking children with SLI (aged 8;0 to 15;6), two groups of younger TD children (mean age 6;2 and 7;4), and a group of chronologically age-matched TD controls. Employing a production task, children were presented with novel nouns with a simple CVC structure (e.g. *dap*) together with potential syntactic and semantic cues (whether the novel nouns referred to an object or a substance). Syntactic cues could signal mass (*some dap*) or count readings (*a dap*). It was argued that in the TD children, the integration of syntactic and semantic cues matured over time, while the children with SLI performed unlike any of the control groups, as they are not able to discriminate between mass and count novel nouns.

From these studies we know that English-speaking children with SLI have difficulties picking up syntactic cues in the input that are associated with the distinction between mass and count nouns: the determiner *a* (used to introduce count nouns) and the quantifier *some* (used to introduce mass nouns). However, neither of these studies investigated whether children with SLI are able to use bound nominal morphology, such as the plural marker in distinguishing mass from count. Additionally, they did not address potential differences in interpretation between classical and flexible count and mass nouns, or object-mass nouns. It is these different types of count and mass nouns and the plural morpheme that we focus on in the present study.

## 2.5 Hypotheses and predictions

The current study addresses two main questions, one regarding the interpretation of mass and count nouns by children with SLI and one regarding the theoretical underpinnings of mass and count nouns. Our developmental hypothesis is that children with SLI are mainly impaired in morphosyntax, including nominal morphosyntax, but less so in terms of lexical-semantics. Our theoretical hypothesis is that the interpretation of flexible nouns relies solely on morphosyntax and that the interpretation of classical mass and count nouns follows from a combination of their morphosyntactic environment and convention/world knowledge. In contrast, we hypothesize that the interpretation of object-mass nouns is lexically determined by their lexical [+individual] feature. Combining these developmental and theoretical hypotheses, we predict that Dutch-speaking children with SLI:

- (i) have most severe problems with the interpretation of flexible mass and count nouns as compared to their TD age controls;
- (ii) have fewer problems with classical mass and count nouns, but are not TD-like in their interpretation on classical nouns;
- (iii) have no problems in their interpretation of object mass nouns and will thus perform similar to their TD age controls.

A secondary aim of the present study is to explore what general background measures potentially underlie the individual variation in performance on the QJT and to investigate whether this is different for TD children versus children with SLI. As these investigations are explorative in nature, we do not have any specific hypotheses regarding our secondary aim.

### 3 Methods

#### 3.1 Participants

The present study includes 28 children with SLI, aged 6–14 (mean age 10;2,  $SD = 2;3$ , 22 male, 6 female) who were recruited from special schools for children with speech and language problems in the Netherlands.<sup>3</sup> Before they participated in the study, all children had been formally diagnosed with SLI by speech clinicians (2 SD below the mean on a standardized language test battery or at least 1.5 SD below the mean on two out of four subtests). Diagnoses were generally based on either the Clinical Evaluation of Language Fundamentals (Dutch version, CELF-4-NL, Kort, Schittekatte & Compaan 2008) or the Dutch Taaltoets Alle Kinderen (TAK, Verhoeven & Vermeer 2001). None of the children had hearing impairment or intellectual disability (Leonard 2014). The control group consisted of 28 gender- and age-matched children with typical development (TD; mean age 10;4,  $SD = 2;2$ , 23 male, 5 female) who were recruited from regular primary schools and have no history of language impairment.<sup>4</sup> The SLI and TD groups did not differ from one another on age ( $F(1, 54) = 0.045$ ,  $p = .832$ ,  $d = .058$ ). Children who were diagnosed with other developmental disorders, such as AD(H)D or autism, an IQ < 80 (based on existing information), and children who were raised bilingually, were excluded from both groups. All these criteria were later confirmed in parental questionnaires. Children were only included in the study if their parents had signed and returned active consent forms.

Since not all children with SLI attended the same school, and were not diagnosed by the same speech clinicians using the same language tests, and to underscore the typical development of the children in the TD group, the two groups were compared on several background measures using one-way ANOVAs with group as the between-subjects variable. General language ability was measured using the Core Language Score (CLS) of the CELF-4-NL (CELF-CLS) and the Raven's progressive matrices test (Raven 2008) was administered as a measure of non-verbal reasoning ability. As expected, group comparisons showed that the children with SLI scored significantly lower on the standardized language measure than their TD peers ( $F(1, 54) = 140.467$ ,  $p < .001$ ,  $d = 0.94$ ). Surprisingly, given their existing IQ scores, they also scored significantly lower on our measure of non-verbal reasoning ability ( $F(1, 54) = 22.533$ ,  $p < .001$ ,  $d = 1.29$ ), which is one part of general intelligence. Because of this group difference on the Raven's, we controlled for the effects of non-verbal reasoning ability in our analyses of children's performance on the QJT (see Section 3.3). The results on the CELF-CLS and the Raven's progressive matrices tests are summarized in Table 3.

**Table 3:** Children's mean scores (and  $SD$ ) on background measures.

	TD	SLI	<i>F</i>	<i>p</i>	<i>d</i>
<b>CELF-CLS</b>	111.4 (12.9)	75.5 (9.5)	11.85	<.001	0.94
<b>Raven</b>	71.9 (24.4)	39.1 (27.3)	22.533	<.001	1.29

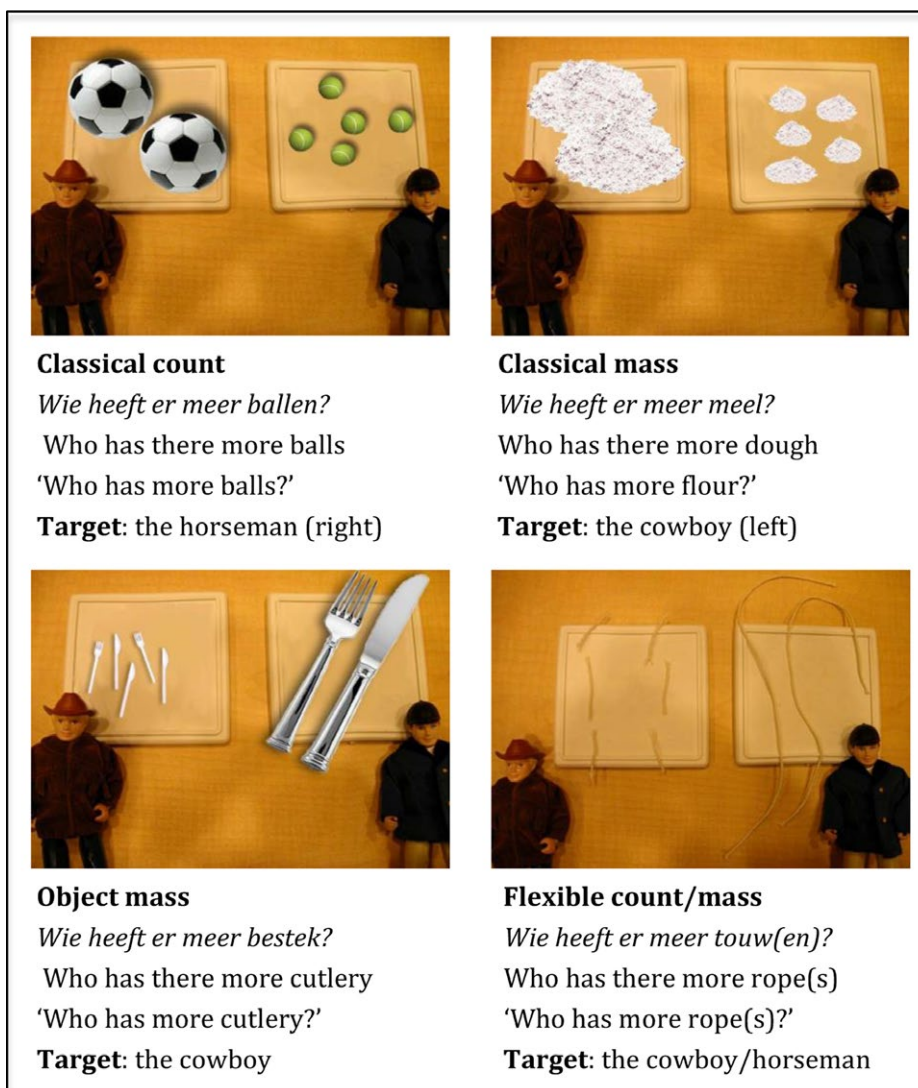
Note. CELF-CLS: standardized score on Clinical Evaluation of Language Fundamentals – Core Language Score; Raven: percentile score on Raven's colored progressive matrices.

<sup>3</sup> The children with SLI are the same as in Schaeffer's (2016) study on differences and similarities in grammar, pragmatics and extra-linguistic cognition between children with SLI and children with high-functioning autism.

<sup>4</sup> This group of children is a subset of the Dutch-acquiring TD children who participated in Van Witteloostuijn's (2013) and Van Witteloostuijn & Schaeffer's (2014) study on the typical acquisition of the mass-count distinction in Dutch.

### 3.2 Quantity Judgment Task: Materials and procedure

In order to investigate the mass-count distinction in Dutch-speaking children with and without SLI, we administered Van Witteloostuijn’s (2013) and Van Witteloostuijn & Schaeffer’s (2014) improved and expanded version of Hacoen’s (2009) QJT.<sup>5</sup> Similar to Barner & Snedeker’s (2005) original task, participants are shown pictures that contain two characters and are asked to choose which of them had more X (e.g. *Wie heeft er meer ballen?* ‘Who has more balls?’). One character was presented with two large objects and the other with four to six smaller objects. It is important to note that the overall volume of the two large objects was more than the overall volume of the smaller objects combined. This allows us to distinguish between judgments based on number from those based on overall volume. Sample items are given in Figure 3 (see Appendix A for a complete list of all experimental items). Although the nouns used in the experimental items were not controlled for frequency, we did ensure that they are part of young children’s vocabularies by confirming their occurrences in Dutch spontaneous speech samples in CHILDES (MacWhinney 2000).



**Figure 3:** Sample items of each of the conditions in the QJT.

<sup>5</sup> We thank Aviya Hacoen for generously sharing her materials with us.

As illustrated in Figure 3, the QJT examined five different noun types in five experimental conditions: classical count, classical mass, object mass, flexible count and flexible mass. Classical count and flexible count nouns were always presented in count syntax, while classical mass, flexible mass and object mass nouns were always presented in mass syntax. For classical count, flexible count and object mass nouns the correct interpretation was the character that had most in terms of number, whereas the correct interpretation for classical mass and flexible mass nouns was the character that had most in terms of overall volume. Note that sensitivity to and understanding of the plural morpheme is crucial for the correct interpretation of the experimental items.

An overview of the experimental conditions, their target interpretations, and their numbers of tokens is presented in Table 4. Since the flexible conditions represent the most crucial test grounds for our hypothesis (as explained in section 2.5), and because we expected higher variability in these conditions, we created more experimental items for the flexible count and the flexible mass conditions (12 each). In addition to the items in the experimental conditions, a total of eight filler items were included in the task, which were similar in nature to the count nouns. Essentially, the pictures in the filler items differ only in the number of individual objects, but not in overall volume, as is the case in the experimental count condition. Prior to the actual experiment, children completed a practice session consisting of four filler items and two flexible nouns presented both in count and mass syntax. All children received the same randomized order.

### 3.3 General procedure

The tasks reported here were part of a larger test battery administered to children with SLI, children with high-functioning autism and TD children (see Schaeffer 2016). Participants were tested individually in a quiet room in their school or home in three or four sessions that lasted approximately 60 minutes each. The standardized background measures were administered in the first test session, whereas the QJT was administered in the final test session. Children were given a small present as a reward for participation.

### 3.4 Scoring and analyses

All answers in the QJT were coded as either 0 (incorrect) or 1 (correct) and these scores were subsequently converted into an average percentage of target-like interpretations for each condition. One flexible noun, namely, *paper* (*Who has more paper(s)?*) was removed from the analysis due to poor performance by the TD children as compared to the other items: only 36% of the TD children judged the experimental items containing this noun correctly when it appeared in mass syntax, while they had an average of 90% correct for other, comparable items.

**Table 4:** Overview of experimental conditions in the QJT.

Condition	Example of Item	Target interpretation	Number of items
<b>Classical count</b>	<i>Ballen</i> (balls)	Individual-item-based	4
<b>Classical mass</b>	<i>Meel</i> (flour)	Overall-volume-based	4
<b>Object mass</b>	<i>Bestek</i> (cutlery)	Individual-item-based	4
<b>Flexible count nouns</b>	<i>Touwen</i> (ropes)	Individual-item-based	12
<b>Flexible mass nouns</b>	<i>Touw</i> (rope)	Overall-volume-based	12
<b>Fillers</b>	<i>Appels</i> (apples)	Individual-item-based	8
<b>Total</b>			<b>44</b>

In order to test our hypotheses and predictions regarding the different experimental conditions, we first compared group performances on each condition with chance (i.e., 50%) using one-sample T-tests. Next, we examined group differences in the conditions that rely on morphosyntax, namely, the classical and flexible mass and count nouns, by using a two-way repeated measures ANCOVA with group (SLI vs. TD) as the between group factor in both analyses and condition (classical vs. flexible) and noun type (count vs. mass) as the within group factors. Follow-up analyses included dependent T-tests that were run to investigate differences between conditions within groups. In using this analysis, we could determine whether the pattern in performance on the different conditions (classical vs. flexible) and noun types (count vs. mass) was similar across groups, or whether we could find evidence for a more specific deficit in children with SLI as compared to TD children. Finally, we investigated whether the children with SLI experienced difficulties relative to the TD children in the interpretation of object mass nouns, by using a one-way ANCOVA with group (SLI vs. TD) as the between group factor. We entered the Raven's percentile score as a covariate in both analyses because of the established group difference on non-verbal reasoning abilities.

In addition to group comparisons, we wanted to explore the individual variability in performance in both groups. To this end, we examined the range and standard deviations and investigated the relationship between overall performance on the QJT and children's age, CELF-CLS and Raven's scores by calculating Pearson's correlations. Subsequently, we investigated what factors predicted performance on the QJT in both groups. In the first model, we entered our control variables (age and non-verbal reasoning ability, Raven percentile score), followed by the predictor of interest (general language ability, CELF-CLS) in the second model. These analyses can shed light on what variables predict the variance in performance on the QJT, and whether the CELF-CLS can explain variability above and beyond age and non-verbal reasoning ability in both groups.

## 4 Results

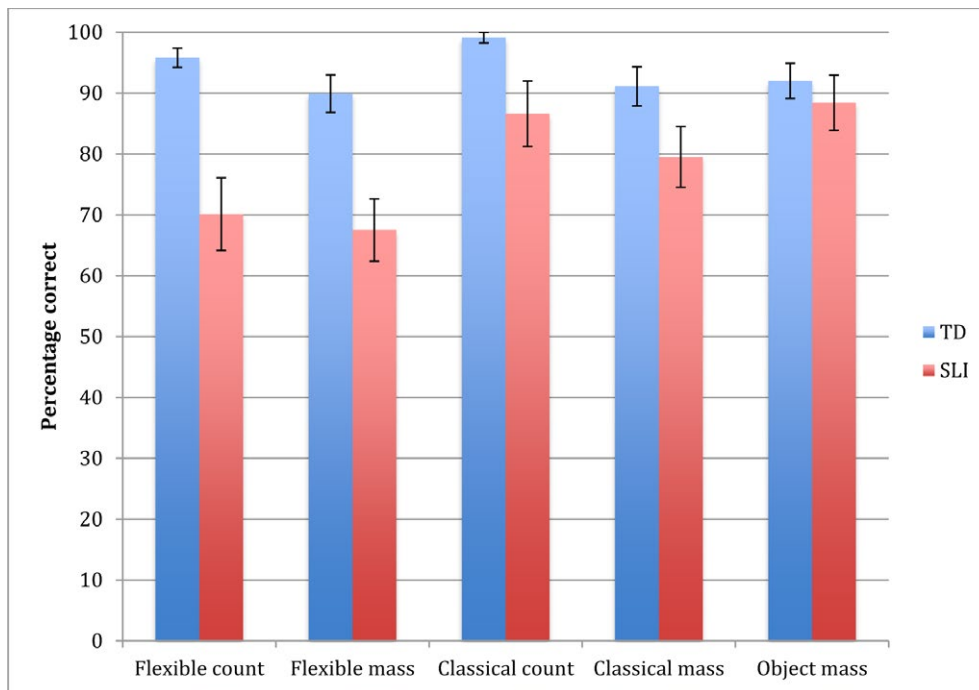
### 4.1 Group results

The data in Figure 4 provide the proportions of target responses of both groups in the different conditions that were tested in the QJT. Recall that the target response in the flexible count, classical count and object mass conditions is a judgment based on number of individual items, whereas judgments should be based on overall volume in the flexible mass and classical mass conditions. Figure 2 does not include the children's performance on filler items, but this was at ceiling in both groups (TD:  $M = 99.6\%$ ,  $SD = 2.4\%$ , SLI:  $M = 98.2\%$ ,  $SD = 5.6\%$ ).

Overall, the performance of the children with SLI on the experimental conditions ranges from a mean of 67.5% ( $SD = 27\%$ ) on flexible mass nouns to 86.6% ( $SD = 28.5\%$ ) on classical count nouns. The TD children systematically appear to score higher, ranging from a mean of 89.9% ( $SD = 16.3\%$ ) on flexible mass nouns to 99.1% ( $SD = 4.7\%$ ) on classical count nouns. Both the SLI and TD groups perform above chance (50%) on all experimental conditions ( $p < .01$ ). To answer our two main questions, we compared the children's performance on the different experimental conditions.

### 4.2 A closer look at the different experimental conditions

The results for classical and flexible mass and count nouns reveal a significant effect of group ( $F(1, 56) = 19.683$ ,  $p < .001$ ,  $d = 1.21$ ), but the main effects of condition (flexible or classical nouns) or noun type (mass or count nouns) were both non-significant ( $F(1, 56) = .622$ ,  $p = .434$ ,  $d = 0.22$ , and  $F(1) = 1.962$ ,  $p = .167$ ,  $d = 0.38$  respectively). Importantly, the results reveal a significant interaction between group and condition



**Figure 4:** Percentages correct ( $\pm 1$  SE) of TD and SLI groups on the experimental conditions in the QJT.

( $F(1, 56) = 10.486, p < .01$ ), showing that the groups did not perform equally on flexible and classical conditions. Follow-up analyses revealed that the children with SLI are outperformed by their TD peers on both classical ( $t(54) = 3.101, p = .003, d = 0.83$ ) and flexible ( $t(54) = 5.572, p < .001, d = 1.49$ ) nouns. However, there is no difference in performance on flexible nouns (mass and count combined) as compared to classical nouns (mass and count combined) in the TD group ( $t(27) = 1.643, p = .112, d = 0.31$ ), while the children with SLI perform significantly better on classical nouns than on flexible nouns ( $t(27) = 3.979, p < .001, d = 0.75$ ).<sup>6</sup> The interaction between group and noun type is not significant ( $F(1) = .472, p = .495$ ), so it is not the case that the children with SLI show a response pattern to mass and count nouns different from that of the TD children.

The results on object mass nouns indicate no significant difference between the groups ( $F(1, 56) = 1.485, p = .228, d = 0.33$ ). This means that the children with SLI ( $M = 88.4\%, SD = 24\%$ ) did not score significantly lower than their TD age-mates ( $M = 92\%, SD = 15.3\%$ ).

### 4.3 Individual variability

Noticeably, the group of children with SLI shows more individual variability than the control group throughout conditions. This is reflected in their range of performance and the standard deviations from the mean in the different experimental conditions and in their overall performance as shown in Table 5. The ranges within the group of TD children range from chance level (50%) to 100% accuracy, whereas in the SLI group there are children who score 0% correct on flexible count, classical count and/or object mass nouns. In fact, there is one child (aged 10) who opts for a mass interpretation for all flexible and classical nouns, regardless of the absence or presence of the plural morpheme.

<sup>6</sup> As suggested by one of the anonymous reviewers, we performed this analysis for a subgroup of participants with SLI who had average to high Raven scores (50<sup>th</sup> percentile or higher,  $N = 11$ ) and obtained similar results: the dissociation between flexible and classical nouns is also found for this subgroup ( $t(10) = 2.339, p = .041$ ).



As mentioned in section 2.5, our secondary aim was to explore potential sources of individual variability in the groups under investigation. To this end, we computed correlations between children’s overall performance on the QJT, their age and their performance on general language ability (CELF-CLS) and non-verbal reasoning ability (Raven percentile score). Table 6 presents the correlations between these variables for the TD and the SLI groups. In the TD group, the only variable that significantly correlated with the QJT was age ( $r = .497, n = 28, p = .007$ ). The QJT performance of the children with SLI did not only significantly correlate with age ( $r = .512, n = 28, p = .005$ ), but also with their general language ability ( $r = .498, n = 28, p = .007$ ). No significant correlations with the children’s non-verbal reasoning ability were found ( $p > .1$ ). The same correlational analyses were run without the child who adopted a “mass strategy”, as described above, but this did not change the pattern of results.

In follow-up analyses, the predictive power of our different background measures was investigated using hierarchical regression analyses for both groups. The first model, including both control variables (age and non-verbal reasoning abilities) significantly explained 33% of the variance in the TD group ( $F(2) = 6.172, p = .007$ ) and 27% of the variance in the SLI group ( $F(2) = 4.579, p = .02$ ). In the second model, the addition of the CELF-CLS did not significantly contribute to the model as a whole for the TD group ( $t = 1.139, p = .266$ ), although the model as a whole still explains a significant amount of variance in the QJT as age remains a significant predictor of performance (37%,  $F(3) = 4.597, p = .011$ ). For the SLI group, however, adding the CELF-CLS significantly contributed to

**Table 5:** Individual variability of children with SLI and TD children on the QJT.

	TD		SLI	
	Range	Mean (SD)	Range	Mean (SD)
<b>Flexible count</b>	64–100	95.8 (8.4)	0–100	70.1 (31.6)
<b>Flexible mass</b>	27–100	89.9 (16.3)	18–100	67.5 (26.7)
<b>Classical count</b>	75–100	99.1 (4.7)	0–100	86.6 (28.4)
<b>Classical mass</b>	50–100	91.1 (17.0)	25–100	79.5 (26.4)
<b>Object mass</b>	50–100	92.0 (15.3)	0–100	88.4 (24.0)
<b>Total</b>	70–100	93.6 (7.8)	37–98	78.4 (15.1)

**Table 6:** Correlation matrix of the QJT and children’s background measures for TD and SLI groups.<sup>7</sup>

	TD				SLI			
	Age	CELF-CLS	Raven	QJT	Age	CELF-CLS	Raven	QJT
<b>Age</b>	1				1			
<b>CELF-CLS</b>	-.293	1			.084	1		
<b>Raven</b>	-.190	.241	1		-.393*	-.006	1	
<b>QJT</b>	.497**	.089	.189	1	.512**	.498**	-.272	1

Note. CELF-CLS: standardized score on Clinical Evaluation of Language Fundamentals – Core Language Score. Raven: percentile score on Raven’s colored progressive matrices.

\* $p < .05$ , \*\* $p < .01$ .

<sup>7</sup> Note that the correlations between age and the CELF-CLS and Raven percentile score respectively are not very meaningful, as the CELF-CLS and Raven percentile scores are normed scores and are therefore already corrected for age. The significant negative correlation between age and the Raven percentile score in the group of children with SLI means that, by chance, the younger children in our sample had lower norm scores.

explaining individual variation ( $t = 2.324$ ,  $p = .029$ ) and the contribution of age was no longer significant ( $t = 1.819$ ,  $p = .081$ ). The model now explained 40% of the total variance ( $F(3) = 5.391$ ,  $p = .006$ ). The Raven turned out not to be a significant predictor in and of itself in any of the models and, thus, a similar pattern of results was obtained when non-verbal reasoning abilities were left out of the regression models. These analyses confirmed the correlations mentioned above: whereas performance on the QJT was mostly predicted by age in the TD group, the SLI group's accuracy was predicted by both age and performance on the CELF-CLS.

## 5 Discussion

The results reveal that the children with SLI perform more poorly on both classical and flexible nouns than their TD age-mates. Moreover, the interaction between group and condition shows that the children with SLI perform more poorly in the flexible conditions than in the classical conditions, while this asymmetry between flexible and classical conditions was not found for the TD group. Note that this was to be expected from the TD children, as they were all age 6 or older, the age at which Dutch-acquiring TD children show sensitivity to the mass-count distinction (cf. Van Witteloostuijn 2013; Van Witteloostuijn & Schaeffer 2014). Finally, the children with SLI do not differ significantly from the TD children on object mass nouns. Overall, it should be noted that, just like their TD peers, the SLI group performed above chance-level on all noun types.

These results confirm our predictions. First of all, the children with SLI have most problems with the flexible nouns. This result provides evidence for the hypothesis that the interpretation of flexible nouns crucially and solely relies on morphosyntax, such as the plural morpheme in our experiment. It also further emphasizes the morphosyntactic impairment in children with SLI, and provides additional evidence that, besides morphosyntactic impairment in the verbal domain (e.g. Rice et al. 1995; Clahsen et al. 1997; de Jong 1999; Rispens & Been 2007; Spoelman & Bol 2012), nominal morphosyntax is also impaired. As noted in section 2.3, to date, most grammatical theories of SLI have focused on deficits in the verbal domain (e.g. Clahsen et al.'s 1997 "Agreement-Deficit Hypothesis"), and it has been suggested that verbal morphology is an important clinical marker for SLI (Verhoeven, Steenge & van Balkom 2011). Importantly, the present study indicates that theoretical explanations of SLI should also be able to account for deficits in nominal morphology and, potentially, problems in nominal morphology could function as an additional clinical marker for SLI. Our results on nominal morphosyntax in Dutch SLI are corroborated by Rice & Oetting (1993), who find problems with plural morphology on nouns in English-speaking children with SLI, and by Novogrodsky & Kreiser's (2015) who argue that Hebrew-speaking children with SLI have incomplete morphological knowledge of nouns.

The fact that the children with SLI perform slightly better on the interpretation of the classical mass and count nouns, such as *flour*, and *ball*, respectively, support the hypothesis that classical mass and count nouns partially rely on convention or world knowledge: in these conditions, the children with SLI benefit from conventional individual-item and overall-volume interpretations. Nevertheless, their morphosyntactic impairment still prevents them from judging the classical mass and count nouns TD-like.

Finally, the result that the SLI group judges object-mass nouns such as *furniture* just as target-like as the TD children supports Bale & Barner's (2004) claim that the interpretation of object-mass nouns does not rely on morphosyntactic knowledge, but rather, on lexical knowledge: object-mass nouns carry a lexical [+individual] feature. This suggests that as soon as the relevant lexical item for an object-mass noun has been learned, the lexical [+individual] feature is in place as well. Although children with SLI are sometimes

reported to have additional lexical impairments, these problems are usually related to lexical access (e.g. Rice 1991; Conti-Ramsden & Jones 1997; Leonard 1998; Hick et al. 2002), or a smaller vocabulary (Seiger-Gardner & Schwartz 2008), and not to lexical-semantic, of which the [+individual] features is part. Apparently, the children with SLI in this study suffer no impairments in that part of the lexicon that is responsible for the correct interpretation of object-mass nouns, although they do have impairments in nominal morphosyntax.

The dissociation in results between classical and flexible nouns on the one hand and object-mass nouns on the other hand (at which the children with SLI perform TD-like) provides evidence for the existence of different language subdomains (i.e., morphosyntax vs. lexical-semantic, respectively) that can be impaired or spared independently of each other (cf. Friedmann & Novogrodsky 2008), or can develop unevenly. Furthermore, it underscores the importance of the role of overt morphology (in this case, the plural morpheme) in the acquisition of language, be it typical or atypical acquisition.

Comparing the children with SLI to their TD controls, we suggest that the acquisition pattern of the mass-count distinction of children with SLI is not qualitatively different from that of TD children, only slower. In both groups, significant correlations between the children's age and their performance on the QJT were found, and age was a significant predictor of variance in children's scores on the mass-count task, especially for TD children. Additionally, in the group of children with SLI, a positive relationship between the CELF-CLS scores and performance on the QJT was found, both in the correlational and the regression analyses. This suggests that in children with SLI, general grammar abilities as measured by the CELF-CLS are associated with knowledge of plural morphology, as tested by the QJT.

Interestingly, no relationship was found between non-verbal reasoning (Raven's Progressive Matrices) and the scores of the QJT. This indicates that the ability to interpret nominal morphology and to use this to distinguish mass from count does not depend on (non-verbal) intelligence. This is also supported by the fact that a similar dissociation between flexible and classical nouns was found for a subgroup of children with SLI who performed well on the Raven.

It is clear from both the SLI and the TD mass-count data that the acquisition of overt morphology plays a major role. Similar to children with SLI, younger TD children acquire flexible count and mass nouns last (van Witteloostuijn 2013; van Witteloostuijn & Schaeffer 2014). Only when morphosyntactic cues such as plural morphology, indefinite determiners and numbers are acquired can children start to cluster them together and associate their presence or absence to count and mass interpretations of flexible nouns, respectively. This morphological knowledge will subsequently enable the use and interpretation of classical count nouns as mass (as in (3a)), and classical mass nouns as count (as in (3b)).

In terms of mass-count theories, both the SLI and the TD data are compatible with Borer's (2005) hypothesis that nouns are in principle flexible between a count and a mass interpretation, and that morphosyntax ultimately decides on one of those. The fact that the distinction between classical count and classical mass nouns is acquired before the flexible mass-count distinction supports Borer's claim that convention contributes to the more frequent mass or count interpretation of certain nouns, such as *cat* (count) or *dough* (mass). Our SLI and TD results also show that there is one exception to this claim, namely, the object mass nouns. The early acquisition of object mass nouns by both children with SLI and TD children suggests that their interpretation is lexically determined, as proposed by Bale & Barner (2004).

Finally, the clinical implication of our finding that overt morphology plays a major role in the acquisition of the mass-count distinction is that intervention in the domain of, for example, plural morphology and (indefinite) determiners, will help children with SLI acquire the mass-count distinction. This would also improve the use and understanding of conventional count nouns such as ‘dog’ with a mass interpretation and vice versa.

## 6 Conclusion

This study examined the interpretation of different types of count and mass nouns in Dutch-speaking children with SLI. It also addressed the question as to how classical, flexible and object-mass nouns are linguistically represented. The results on an improved QJT (van Witteloostuijn 2013; van Witteloostuijn & Schaeffer 2014) show that the children with SLI have most problems with flexible nouns such as *rope*, of which the interpretation crucially relies on the presence or absence of the plural morpheme (count: *two ropes*; mass: *a piece of rope*), and is not aided by convention/world knowledge, as is the case for classical count (*ball*) and mass (*flour*) nouns. Although the SLI group’s performance on the classical count and mass nouns is slightly better than their performance on the flexible nouns, it is still significantly poorer than that of their TD age-mates. These results support the hypothesis that, besides being impaired in verbal morphology, children with SLI have difficulties with nominal morphology. They also provide evidence for the hypothesis that nouns are interpreted as count or mass depending on their morphosyntactic environment (Borer 2005 a.o.). In contrast, the object-mass (*furniture*) condition presents no problems for the children with SLI: they score no differently from the TD control group, supporting Bale & Barner’s (2004) claim that the interpretation of object-mass nouns relies on lexical-semantic, rather than morphosyntactic knowledge, and for the hypothesis that children with SLI have fewer problems with lexical-semantics than with morphosyntax. Although the development of the mass-count distinction in children with SLI is slower than that of TD children, it follows the same developmental path, and is therefore not qualitatively different from TD children’s mass-count acquisition.

Future research could investigate other aspects of nominal morphology to further examine children with SLI’s impairments in the nominal domain. Additionally, children with SLI could be compared to a group of language-matched TD children to strengthen the suggestion that the impairments reported in the present paper are the result of a developmental delay in (nominal) morphosyntax in SLI, rather than of deviant development in this group. A future study could also include more items in the conditions other than the flexible mass and count conditions, in order to better control for the effect of differential numbers of items per condition and replicate the results reported here. Finally, it would be interesting to systematically control for lexical-semantics in a follow-up study in order to provide further insights regarding the theory that object mass nouns are lexically specified for individuation. One way to do this may be to identify subgroups of children with SLI in a larger sample, with either morphosyntactic or lexical-semantic impairments, and compare the performance of these subgroups on the different noun types tested in the present QJT.

## Abbreviations

AD(H)D = Attention Deficit (Hyperactivity) Disorder, CELF-4-NL = Dutch version of the Clinical Evaluation of Language Fundamentals – Version 4, CELF-CLS = Clinical Evaluation of Language Fundamentals – Core Language Score, CHILDES = Child Language Data Exchange System, IQ = Intelligence Quotient, SD = Standard Deviation, SE = Standard Error, SLI = Specific Language Impairment, TAK = Taaltoets Alle Kinderen, TD = Typical Development, QJT = Quantity Judgment Task.

## Additional File

The additional file for this article can be found as follows:

- **Appendix A.** Complete overview of experimental items. DOI: <https://doi.org/10.5334/gjgl.370.s1>

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## Competing Interests

The authors have no competing interests to declare.

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